[En]

WA7025-10E Tower Crane

Instruction Manual

WA7025-10E-138EN-E02

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INTRODUCTION

This document has been issued for the crane as defined at the time of ordering. **Please read carefully the instructions therein** before any crane operation.

Make sure that one complete copy of this document is always present at the location provided for on the crane, especially in case of crane rental or resale.

The safety signals, rating plates and instruction plates as well as this document are integrated part of the crane. In case of loss or damage of this instruction material you have order a new one from the manufacturer indicating the serial number and the crane type.

IMPORTANT: In case of a technical crane modification, please make sure that this instruction material will be updated.

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This document consists of 7 parts. The “safety instructions” part must compulsorily be read and under-stood by every operator. The other parts give specific instructions to the concerned operators for doing their tasks.

Part name	Part intended for:
1 DOCUMENTS	The crane operator
2 SAFETY INSTRUCTION	Everybody
3 TECHNICAL DATA OF CRANE AND SITE	Everybody
4 ERECTION/ADJUSTMENT/DISMANTLING	The fitter
5 OPERATION AND CONTROL	The crane driver
6 MAINTENANCE AND INSPECTION	The maintenance technician
7 SPARE PARTS	Everybody

Development of the technical instructions

ZOOMLION reserves the right, without prior notice, to improve the content and the form of this document. For each technical modification ordered or carried out after delivery, an updating will be supplied. On receipt of these new chapters, please insert them at the indicated space.

Warnings

The safety rules and the important observations which you must compulsorily observe are marked in the various parts of this documents by the following symbols:

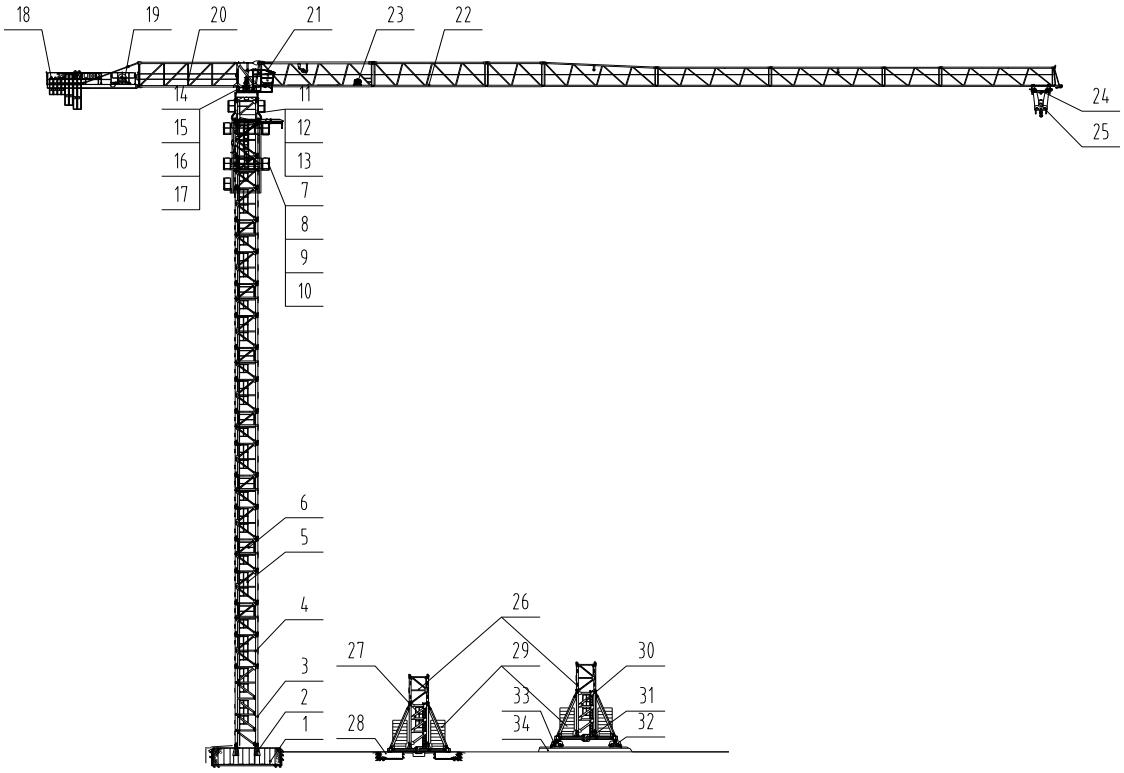
Signaling of an important risk of body injuries and even mortal danger, if the described instructions are not observed.

Indicates the risk of equipment damage if the described instructions are not observed.

Important information

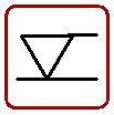
Note

TOWER CRANE VOCABULARIES

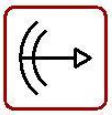
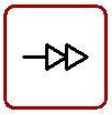
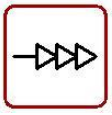
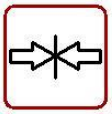


(1) Outrigger stationary foundation
(2) Outrigger
(3) Base tower section
(4) Tower section
(5) Passageway J
(6) Passageway H
(7) Climbing equipment
(8) Climbing mechanism
(9) Climbing hydraulic cylinder
(10) Pump station
(11) Erection platform
(12) Mounting device
(13) Transition section
(14) Slewing support
(15) Slewing ring
(16) Turntable
(17) Slewing mechanisms
(18) Counter ballast
(19) Hoisting mechanism
(20) Counter jib
(21) Cabin
(22) Jib
(23) Trolley mechanism
(24) Trolley
(25) Hook
(26) Tower section (for chassis)
(27) Stationary chassis
(28) Stationary chassis foundation
(29) Central ballast
(30) Travelling chassis
(31) Cable drum
(32) Powered wheel bogie
(33) Idler wheel bogie
(34) Travelling chassis foundation

GRAPHIC SYMBOLS

SYMBOLS	SUBJECT
	FORBIDDEN
	STOPPING THE MOVEMENT
	COMPULSORY SAFETY HARNESS
	AUTHORIZED
	PARALLEL
	LEVEL
	LISTEN
	WEATHERVANE

SYMBOLS	SUBJECT
	SLEWING
	SLEWING LEFT
	SLEWING RIGHT
	HOISTING
	HOISTING UP
	FALLING DOWN
	TROLLEYING
	TROLLEY OUT
	TROLLEY IN

SYMBOLS	SUBJECT
	TRAVELLING FORWARD
	TRAVELLING BACKWARD
	CREEP SPEED
	LOW SPEED
	HIGH SPEED
	SM (2-fall rope reeving, used in 2-fall)
	DM (4-fall rope reeving, used in 4-fall)
	TIGHTEN-LOCK-PRESS
	LOOSEN-UNLOCK

METRIC SYSTEM AND IMPERIAL SYSTEM

1. CORRESPONDENCES

1.1 GEOMETRIC UNITS

Metric system		Imperial system		Values
Unit	**Symbol**	**Unit**	**Symbol**	
Lengths − distances				
meter	m	inch	in	**1 m = 39.3700787 in**
		foot	ft	**1 m = 3.2808399 ft**
		yard	yd	**1 m = 1.0936133 yd**
		mile	mi	**1 m = 0.0006214 mi**
Area or surface				
square meter	m^2	square inch	in^2	**1 m^2 = 1 550.0031 in^2**
		square foot	ft^2	**1 m^2 = 10.7639104 ft^2**
		square yard	yd^2	**1 m^2 = 1.195990 yd^2**
Volume				
square meter	m^3	square inch	cu in / in^3	**1 m^3 = 61 023.7438368 in^3**
		square foot	cu ft / ft^3	**1 m^3 = 35.3146666 ft^3**
		square yard	cu yd / yd^3	**1 m^3 = 1.3079506 yd^3**
Flat angle				
revolution	r	radian		**1 r = 2 π rad**
		degree		**1 r = 360 °**
degree	°	radian		**1 ° = 0.0174533 rad**
		minute		**1 ° = 60’**
		second		**1 ° = 3600”**

1.2 MECHANICAL UNITS

Metric system		Imperial system		Values
Unit	**Symbol**	**Unit**	**Symbol**	
Flow rate				
meter per second	m/s	mile per hour	mph	**1 m/s = 2.2369 mph**
		foot per second	ft/s	**1 m/s = 3.28084 ft/s**
		inch per second	in/s	**1 m/s = 39.3701 in/s**
Radian frequency				
radian per second	rad/s	radian per second	rad/s	**1 rad/s = 1 rad/s**
revolution per minute	r.p.m.	revolution per minute	rpm	**1 tr/min = 1 rpm**
Acceleration				
meter per square second	m/s^2	foot per square second	ft/s^2	**1 m/s^2 = 3.2808399 ft/s^2**
Force				
Newton	N	kilogram force	kgf	**1 daN = 1.0197162 kgf**
		pound force	lbf	**1 daN = 2.248 lbf**
Moment of force				
Newton meter	N·m	force pound foot	lb−ft	**1 N·m = 0.7375621 lb−ft**
Energy. work. quantity of heat				
Joule	J	Watt−second	Ws	**1 J = 1 Ws**
Power				
Watt	W	Joule per second	J/s	**1 W = 1 J/s**
		kg−force meter per minute	kgf. m/min	**1 W = 6.1182973 kgf.m/min**
		horsepower (metric)	hp	**1 W = 0.00135962 hp**
Pressure. stress				
Pascal	Pa	pound per square inch	psi	**1 Pa = 0.000145038 psi**
		bar	bar	**1 Pa = 0.00001 bar**
		kg−force per square meter	kgf/m^2	**1 Pa = 0.1019716 kgf/m^2**
		Newton per square centimeter	N/cm^2	**1 Pa = 0.0001 N/cm^2**

1.3 MASS UNITS

Metric system		Imperial system		Values
Unit	**Symbol**	**Unit**	**Symbol**	
Mass				
kilogram	kg	pound	lb	**1 kg = 2.2046226 lb**
		ton (short)	ton	**1 kg = 0.0011023 ton**
Mass per unit length				
kilogram per meter	kg/m	pound per inch	lb/in	**1 kg/m = 0.055997 lb/in**
		pound per foot	lb/ft	**1 kg/m = 0.6719689 lb/ft**
		pound per yard	lb/yd	**1 kg/m = 2.015905 lb/yd**
Surface mass				
kilogram per square meter	kg/m3	pound per square foot	lb/ft^2	**1 kg/m^2 = 0.2048161 lb/ft^2**
		pound per square inch	lb/in^2	**1 kg/m^2 = 0.0014223 lb/in^2**
		pound per square yard	lb/in^2	**1 kg/m^2 = 1.8433451 lb/yd^2**
Density				
kilogram	kg	pound	lb	**1 kg = 2.2046226 lb**
		ton (short)	ton	**1 kg = 0.0011023 ton**
Mass per unit length				
kilogram per meter	kg/m	pound per inch	lb/in	**1 kg/m = 0.055997 lb/in**

1.4 UNITS OF TIME

Metric system		Imperial system		Values
Unit	**Symbol**	**Unit**	**Symbol**	
Time (duration)				
second	s	second	s	
minute	min	minute	min	**1 min = 60 s**
hour	h	hour	h	**1 h = 60 min = 3600 s**
day	d	day	d	**1 d = 24 h = 1440 min**
Frequency				
Hertz	Hz	Hertz	Hz	**1 Hz = 1 s^{-1}**

1.5 ELECTRIC UNITS

Metric system		Imperial system		Values
Unit	**Symbol**	**Unit**	**Symbol**	
Strength				
Ampere	A	Ampere	A	
Voltage				
Volt	V	Volt	V	
Power				
Volt−Ampere	VA	Volt−Ampere	VA	
kiloVolt−Ampere	kVA	kiloVolt−Ampere	kVA	
Watt	W	Watt	W	
Electric resistance				
Ohm	Ω	Ohm	Ω	
Quantity of electricity. load				
Coulomb	C	Coulomb	C	
		Ampere·hour	Ah	**1 Ah = 3600 C**
Capacity				
Farad	F	Farad	F	

1.6 THERMAL UNITS

Metric system		Imperial system		Values
Unit	**Symbol**	**Unit**	**Symbol**	
Temperature				
kelvin	K	Kelvin	K	**°K = (°F + 459.7)/1.8**
		Celsius	C	**°C = 5/9 * (°F − 32)**
		Fahrenheit	F	**°F = (9/5 * °C) + 32**

1.7 ACOUSTIC UNITS

Metric system		Imperial system		Values
Unit	**Symbol**	**Unit**	**Symbol**	
Sound pressure and acoustic power				
decibel	dB(A)	decibel	dB(A)	**1dB=0.1B**

2. EQUALITY BETWEEN FREQUENTLY USED UNITS

2.1 LENGTHS−DISTANCES

Metric system		Imperial system
1 centimeter (cm)	= 10 millimeters (mm)	= 0.3937008 inch (in)
1 decimeter (dm)	= 10 centimeters (cm)	= 3.937008 inches (in)
1 meter (m)	= 10 dm = 100 cm	= 1.0936133 yards (yd)
1 kilometer (km)	= 1 000 meters (m)	= 0.6213712 mile (mi)
Imperial system		**Metric system**
1 inch (in)		= 2.54 cm
1 foot (ft)	= 12 inches (in)	= 30.48 cm
1 yard (yd)	= 3 feet (ft) = 36 inches (in)	= 0.9144 m
1 mile (mi)	= 1 760 yards (yd)	= 1.609344 km

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1 DOCUMENTS

1.1 Sound pressure

The sound pressure (LpA) is measured at the level of the crane driver's ears by means of a microphone under the most unfavorable conditions: noisy winch, short counter jib.

Cranes with cabs:

Air conditioning at maximum level, windows closed, hoisting mechanism at low speed, hoisting/lowering with maximum load.

Air conditioning at maximum level, windows closed, hoisting mechanism at high speed, hoisting/lowering without load.

The highest value is taken for determining the sound pressure at the control unit.

Cranes with radio control:

The sound pressure level is given for a control unit which is at least 15 m away from the hoisting mechanism.

Sound pressure level measured in the cab or on the ground:

LpA (dBA)	Crane with winch in the jib	Crane with winch in the counter - jib
Not soundproof cab V140C or V140S	Sound pressure level = 79 dB(A)	Sound pressure level = 72 dB(A)
Sound proof cab V140SX	Sound pressure level = 76 dB(A)	Sound pressure level = 70 dB(A)
Control from the ground	Sound pressure level lower than 70 dB(A)	

1.2 Commissioning report

ZOOMLION

Email: service-hotline@zoomlion.com

DELIVERY INSPECTION REPORT FOR ZOOMLION TOWER CRANE

Report No.		Machine Model		Serial No.	
Region		Country		Service Date	
Customer Name		Location of Machine			

※ Mark the below corresponding symbols in right 'Result' columns according to the results of check.

√ Good Condition | X Bad Condition | ⊗ Correction Made

Inspection Items		Result	Inspection Items		Result
Visual Check	(1) The Actual Unpacked Attachments Conform with the Corresponding Shipping List.		Hoisting Mechanism	(1) Brake works reliably.	
	(2) The Actual Packed Attachments Conform with the Packing List.			(2) Hoisting limiter works properly.	
Erection	(1) Erection height of tower crane			(3) Tower Crane works properly at all hoisting and lowering speeds.	
	(2) Verticality of tower crane (design value: ≤ 4/1000)		Safety Device	(1) Load moment limiter works properly.	
Hydraulic System	(1) Working pressure of pump station			(2) Weight limiter works properly.	
	(2) Pump station gets no oil leakage.		Slewing Mechanism	(1) peed regulation for slewing to the left and right is smooth.	
	(3) All valves work properly.			(2) Brake works reliably.	
Trolleying Mechanism	(1) Reducer gets no oil leakage.			(3) Slewing limiter works properly.	
	(2) Brake works reliably.		Electrical System	(1) Complete machine is well insulated.	
	(3) Trolley moves smoothly.			(2) All electrical components work properly.	
	(4) Trolleying limiter works properly.			(3) Motor works properly.	
	(5) Tower crane works properly at all speeds no matter for trolleying in or trolleying out.			(4) Ground resistance of tower crane shall be no more than 4 Ω.	
			Traveling Mechanism	(1) Dolly moves smoothly.	
				(2) Traveling limiter works reliably.	

Foundation Checks and Others	Yes	No
(1) Foundation is made and maintained in accordance with drawings and instructions.		
(2) Make an clear explanation on rights and responsibilities of customer, Zoomlion warranty terms and conditions, service rules and so on.		

Detailed Description on Abnormalities Found during Delivery

Delivery Date: 本设备于_____年(Year)_____月(Month) _____日(Date) 正常交付使用。

Customer Comments and Suggestions

Very satisfied		Satisfied			Dissatisfied			Very dissatisfied	
☐ 10'	☐ 9'	☐ 8'	☐ 7'	☐ 6'	☐ 5'	☐ 4'	☐ 3'	☐ 2'	☐ 1'

Signature of Customer	
Customer Email/Phone No.	

Signature of Service Engineer		For Zoomlion Use Only	
Signature/Seal of After Service Provider			

ZOOMLION ZOOMLION HEAVY INDUSTRY SCIENCE & TECHNOLOGY CO.,LTD.

2 SAFETY INSTRUCTION

2.1 Foreword

The Safety Instructions describe the measures to be observed in order to reduce the risk of personal or material accidents when operating a crane. They are of utmost importance and must be consulted, comprehended, and applied by all parties intervening on the crane. A version translated into the language understood by the person consulting those instructions shall be supplied by the crane manager, if necessary.

Safety instructions figuring in the present chapter and based on the current state of knowledge at the time of their establishment are to be considered as simple guide−lines for the reader: ZOOMLION cannot anticipate in an exhaustive manner all the dangerous situations that may arise. Consequently, safety operation of the crane is a responsibility incumbent to yourselves.

Local regulations that are valid at moment of crane utilization may stipulate adherence to instructions that are more stringent than the present instructions, in which case those local regulations shall prevail.

The crane is a hoisting device destined for handling suspended loads on a protected operational site. It shall consequently be used exclusively for that purpose (cf. general utilization conditions chapter).

The crane has been designed in compliance with EC directives concerning safety, and to be used by professionals that are physically apt and qualified for the operation, assembly, piloting, and maintenance of this type of equipment (identified in the present manual as “competent persons”).

These persons must know the technical data (***Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>***) so as not to exceed the utilization limits described in this manual.

The illustrations of this part are general and do not correspond to your crane.

2.2 Intended use, misuse

The following describes the intended use of this ZOOMLION tower crane and warns against foreseeable misuse. Although the crane has been designed and manufactured according to the state of the art, it is not possible to completely eliminate all hazards that may occur during operation. The residual hazards, basic safety instructions, therefore draws particular attention to this.

Hazard prevention is carried out by:

- warning signs on the crane directly at the danger point,
- basic safety instructions for instructing the individual groups of persons in the operating instructions,
- action-related safety instructions before the activities described in the operating instructions.

2.2.1 Intended use

The design, manufacture, materials, equipment, operation, and maintenance of the ZOOMLION tower crane correspond to the state of the art, based on proven knowledge from science and technology. Nevertheless, its use may cause danger to life and limb of the user or third parties or damage to the crane and other property.

You may only use the crane in a safety-conscious and hazard-conscious manner, and in compliance with the operating instructions.

You may only use it for lifting, lowering, and horizontal load movements! You may only transport the load when it is freely suspended on the load hook! Damage and malfunctions which may impair safety must be rectified immediately!

Only skilled, instructed, and trained personnel may operate and monitor the crane from the crane operator's cabin and with radio operation.

The intended use, in particular the permissible loads for the crane components, is entered in the load tables in ***Section 3.6.3***. They must not be exceeded under any circumstances! Immediately rectify damage and malfunctions which may impair safety!

You may only use base elements for this crane which have been approved by the manufacturer. When selecting the installation site for stationary cranes, it is essential to maintain safety distances

from overhead electrical cables, solid objects in the vicinity (structures, stacks of material, etc.), and embankments. When preparing the installation site for stationary cranes, be sure to observe the design guidelines for foundation construction.

2.2.2 Foreseeable misuse

The previous section describes the intended use of the crane.

Any other use or use going beyond this is not in accordance with the intended use and must be refrained from.

In the event of foreseeable misuse or improper handling of the crane, the manufacturer's EC declaration of conformity and thus the operating permit automatically expire.

Examples of misapplications:

- Pull loads horizontally over the ground,
- Increase load when it has left the solid base,
- Transport of swinging loads (use guide ropes),
- Overload from non-observance of the permissible load capacity,
- Diagonal pull,
- Tearing loads up and/or loose from stacks or jammed loads,
- Carriage of persons during load transport or on the reception facilities,
- Attach load hook, operation with slack rope,
- Assembly / disassembly of the crane at wind speeds above 14 m/s = 50 km/h,
- Continue working despite error/malfunction messages,
- Inadequate, removed, bypassed safety devices and indicators.

Improper use includes:

- Lifting of persons in normal operation,
- Use for demolition work such as with grab or wrecking ball,
- Modifications of the steel structure,
- Attachment of additional wind-impact surfaces (such as advertising boards) without the manufacturer's approval,
- Incorrect maintenance work and repairs,
- Omitted replacement of wearing parts,
- Maintenance intervals not observed,
- Operation without the necessary double safety devices,
- Operation at temperatures below -20 °C,
- Operation without required supervision/instruction personnel when the crane operator has little or no visibility of the load,
- Failure to carry out the inspection by an expert after each new installation/conversion, but at least once a year,
- Failure to carry out the inspection by an expert.

2.3 General conditions of use

The purpose of these general conditions is to explain the conditions indicated in ***Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>***. In the event of unforeseen conditions, please contact us.

Certain critically important information on crane driving is represented in illustrated form in ***Chapter 4 <ERECTION/ADJUSTMENT/DISMANTLING>*** of the present manual.

2.3.1 Climatic and geographical conditions

A. Wind

Out of service, the crane operating conditions, i.e.: free standing height, ballast, reaction, and pressure under slab are determined by the storm reference wind speed measured at the crane installation site.

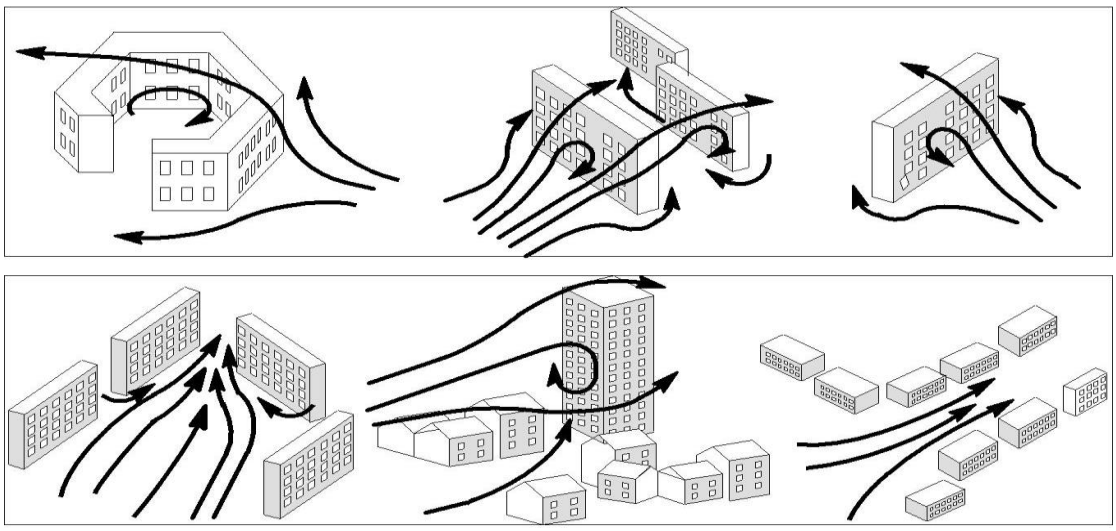
The storm wind speeds are described in the ***Section 2.7***.

a) Specific conditions

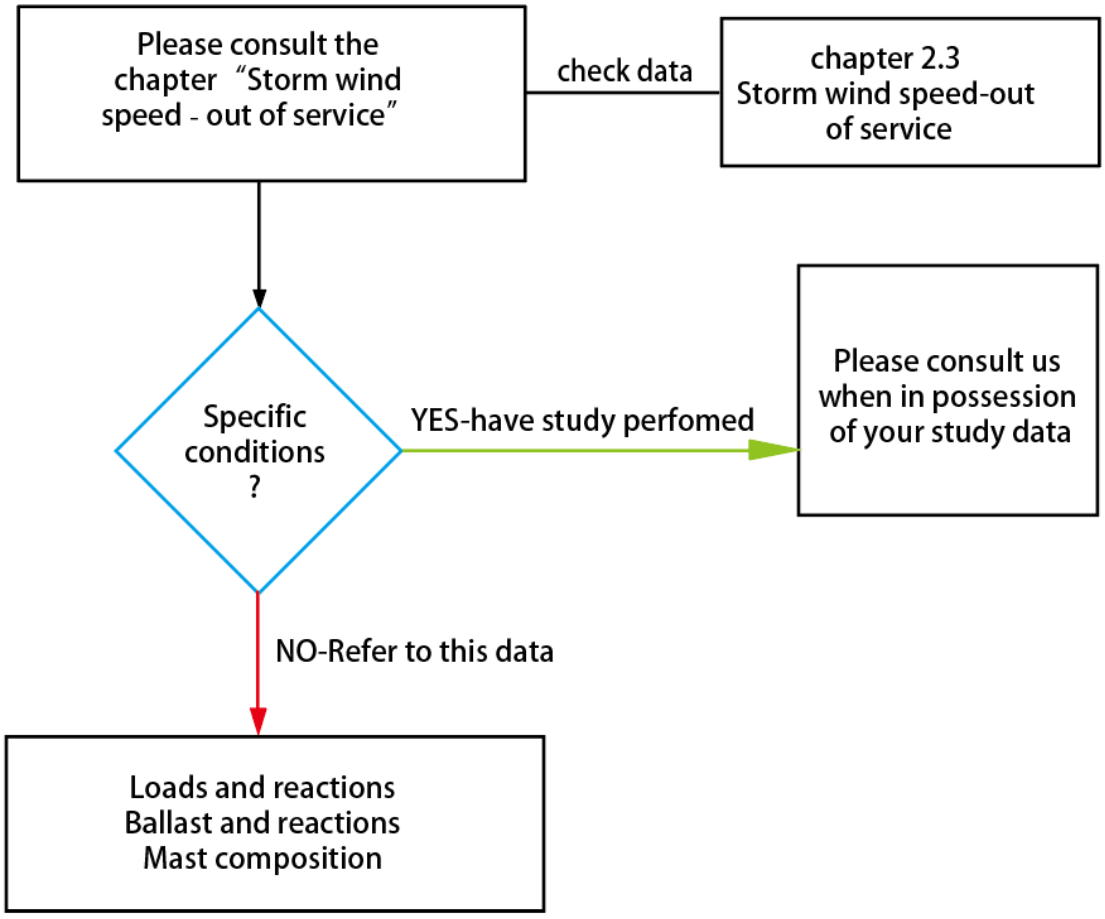
Some conditions or configurations require prior study on your part to determine the storm reference wind speed to be accounted for at the crane installation site. Please contact us when in possession of such data.

These conditions are:

- absence of map,
- national or local regulations,
- altitude higher than that indicated on your map if that is specified,
- bottom of hollow, narrow valley, hill top,
- isolated hill or mountain,
- cliff top,
- crane installed on a building,
- constructions: refer to the examples below.



b) Table for determination of crane operating conditions



c) Assembly, dismantling, change of configuration

Assembly, dismantling, change of configuration operations are possible only if the maximum wind speed (gust) measured at top of crane (cathead or strut) is lower than 14 m/s.

d) Crane in service

Use of the crane is possible only if the maximum wind speed (gust) measured at top of crane (cat head or strut) is lower than 20 m/s.

e) Surface exposed to the wind of the load handled

The surface exposed to the wind of the loads handled is considered as being less than or equal to 1 m^2/t. If this value exceeded, the "in service" wind speed must be limited to a value lower than 20m/s. The value to be taken into accounting is given in the table "Maximum admissible wind speed for a load surface higher than 1 sq. m/t" (see ***Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>***).

For surface areas greater than those provided in the table, please consult us.

B. Ambient air temperature measured under cover

This corresponds to the temperature measured within a non−closed shelter, protected from wind and rainfall, located 2 m above ground and within a max. 100 m radius.

Except for specific provisions defined by contract (E.g.: country specifications), the range of temperatures for crane use is as follows:

- Crane in service: − 20 °C to + 40 °C:

In case of temperatures out of the above range, cease any work with the crane (risk of malfunctioning or destruction of the components by abnormal overheating).

- Crane out of service: − 25 °C to + 55 °C:

In the case of planned temperatures out of the above range, it is preferable to dismantle the crane. In every case, apply the instructions concerning the extended standstill of the crane in the maintenance part.

C. Humidity / rainfall

The maximum rate of humidity for crane use (in service and out of service) is of 95% without condensation, excepting specific contractual provisions.

The maximum rate of humidity for a stored crane (dismantled) is of 95%.

D. Height above sea level

The operation height above sea level should be less than 1000m. The type of motor and electrical device should be increased.

E. Chemical environment

The requirement of chemical environment refers to urban industrial standard.

F. Electromagnet environment

The electrical field intensity should lower than 10V/m, extra design is needed when the television tower or other intense electrical field exists.

The nylon rope is recommended when the tower crane locates near the transmit tower.

The requirements above are general requirements; extra appointment is needed when dealing with special requirements.

G. Frost, ice, or snow

Frost, ice, or snow increase the weight of the structure and its surface exposed to wind. Those conditions may generate damage to moving parts. They can also cause personnel to fall when accessing the drivers stand.

It is strongly recommended to avoid using a crane when the latter is covered with frost, ice, or snow.

H. Lightning

Lightning can generate current circulation in the crane framework and lead to a risk of electrocuting any person in direct or indirect contact with the crane. E.g.: on part of the steel structure, on a ladder, on ground when touching the crane or load.

Lightning may interfere with the operating of radio controls.

In the event of risk of storm, cease work and set crane to idle mode. Do not access the crane during a storm.

In the case where the driver does not have time to leave the crane (sudden storm), he should never attempt to leave the crane during the storm. The driver runs less risk if he stays in the driving cab if he avoids touching any controls.

I. Sand storms

After a sand storm, sand may have penetrated internal electrical and mechanical elements and plugged orifices.

Before restarting the crane, completely clean the electrical and mechanical elements and remove moving parts if necessary.

J. Flooding / tidal waves

The above conditions are not accounted for, excepting specific contractual provisions.

In the case of flooding or tidal waves crane stability is reduced, thus cease any work with the crane.

K. Earthquake

The crane is not designed to be seismic−resistant whatever the magnitude of the earthquake, excepting specific contractual provisions.

L. Special installations

The crane is not designed to be installed on moving foundations such as off−shore platform, barge, floating bin, etc. excepting specific contractual provisions.

M. Crane supports

Crane supports shall be designed to withstand the forces indicated in the crane technical data and implemented in strict compliance with the tolerances provided.

2.3.2 Conditions relative to crane design

A. Appropriateness of crane to the operating site

Appropriateness of the crane to the operating site is incumbent to the user.

B. Crane power supply

The crane has been designed to work with a power supply the values and tolerances of which must be strictly adhered to ***Section 3.8***.

Non−adherence to the values indicated can lead to malfunctioning of the crane.

C. Driver control stand

According to options, the crane is driven from the cab or the control station on the ground. Driving can be radio−controlled or remotely controlled.

Safety devices (force, movement, speed limiters) prohibit use of the crane out of its normal operating conditions.

D. Safety devices

Safety devices (force, movement, speed limiters) prohibit use of the crane out of its normal operating conditions.

Never modify safety device settings, nor hinder their functioning or neutralize them.

E. Load indicator

The load indicator shall not be employed as a measurement tool.

F. Protective elements

Protective elements or devices prohibit access to dangerous areas. They must never be suppressed.

Never start up a crane before all the protective elements (e.g.: housings, life−lines, railings, trap−doors etc...) are set in place.

G. Nominal crane life duration

The nominal crane life duration corresponds to the minimum life duration accounted for when calculating the crane fatigue factor.

Except for specific contractual provisions, that nominal life duration is in conformity with the classification FEM 1.001 version 3.

It is evaluated separately and differently for the complete crane and its individual mechanisms.

H. Nominal steel structure life duration

This is expressed in hoisting cycles (1 hoisting cycle = hoisting of a load, slewing and/or trolleying of that load, lowering for laying down).

The classification group for single tower cranes is A4.

I. Nominal mechanism life duration

This is expressed in operating hours of the given mechanism.

The classification group for mechanisms depends on the type of crane and the given movement.

The classification group determines a nominal life duration according to mechanism load−supporting state.

The different values above are provided in ***Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>***.

J. Mechanism working factor

The mechanism working factor is expressed by the percentage of: mechanism usage time / mechanism usage time + rest time) measured over 20 cycles per hour.

The working factor indicated for mechanisms in ***Chapter 6 <MAINTENANCE AND INSPECTION>*** must in no case be exceeded.

K. Weathervane

The crane shall be able to weathervane through 360°. If that is not possible, please consult us.

L. Customer advertising plates

The dimensions of these plates shall not exceed planned dimensions.

Installation of advertising plates in areas other than those specifically provided is prohibited without the written authorization of the manufacturer.

Attachment of plates is entirely incumbent to the customer.

M. Fire extinguisher

The supply and implementation of a fire extinguisher in the cab is incumbent to the user.

N. Modifications of the crane / welding

Without written agreement of the manufacturer, it is prohibited:

- to modify crane construction (E.g.: addition or renovation d of elements, blow−torch work, welding, etc...),
- to adapt non−authorized accessories,
- to modify crane settings (E.g.: modification of pressures, tares, adjustment values, etc...),

- to perform welding operations on the crane.

Welding work under the load is prohibited if the load is not secured by electrically insulated slings.

O. Adaptation of equipment / Replacement of parts

Any adaptation of equipment not supplied or recommended by the manufacturer and any replacement by parts which are not genuine spare parts or parts authorized by the manufacturer will be carried out under the entire responsibility of the user.

The user also has the responsibility for the consequences of these adaptations and replacements.

P. Surveillance of the crane / verifications

To ensure the crane is monitored, is kept in good working order, and is used safely, it shall be submitted to the verifications (frequent, periodical, and extended) described in ***Chapter 6 <MAINTENANCE AND INSPECTION>***.

If they are stricter, the verifications and directives related to local regulations shall take priority over the instructions in this manual.

Update the crane's maintenance records according to the instructions supplied in the manual.

Q. Scrapping

Eliminate all used products such as oil, grease, batteries in conformity with the regulations prevailing at the site where the crane is used.

2.3.3 Crane installation conditions

A. Distance between crane and fixed obstacle

Adhere to the minimum regulatory distance between the pointing mobile part of the crane and fixed obstacles. In the absence of regulations, that distance shall be of at least 0.5 m on ground and 2 m for above ground elements.

B. Distance between crane and overhead electric line

Adhere to the safety distances imposed by the regulations at the operating site, concerning hoisting devices with suspended loads, between crane elements and overhead electric lines. In the absence of regulations, that distance shall be of at least 3 meters for voltages less than or equal to 50000 V, with the addition of 1cm per additional 1000 V above 50000 V.

C. Distance between 2 cranes

If several cranes are close to each other, the minimum safety distance between any individual part of a crane or its load must be greater than 2 m in relation to any individual part or load of another crane.

D. Safety distance at track extremities

Adhere to the safety distances imposed by the regulations at the operating site concerning hoisting devices with suspended loads, for track extremities.

In the absence of regulations, provide for a track length exceeding the end position planned for the crane by 6m, in order to account for the stopping distance and the safety distances for installation of end dampers.

E. Aircraft limiting lights

Use of the crane in areas close to airports or aerodromes, in the aircraft taking off or landing cone, dictates the necessity of daytime and/or nighttime limiting light installations.

Apply the regulations prevailing at the operating site.

2.3.4 Handling conditions

A. Handling equipment

The crane is destined for load handling with use of its hook.

The use of any hoisting equipment generating dynamic effects such as, for example, electromagnets, clutches, hammers, gathering buckets is prohibited.

B. Load handling

- **Never hoist an incorrectly secured load.**
- **Never drag a load in oblique direction. The load must always be hoisted in line with the trolley.**
- **Never hoist a load adhering to the ground or other elements.**
- **Never increase the weight of a load when suspended on the hook.**
- **Never swing the load to rest it out of the admissible range.**
- **Never leave the driving stand with a load suspended on the hook.**

C. Handling with 2 cranes

The use of 2 cranes to hoist one and the same load is prohibited.

D. Hoisting of persons

The crane is not designed for hoisting persons. Such usage, which may be authorized by national regulations concerning suspended−load hoisting devices, is the entire responsibility of the user.

E. Ballasting derricks

Ballasting derricks are reserved for the handling of ballast blocks and accessories provided for in the present manual. Any other utilization is prohibited.

F. Maintenance derricks

Their use is strictly reserved for loads lower than those indicated on the derrick.

2.4 General safety instructions

2.4.1 Requirements for personnel/qualification and duties

This section describes the required qualifications of the personnel employed. Only specially authorized personnel may work on the crane.

The contractor may only employ persons for independent work on the crane who:

- have reached the age of 18,
- are physically and mentally fit,
- have been instructed in the field of activity and have demonstrated their competence, know and be able to apply the applicable accident prevention regulations and safety instructions for crane operation,
- have understood the contents of the safety chapter and are able to apply and implement them in practice,
- have been trained and given practical instruction on the tower crane in accordance with their responsibilities, tasks and activities, have understood the associated technical documentation and can implement it in practice,
- reliably perform the tasks assigned to them as expected,
- a specialist is someone who is able to assess the tasks assigned to him and recognize hazards on the basis of his specialist training, knowledge, and experience,
- In your own specialist responsibility, you may only carry out activities for which training has been proven.

2.4.2 Duties and responsibilities

The following duties exist:

- of the operator in relation to the personnel deployed,
- of the personnel vis-à-vis the employer/operator.

Duties and responsibilities are divided:

- Operator/entrepreneur,
- Supervisors/department heads,
- Crane operator,
- Other personnel for transport, assembly, dismounting, maintenance and repair, slingers, banksmen, and experts.

2.4.2.1 Obligations of the entrepreneur

As the operator, the employer must designate a supervisor who is responsible for ensuring that the personnel assemble, dismounts, or converts the crane in accordance with the assembly/disassembly instructions.

The operator of this crane must ensure that the personnel:

- complies with the necessary safety and monitoring measures,
- attaches safety signs to the workplaces,
- attaches and makes known any necessary internal safety and work instructions,
- obtains and uses required personal protective equipment,
- is trained and instructed according to its responsibilities, tasks and activities on the crane, especially in all safety aspects and the avoidance of risks from, fatigue, and mental stress,
- has the technical documentation available,
- has the necessary work equipment at its disposal,
- maintains cleanliness and clarity on the crane,
- keeps maintenance and inspection intervals.

2.4.2.1.1 Accident prevention

In addition to the information given in this manual, observe the regulations applicable in the respective country of use.

Accident prevention regulations are primarily aimed at the employer and are intended to help him to implement his obligations arising from state occupational health and safety regulations, and to show him ways of preventing occupational accidents, occupational diseases, and work-related health hazards.

The employer can assume that he will achieve the required protection goals if he follows the recommendations of the accident prevention regulations. Other solutions are possible if they ensure safety and health protection in the same way. If special committees have identified technical rules for the specification of national occupational health and safety regulations, observe them as a matter of priority.

2.4.2.1.2 Periodic inspections

Observe the manufacturer's inspection instructions in the operating manual.

The entrepreneur must ensure that:

- a competent person inspects the crane as required, but at least once a year, depending on the conditions of use and the operating conditions,
- in addition, a competent person inspects the crane each time it is assembled and after each conversion,
- An expert inspects the crane at least every 4 years,
- in the 14th and 16th year of operation, and after that, an expert inspects the crane annually.

2.4.2.2 Duties of the superior

The supervisor / group leader of the personnel of this crane must ensure that:

- the corporate duties have been implemented and complied with, see ***Section 2.4.2.1***.

In particular, he must ensure that the authorized personnel:

- is trained and instructed according to his responsibilities, tasks, and activities on the crane,
- is instructed and trained in all safety aspects, and observes the safety aspects,
- observes the specifications of the technical documentation,
- has received and is using the required personal protective equipment,
- uses the necessary work equipment,
- maintains cleanliness and clarity on the crane,
- keeps maintenance and inspection intervals,
- rectifies reported safety deficiencies immediately.

2.4.2.3 Duties of personnel

The personnel working on the crane is obliged to:

- observe internal safety and work instructions,
- report safety deficiencies immediately to the appropriate supervisor or department head,
- keep the required safety signs visible/readable at the workplace,
- work on the crane only in accordance with its responsibilities, tasks and authorized activities,
- avoid risks from noise, fatigue, and mental stress,
- observe the specifications of the technical documentation,
- use the required personal protective equipment,
- to use the necessary work equipment,
- maintain cleanliness and clarity on the crane.

2.4.2.4 Duties of the crane operator

Before starting work

- Check crane for obvious defects.
- Check brakes and emergency end stop devices.
- Check assignment of control unit and crane with wireless controlled tower cranes.
- Check the function of the hook safety device on the load hook.
- Check track system and running gear, if present.
- Before releasing the energy supply to the drive units, set all control devices to zero or idle position.

During operation

- Record inspections and defects found in the control book.
- Operate control devices only from control stands.
- Watch the load during all movements, or the pick-up devices during empty runs if this could cause hazards. If this is not possible, the crane operator may only steer the crane on the signal of a banksman.
- Give warning signs if necessary.
- Loads attached by hand may only be moved when there is a clear signal from the slinger, the banksman, or another responsible person designated by the employer. If you have to use signals, agree on them beforehand with everyone involved. If loads are improperly

attached, they must not be transported under any circumstances.

- As long as a load is suspended from the crane, you must have the control devices within reach.
- Do not accept an overload after the load moment limit switch has tripped.
- It must be possible stop started driving or turning movements without danger.
- Report all defects on the crane to the responsible supervisor, and when changing the crane operator, also to the person taking over.

Avoid the following:

- Pulling loads at an angle, swinging.
- Tearing loose fixed loads.
- Permit the transport of persons with the load or the lifting device, (exception: for example, concrete bucket with stand for operating personnel; however only with the approval of the competent supervisory authority).
- Carrying loads over people. Use pick-up devices that hold the load by magnetic, frictional, or suction forces without additional securing. In general, loads must not be carried over persons.
- Approach of end positions limited by end switches.

Stop the crane operation under the following conditions if:

- you cannot safely hold and take off the load in windy conditions;
- the wind speed exceeds the permissible limit of 20 m/s;
- the temperature falls below -20° C;
- defects occur that endanger operational safety.

At the end of work

- Before leaving the control stand, unhook loads, sling or pick-up equipment, pull up hooks, release slewing gear brake, move trolley into rest position, set control equipment to zero or idle, shut off power supply.
- Secure the control unit for wireless control against unauthorized switching on before putting it down.
- Do not leave loads hanging on the unoccupied crane.
- Activate wind release.
- Fasten track-operated tower cranes with rail tongs; put crane in "out of service" position.

Regular maintenance

- Maintain ropes.
- Check ropes for damage.
- Check load display control device.
- Check protective covers.
- Check safety switches.

2.4.2.5 Expert

Observe the regulations on experts applicable in the country of use!

Only persons authorized by the supervisory authority (Employer's Liability Insurance Association) are deemed to be experts for the periodic inspection of tower cranes. Immediately send the test report to the supervisory authority responsible for the contractor (Employer's Liability Insurance Association).

2.4.2.6 Competent persons

Competent persons carry out periodic inspections on tower cranes.

A competent person is a person who, on the basis of its professional training and experience, has sufficient

knowledge of tower cranes and is familiar enough with the relevant state occupational health

and safety/accident prevention regulations, guidelines, and generally recognized rules of technology

to be able to assess the safe working condition of tower cranes.

In addition to the competent persons, you can also use specially trained personnel as experts, provided

they have experience and sufficient knowledge to assess the safe condition of the crane to be inspected.

2.4.2.7 Crane operator

The crane operator is primarily responsible for the intended use of the crane. His responsibility must be precisely defined and adhered to, also in the case of traffic route regulations. Instructions from third parties are not binding on him.

Keep and store tools, operating materials, and loose objects safely. Keep ascents, handholds, railings, and platforms clean and, in winter, free of ice and snow.

The crane driver must familiarize himself with the conditions at the construction site at the location.

Obstacles in the work area must be known, and the construction site must already be secured to public traffic.

Any working method endangering the crane stability is prohibited!

After work, the crane operator must ensure that all operating elements and equipment are switched

off or set to the neutral position.

Before leaving the crane, the crane operator must secure it against accidental and unauthorized use.

See corresponding sections in *Chapter 5 <OPERATION AND CONTROL>*.

2.4.2.8 Banksman

The use of a banksman is mandatory when transporting loads that you cannot see.

The banksman gives instructions to the crane driver for certain operations. He must be able to observe the entire process without danger. The banksman must devote himself exclusively to control the work processes and the safety of persons being in the vicinity. He also pays attention to safety distances and danger areas which he closes off and secures them if necessary.

The banksman must be easily recognizable to the crane operator. Clothing should be conspicuously colored (signal color), preferably uniform, and be reserved for the banksman.

Communication takes place by means of defined hand signals, or radio telephony. Radio is best.

If the working areas of several cranes overlap, you must define, plan, and coordinate the processes with all parties involved.

2.4.2.9 Slinger

The slinger attaches a wide variety of loads to the hook.

For the smooth transport of load, only the signs of the banksman are decisive, who must observe the slinger closely and follow his signs. They communicate by means of defined hand signals, or radio telephony. Radio is best used when you cannot see the slinger or the banksman.

Loads may only be attached by instructed, trained, and authorized persons who have been instructed in the execution and function of the lifting equipment.

2.4.2.10 Assembly personnel

Only trained personnel instructed by ZOOMLION may be used to assemble a crane. The foreman is responsible for supervision and has the authority to issue instructions.

The installation personnel must always observe the local regulations and occupational health and safety when working.

2.4.2.11 Supervisor

The employer must designate a supervisor who is responsible for ensuring that the personnel assemble, dismounts, or converts the crane in accordance with the Erection instructions.

2.4.2.12 Maintenance/repair personnel

Specialists maintain and repair the crane. They can use work stands or platforms if they cannot work from the ground (accessible area on the crane).

However, this does not apply when the crane is switched on and during work:

- there is no danger of crushing or falling,
- there is no danger of touching live parts of electrical installations and equipment,
- voice or line-of-sight communication with the crane operator is possible.

2.4.2.13 Miscellaneous tasks

Danger from electrical voltage

The **employer and the crane operator** must ensure that persons in the vicinity of live parts of electrical systems and equipment can work safely on the crane.

Repairs of/modifications to the crane and its working area

Whenever repairs, maintenance, or modifications are carried out on the crane or in its working area, the employer must also order and monitor the following safety measures:

- Switch off crane, secure against unauthorized restart;
- Secure the danger area under the crane by blocking or by warning posts;
- Secure the crane so that other cranes cannot approach it;
- Inform the drivers of neighboring cranes about the type and location of the work.

This also applies to shift changes.

If these safety measures are inappropriate or inadequate for operational reasons, the employer has to order and supervise other, additional, or specifically prescribed safety measures.

Recommissioning after repairs and modifications

You may only operate the crane after the entrepreneur has released it. Prior to release, the entrepreneur or his representative shall satisfy himself that:

- the work is completed,
- the crane is again in a safe condition,
- all persons involved in the work have left it,

In case of modifications, an expert must approve the crane; see special instructions in the other chapters of this manual.

2.4.3 Workplaces

This section describes the workplaces that are directly or indirectly related to the crane.

2.4.3.1 Personal protective equipment against falls from a height (PPE)

For many maintenance/repair jobs on the crane such as on jibs, you cannot use workman baskets/ working platforms, etc., to work safely. Therefore, use your personal protective equipment against falls from a height (PPE) when doing so, and during any assembly / dismounting or retrofitting.

Caution about impact by heavy parts, missteps in areas without railings, tripping, wind, movement of the standing surface, etc. when you work at great heights.

Death, personal injury, or property damage are the result.

- Use a safety harness everywhere on the crane where you can fall, for example when you leave the railing-secured areas!
- Always use the safety ropes/braces fitted for securing.

Observe and comply with the regulations applicable in the country of use!

Accident prevention regulations are primarily addressed to the employer. They are to assist him to implement obligations arising from state occupational health and safety and/or insurance regulations, and show him how to avoid occupational accidents, occupational diseases, and work-related health hazards.

Before selecting and using PPE, the employer must determine the hazard(s). In doing so, he identifies hazards which technical or organisational measures can neither prevent nor minimise.

The employer must specify the characteristics for the PPE in order to protect against the hazards mentioned. The hazards which arise or may arise from the use of the PPE must be taken into account.

If workplace conditions change, the employer must review the investigations.

The employer must document his findings on the basis of the risk assessment. If work characteristics and hazards are comparable, he can create joint documentation for several users.

The PPE to be used must comply with the relevant regulations on the safety and health of users at work. Thereafter, an EC type examination must be carried out, a CE marking must exist, and a manufacturer's declaration of conformity must be available.

Before selecting the PPE, the employer must evaluate the products he intends to use to determine whether they:

- protect against the dangers to be averted without posing a greater danger by itself,
- are suitable for the prevailing workplace conditions,
- meet the user's ergonomic requirements and health needs,

- can be adapted to the user if this is required by the nature of the personal protective equipment against falls from a height.

Notes on the selection

Do not combine different fall arrest systems with each other!

For the use of PPE, the employer must draw up operating instructions containing all the information required for safe use, in particular the hazards according to the risk assessment, the behaviour during use and in the event of any defects found.

Instruction

The employer must instruct users before first use and as required, but at least once a year. The instruction must include at least:

- detection of damage;
- the specific requirements of the individual equipment;
- proper wearing;
- intended use;
- proper storage.

Maintaining / cleaning / storing PPE

The employer must ensure that defective parts of PPE are only replaced by parts that correspond to the original part.

Clean and maintain all PPE equipment as necessary and in accordance with manufacturer's instructions.

Keep your personal protective equipment safe and comply with the respective manufacturer's instructions.

Inspections

Users must visually inspect their PPE for proper condition and operation before each use.

Depending on the conditions of use and the operating conditions, the employer must have the equipment inspected by a competent person as required, but at least once a year, to ensure that it is in perfect condition.

By way of derogation from this, the contractor shall have fixed guides for the installation of equipment (rails and ropes) inspected by a competent person as required, but at least once a year, to ensure that they are in perfect condition.

2.4.4 Instructions relative to operating conditions

A. Regulations relative to suspended-load hoisting devices

- Adhere to local regulations concerning suspended−load hoisting devices for matters covering:
  - roadway traffic,
  - fire−fighting equipment,
  - protection of the environment,
  - radio−control transmission−reception frequencies,
  - periodical verifications.

The dangers linked to the utilization and configuration of the machine must be taken into accounting by the security services and rescue services during the analysis carried out by the inspection authorities.

B. Climatic circumstances

- Establish a procedure relative to the behavior to be adopted in the case of particularly climatic circumstances (E.g.: reduced−function operation, evacuation of the area). That procedure may be supported by a system of climatic condition forecasting implemented by the local meteorological department.

C. Access to crane / driving stand

- Access the driving stand via the access path provided, with the crane stopped.
- Access the driving stand with an elevated cab or personnel elevator only when the crane is stopped and in adherence to the maximum authorized carrying capacity.
- Keep the access paths and control station perfectly clean. In particularly, remove all waste, traces of grease or oil, spare parts, tools, etc. Store tools, accessories, and parts in the positions provided for that purpose.
- Access the crane with hands unhindered by any object, facing the crane and always maintaining contact at 3 points with its elements: ladders, railing, stairs, catwalks, railings, etc... (e.g.: 2 feet and 1 hand, 2 hands and 1 foot).

D. Malfunctioning

- In the case of malfunctioning, stop the crane until the risk has been assessed by a competent person.
- Immediately correct any malfunctioning liable to compromise safety.
- Enter all malfunctions in the crane's maintenance records.

E. Electric lines

- Define the procedure to be applied in the case of accidental contact between crane and electric lines under voltage (direct contact or start of an electric arc).

- Examples:
  - Do not leave the crane,
  - Do not touch the metallic structure,
  - Warn all persons outside that they must avoid approaching or touching the crane,
  - Withdraw the crane from the danger zone,
  - Have the electric line powered off then leave the crane.

F. Conditions for visibility

- Adapt the communication means to the visibility conditions at the site where the crane is operated, for example use transceivers or video systems.
- In the case of low light, do not use the crane without an appropriate artificial lighting.

2.4.5 Instructions relative to specific danger

A. Installation

- Make sure that the electrical system is complete and undamaged.
- Make sure that the electrical system has no condensation and humidity.
- The lifting lugs are recommended to be used during removals.
- The cabinet is recommended to be installed in predesigned position, and the number of fasten needs to meet the designer's needs.
- Fasten the screws with required torque (see details on ***Section 6.10***), using recommended plane pad or spring washer.

B. Wiring

- Confirm the power is off and no residual voltage.
- Wiring should be conducted by professional.
- Do not wiring when wearing loose clothes or jewelry.
- Avoid the damage of wires.
- Wiring with required wiring diagram.
- Wiring with required wires.

C. Test run

- Confirm the validity of the cabinet's installation; turn on the power after closing the cabinet's door. DO NOT open the cabinet's door when operating.
- Confirm the tower and mechanisms operate in allowable range.

D. Maintenance and Checking

- High-voltage exists in the high-voltage terminal, please DO NOT touch them.
- Turn off the cabinet's door when operating. Close the related breakers and confirm no residual voltage when disassembling the elements.
- DO NOT maintenance, check or replace the element unless an appointed specialist. Take off the metal jewelry (watch, rings) before operating, using insulated tools when operating.

- Apply extra braking methods when checking any brake.
- DO NOT wiring or remove wires when the power is on.
- DO NOT Maintenance or checking when the weather is bad.
- Maintenance and checking are recommended to carry on in 20 minutes after power-off, the residual voltage or high temperature exists in some elements.
- DO NOT reform the electrical system.

E. Additional

- DO NOT operate other mechanism when climbing.
- DO NOT operate when the safety device is not installed or debugged.
- The operator should pass through professional training.

2.4.6 Safety instructions relative to the preparation of each operating phase

A. Transport

- Provide for access to the site where the crane is operated, suited to crane transport conditions and, if necessary, the transport of auxiliary equipment used for assembly−dismantling (ground resistance, climatic conditions, access ramp, maneuvering zone, etc.).
- Install signaling equipment before any transport by road.

B. Preparation of the site

- Ensure that the site where the crane is used meets all crane characteristics and utilization conditions.

a) Crane installation area

- Before installing the crane, study the constraints related to its operating site, such as:
  - local regulations concerning work above public buildings or other, above roads, railroads, fluvial canals, etc.
  - proximity to other cranes, to an airport, to electric lines, to a transmitter of electromagnetic waves, etc.
  - configuration of the terrain, resistance of ground, excavations, slope, underground structure, etc.
  - storage zones for elements used in crane assembly or dismantling, positioning of handling equipment, in order to determine the optimal crane position, in compliance with assembly−dismantling and operating conditions.

b) Power supply

- Ensure that the power supply conforms to crane data and possesses the mandatory protections.

C. Assembly-dismantling part

a) Preparation of assembly−dismantling

- Establish a document, for the attention of the personnel at the crane operating site, that details the risks of assembly, dismantling or change of configuration operations and the appropriate protective measures.
- Before any assembly, dismantling, change of configuration (e.g.: raising on supports, passage to raised jib) of the crane, ensure with the relevant authorities that wind speeds will not exceed the maximum authorized speed (refer to utilization conditions) throughout the entire operation.
- Stake out the safety areas (zones for storage, handling, assembly, ...) when assembling, dismantling, or testing the crane, with the use of signaling prohibiting access to non−authorized personnel.

b) Assembly − dismantling − change of configuration

- Do not use the crane during assembly, dismantling or change of configuration operations.
- For any assembly or dismantling operations not covered by the normal procedures (example: constraints related to the crane operating site, malfunctioning during assembling or dismantling), please consult us.

D. Maintenance part

a) Preparation for maintenance

- Stake out a safety area in the case of crane malfunctioning or during maintenance interventions, with the use of signaling prohibiting access to non−authorized personnel.
- Inhibit re−start of the crane on stoppage for intervention and signal that inhibition of re−start by a warning attached to the main switch.

b) Maintenance

- Do not use the crane during maintenance operations.
- For any non−standard maintenance operation, please consult us.

2.5 Residual hazards, basic safety instructions

The hazards were determined during the design and manufacture of the crane by a risk assessment in accordance with DIN EN ISO 12100 and EN 14439, and the risks were evaluated. Constructively unavoidable residual hazards are named and explained

- in the basic safety instructions,
- and in individual chapters situation and/or action-related (specific warnings).

The safety briefing contains basic safety instructions to permanently influence your behavior in a positive way. Information of results and interrelationships promotes your understanding and leads to safety-conscious behavior.

Observing and practical implementation of generally valid specifications in the country of use will give you further suggestions and tips, such as:

- Accident Prevention Regulation "Principles of Prevention".
- Accident prevention regulation "Cranes".
- Accident prevention regulation "Winches, lifting, and pulling devices".
- Accident prevention regulation "Load handling attachments with hoist operation".
- EC Directive 89/391/EEC "Measures to encourage improvements in the safety and health of workers at work".
- EC Directive 89/655/EEC "Minimum safety and health requirements for the use of work equipment by workers at work".
- EC Directive 92/58/EEC "Minimum requirements for the provision of safety and/or health signs at work".

In particular, note the following in addition:

- Machine/system-specific safety regulations by the operator.
- Safety instructions in the suppliers' operational documentation.

Basic safety instructions with information on residual hazards are structured according to target groups and can be found for:

- All persons in this chapter.
- Storage and transport personnel in this chapter and in the ***Section 3.4.***
- Assembly personnel in this chapter and in ***Chapter 4 <ERECTION/ADJUSTMENT/DISMANTLING>.***
- Crane operators in the Safety section in ***Chapter 5 <OPERATION AND CONTROL>.***
- Dismounting personnel in the Safety section in ***Chapter 4 <ERECTION/ADJUSTMENT/DISMANTLING>.***
- Maintenance personnel in the Safety section in ***Chapter 6 <MAINTENANCE AND INSPECTION>.***

2.5.1 Dangers on the crane

The operating manual is an essential part of the crane for safe and efficient operation, therefore:

- observe the operating instructions;
- keep operating instructions available on the crane;
- forward the operating instructions to all subsequent users.

An employee is an authorized person if it is instructed by the employer and informed about the dangers/hazards.

All persons on or near the crane are exposed to the following hazards:

- **DANGER! Incorrect lifting accessories.**

Loads fall down if inadequate/defective lifting accessories break.

Death, personal injury, or property damage are the result.

► Close off and monitor hazardous areas.

► NEVER work under suspended loads.

► NEVER swing loads over people. In exceptional cases, give a warning signal to clear the area.

► Only use sufficient, intact, and tested lifting accessories.

► Secure the load so that it neither slips nor tips. If the balance point shifts, overloaded lifting accessories tear.

► Regularly check and maintain ropes and lifting accessories.

■ **DANGER! Incorrect slinging**

Loads crash if you sling them at unsuitable positions and a part break.

Death, personal injury, or property damage are the result.

► Only attach loads to the intended and marked slinging points.

► Secure inserted outriggers.

► Close off and monitor hazardous areas.

► NEVER work under suspended loads.

► NEVER swing loads over people. In exceptional cases, give a warning signal to clear the area.

■ **DANGER! Loose parts of overhead loads**

Loads crash when parts detach and fall off.

Death, personal injury, or property damage are the result.

► Secure loads so that they neither slip nor tip.

► NEVER deposit loose parts on the load! Remove loose parts, transport, or secure them separately if necessary.

► Close off and monitor hazardous areas.

► NEVER work under suspended loads.

► NEVER swing loads over people. In exceptional cases, give a warning signal to clear the area.

■ **DANGER! Overhead loads**

Suspended loads moving in a controlled or uncontrolled way strike persons or objects.

Death, personal injury, or property damage are the result.

► Close off and monitor hazardous areas.

► NEVER work under suspended loads.

► NEVER swing loads over people. In exceptional cases, give a warning signal to clear the area.

► Loads must not swing in order to keep the danger area small. Always use the guide rope.

► Wear safety helmet and safety shoes!

■ **DANGER! Overhead loads**

Suspended loads can bump or crush people / objects. Slings come loose. Load slips, tips, or crashes.

Death, personal injury, or property damage are the result.

► Have the danger area cleared before hoisting the load.

► Be aware of the balance point when hoisting the load.

► The crane operator, banksman, and slinger must ensure that you can hoist the load safely.

► Lower the load and have it realigned/newly slung if it is suspended incorrectly.

► Hoist loads gently until the hoisting rope is taut. Jerky hoisting activates the overload protection and puts excessive stress on the load hook, hoisting rope, and crane.

■ **DANGER! Danger of collision and tipping due to new cranes in the working area!**

When you set up other cranes, the working areas may overlap.

There is a danger of collision.

Death, personal injury, or property damage are the result.

► The working areas of all cranes are to be coordinated and limited if necessary.

► Limit the working range.

► Notify site supervisors and service personnel.

2.5.1.1 Falling objects

■ **DANGER! Falling objects**

Objects such as dismounted components, tools, etc., fall due to wind, impact, or movement of the crane.

Death, personal injury, or property damage are the result.

► Collect tools and assembly materials such as pins and split pins, and stow them properly! Do not store or transport loose parts on the load!

► Persons without an order to work on the crane are not allowed to enter the construction site!

► Block off the danger area under the crane widely from unauthorized access, or secure it with warning posts.

► Wear safety helmet and safety shoes!

■ **WARNING! Falling objects**

Inadequately fixed advertising boards fall from a great height.

Death, personal injury, or property damage are the result.

■ Adequately secure advertising boards.

■ Also check the attachment of the advertising boards during inspections before putting the crane into service.

2.5.1.2 High voltage

■ **DANGER! Overhead lines, electrical high voltage**

When the crane approaches or touches electrical lines, it is live. If someone leaves or enters it, it discharges through the body.

Death, personal injury, or property damage are the result.

► Always work with a banksman when working near overhead lines. From the best possible

vantage.

point, it makes sure you stay within limits, and warns you immediately if you exceed them.

► Move the crane slowly near overhead lines. To prevent the load from swinging: Use polypropylene guide ropes. Manila or nylon ropes are unsuitable as they absorb moisture and conduct electrical voltage.

► After contact with the overhead line:

- Act prudently and in accordance with your instructions!
- Do not leave or enter the crane! Keep a safety distance of at least 5 m, cordon off and secure the danger area.
- Warn outsiders not to approach or touch the crane!
- Do not leave or enter the crane until the touched / defective cable has been safely de-energized!

► The crane driver initiates further measures.

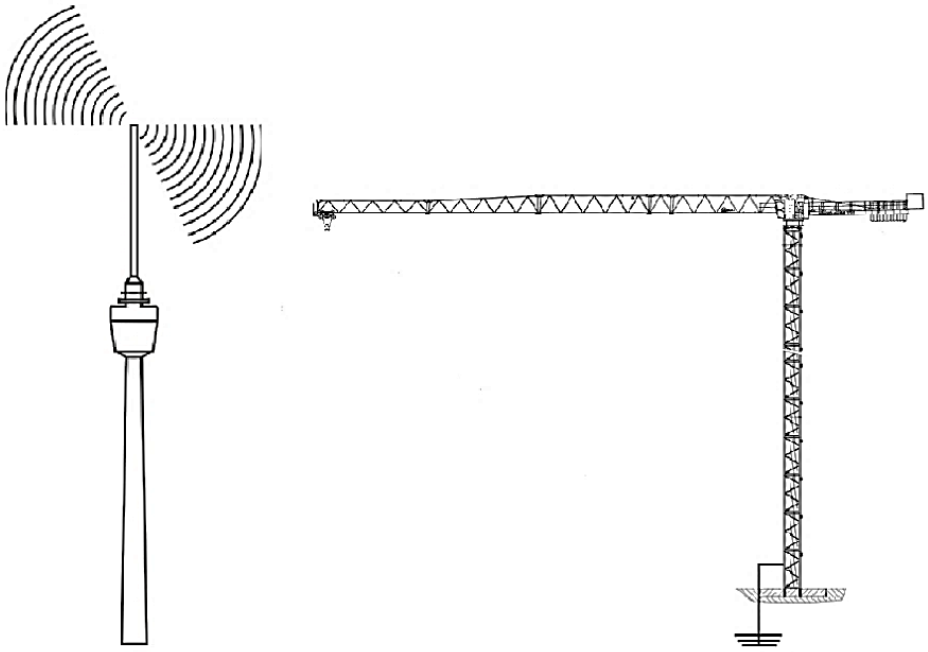


Fig. 2-1 Charging by electromagnetic fields - Ground the crane

- **WARNING! Radio waves**

The crane jib charges itself like an antenna in the electromagnetic field of adjacent radio towers. If someone leaves or enters it, the voltage discharges through the body.

Death, personal injury, or property damage are the result.

- Ground the crane!

2.5.1.3 Lightning

■ **DANGER! Lightning**

Lightning can strike the crane during a thunderstorm. If someone leaves or enters it, the voltage discharges through the body.

Death, personal injury, or property damage are the result.

► Ground the crane in accordance with applicable legal requirements.

► Observe the local regulations for lightning protection when constructing the foundations. Check with the local acceptance authorities.

► Do not leave or enter the crane during thunderstorms.

► After a lightning strike, check the crane for damage (power supply, grounding).

2.5.1.4 Electrical voltage

DANGER! Electrical voltage

Dangers arise in electrical operating areas and on components:

■ Live parts.

■ Live parts due to faulty conditions.

■ Parts under high voltage.

■ Electrostatic processes and charges.

■ Thermal radiation, ejection of molten particles, or chemical processes during short circuits or overload.

Death, personal injury, or property damage are the result.

► Only authorized electricians may work on electrical systems and their parts.

► Before working on electrical equipment/parts:

■ Comply with legal and local regulations.

■ Disconnect from power supply and check that no voltage is present.

■ Secure against restarting.

■ Cover adjacent live parts.

2.5.1.5 Danger of falling

■ **DANGER! Falling**

If you lose your footing or balance, you will fall. Causes: Misstep in areas without railings, tripping, wind, inattention, etc.

Death, personal injury, or property damage are the result.

► Unauthorized persons are NOT allowed to ascend the crane or use it.

► Notify the crane operator before entering the crane.

■ **WARNING! Danger of falling**

If you lose your footing or balance while ascending/descending, for example on slippery ascents, due to misstep, stumbling, wind, inattention, etc., you will fall.

Death, personal injury, or property damage are the result.

► Use the railing!

► Check steps and railings regularly for safety and clean them.

2.5.1.6 Wind

■ **DANGER! Strong wind, gusts**

You can no longer move bulky, large, and light parts in a controlled manner.

Death, personal injury, or property damage are the result.

► DO NOT lift light, large, bulky loads in strong, gusty winds!

2.5.1.7 Dangers from crushing and drawing in

■ **WARNING! Crushing/drawing in**

Danger of crushing and drawing in from unintentional start-up of the drive.

Death, personal injury, or property damage are the result.

► Before starting work, switch off the main crane switch, and secure it against being switched on again.

► Make sure that all drives are in a free of voltage.

■ **WARNING! Crushing/drawing in**

Danger of crushing/traction between gear ring and multi-turn actuator.

Death, personal injury, or property damage are the result.

► Only work on the gear ring when it is at a standstill! Switch off crane without wind release, secure against restarting: Lock the crane disconnector. Brakes on the slewing gear are closed. Place a sign at the switch-on point indicating that maintenance is required.

► Keep clothing and hands away from the rotating drive. Wear tight-fitting work clothes and a hair net if required.

■ **WARNING! Crushing/drawing in**

Danger of crushing/pulling in between the hoisting rope and drum on the hoist gear.

Death, personal injury, or property damage are the result.

► Only work on the hoisting rope, brake, and rope drum when the machine is at a standstill. Switch off crane, secure against restart: Lock the crane disconnector. Put a sign at the switch-on point indicating that maintenance is required.

► Keep clothing and hands away from the rotating drive. Wear tight-fitting work clothes and a hair net if required.

■ **WARNING! Crushing/drawing in**

Danger of crushing and pulling in between trolley rope and rope drum when the trolley gear is rotating. Death, personal injury, or property damage are the result.

► Only work on the trolley rope and rope drum when the machine is at a standstill. Switch off crane, secure against restart: Lock the crane disconnector. Put a sign at the switch-on point indicating that maintenance is required.

► Keep clothing and hands away from the rotating drive. Wear tight-fitting work clothes and a hair net if required.

2.5.1.8 Other hazards

DANGER! Dangerous crane movements

During operation, the crane moves in a dangerous way. The cab protects the crane operator. Other persons on the crane are at risk.

Death, personal injury, or property damage are the result.

► Unauthorized persons are NOT allowed to ascend the crane!

► Notify the crane operator before allowing authorized persons to ascend or descend!

► The crane operator must interrupt or stop the crane operation to exclude any danger!

2.5.1.9 Large hook heights

For cranes with large hook heights, the weight of the hoisting rope reduces the maximum load that can be lifted; for details see ***Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>***.

Liftable load = permissible load - additional weight of the hoisting rope.

2.5.1.10 Fire hazard

■ **WARNING! Stability is endangered**

If flammable or explosive substances ignite on the crane, they will damage the steel structure.

Stability is then no longer guaranteed, and the crane falls over.

Death, personal injury, or property damage are the result.

► Do not store any:

 fire-promoting,

 combustible, or

 explosive

substances in the vicinity of the crane!

NOBODY is allowed to enter or work in hazardous or work areas under the influence of alcohol, drugs, or mind-expanding substances!

2.5.2 Disposal and environmental protection

Environmental protection.

Recycle environmentally hazardous substances in accordance with the national regulations of the country of use.

Dispose of operating and auxiliary materials as well as replacement parts safely and in an environmentally friendly manner.

According to Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) of the European Parliament, do not dispose of this equipment with your normal household waste. Use the appropriate take-back systems of the municipality or a specialist disposal company with separate collection for electrical and electronic equipment.

Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) of the European Parliament prohibits the introduction onto the European market of new electrical and electronic equipment containing more than the maximum permitted levels of lead, cadmium, mercury, hexavalent chromium, fire retardant polybrominated biphenyl (PBB), and polybrominated diphenyl ether (PDBE).

2.5.3 Dangers during transport

■ **WARNING! Wrong shelves**

Transported loads fall or tip if they are placed on uneven or insufficiently stable surfaces.

Death, personal injury, or property damage are the result.

► Only place loads on level and sufficiently stable surfaces.

► Use a suitable base on soft ground.

■ **WARNING! Danger of falling**

If you work above body height, you will fall when you lose your footing or balance.

Death, personal injury, or property damage are the result.

► When working above body height, use appropriate safety access aids and working platforms.

► DO NOT use machine parts as climbing aids.

■ **CAUTION! Sharp-edged machine parts**

Sharp-edged machine parts cause serious injuries.

► Wear the required personal protective equipment during assembly/dismounting and repair.


Protective gloves


Safety shoes or boots


Safety helmet


Safety belt

■ **WARNING! Incorrect lifting accessories**

Loads fall down if inadequate/defective lifting accessories break.

Death, personal injury, or property damage are the result.

► Close off and monitor hazardous areas.

► NEVER work under suspended loads.

► Do not swing loads over people. If this is exceptionally necessary, give a warning signal to clear the area.

► Only use intact lifting accessories which are sufficient for the load.

► Secure the load so that it neither slips nor tips. If the balance point shifts, overloaded lifting accessories tear.

► Check and maintain ropes and lifting accessories regularly.

2.5.4 Dangers during assembly

2.5.4.1 General

■ **DANGER! Incorrect assembly sequence, assembly interruption, crane falls over.**

If the assembly sequence is not observed or is interrupted, you endanger the stability of the crane.

Death, personal injury, or property damage are the result.

► Adhere to the sequence of the individual assembly steps.

► Do not interrupt the assembly in order not to endanger the stability of the crane, for example in the event of a storm.

► From the step "Removing the concrete counter ballasts" to the step "Dismantling the counter jib", work must be carried on continuously!

► Place the required central ballast before erecting the tower and mounting the counter jib!

■ **DANGER! Incorrectly loaded crane**

An incorrectly loaded crane falls over.

Death, personal injury, or property damage are the result.

► Insert the counter ballasts into the counter jib AFTER assembling the jib.

Exception: Insert the necessary counter ballasts of the intermediate ballasting before jib assembly.

■ **DANGER! Strong wind, gusts**

Wind speeds above authorized speed endanger the stability of the crane during the assembly! You can no longer move loads in a controlled manner. These loads are not statically permissible.

Death, personal injury, or property damage are the result.

► Crane assembly is prohibited at these wind speeds!

► As the assembly of a crane takes longer, inform yourself about the wind conditions on site; if necessary, postpone the work!

■ **DANGER! Larger wind attack areas**

Additional advertising boards or other objects increase the area exposed to wind. These additional forces endanger the stability; the crane can fall over.

Death, personal injury, or property damage are the result.

► Only attach additional signs with the approval of the manufacturer.

► Check the statics.

■ **DANGER! Unsuitable components**

Unsuitable base, tower, or connecting elements endanger the stability.

Death, personal injury, or property damage are the result.

► Only use tested base elements, such as foundations, cross frames, cross frame elements, or undercarriages.

► Holes of the tower elements wear out. Tower elements are arranged according to the accuracy of fit of the holes. Use elements with larger deviations in the upper part of the tower. Permissible Deviations: ***Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>***.

■ **WARNING! Wrong shelves.**

Loads will fall or tip if you place them on uneven/unstable surfaces.

Death, personal injury, or property damage are the result.

► Only place loads on level and sufficiently stable surfaces.

► Use a suitable base on soft ground.

■ **CAUTION! Jib bends due to attachment to top boom.**

The jib bends to the point of being unusable.

► Always suspend the jib only by the bottom boom, and lift it horizontally from the assembling trestles.

■ **WARNING! Key switch.**

Key switches override safety settings. Functions which are not permitted in regular operation are possible.

Death, personal injury, or property damage are the result.

► Make keys available only to authorized, trained personnel who know and control the risks.

■ **WARNING! ASSEMBLY MODE**

In assembly mode, limit switch and overload limitations are not active. Too heavy a load, and movements with inadmissible radii will cause the crane to fall over.

Death, personal injury, or property damage are the result.

► Use specially trained personnel who are aware of the particular hazards!

► Observe the load table for the rope line variant and hoist gear!

► DO NOT lift loads which exceed the crane's load capacity!

► Only approach permissible radii!

■ **DANGER! Incorrect calibration, crane falls over**

An incorrectly calibrated load measuring axis endangers the crane stability. This also produces incorrect monitoring of the maximum load and load torque. You can lift loads that are too heavy - the crane falls over.

Death, personal injury, or property damage are the result.

► Enter the known test load and the correction value carefully and without errors!

► To determine an unknown test load, use a calibrated crane scale between the load hook and the test load.

■ **CAUTION! Driving positions not limited.**

Do not limit either trolley or load hook travel positions in assembly mode; they will collide with the trolley or ground.

If the trolley and load hook are defective, do NOT operate the crane!

► Do not move the load hook against the trolley nor on the ground.

► DO NOT move the trolley to the inner and outer mechanical limits.

■ **DANGER! Activating safety devices.**

Activate safety devices after making adjustments. Otherwise, neither the limit switches nor the overload limitations are active. Movements into impermissible areas will cause the crane to fall over, or lead to collisions with objects.

Death, personal injury, or property damage are the result.

The crane is not ready for operation until:

► PROGRAMMING and/or ASSEMBLY OPERATION are switched off in the touch panel.

► all safety devices are adjusted and checked;

► the slewing gear brakes are ready for operation (brakes unlocked).

2.5.4.2 Foundations

■ **DANGER! Improper foundations, crane falls over**

Improper foundations endanger the crane stability.

Death, personal injury, or property damage are the result.

► The crane operator's structural engineer determines the foundation loading and its calculation!

► The building contractor makes the foundation.

► Wait for curing time before putting load on the foundation!

► Keep a safety distance of 2 - 3 m between the crane and surrounding objects!

► The foundation dimensions are determined by the permissible subsoil pressures, the type of subsoil at the construction site, and the foundation load. See ***Section 3.6.3***!

► Check the horizontal alignment before erecting the tower. It may only deviate by max. 1 ‰, i.e. on a measured length of 1 meter, the permissible deviation is 1 mm!

■ **DANGER! Electrical voltage**

Danger from:

► Voltage differences between conductive parts.

► Red-hot compensating currents.

► Lightning.

Death, personal injury, or property damage are the result.

► Comply with the local regulations for lightning protection when making foundations.

Check them with the local acceptance authorities.

► Ground the foundation and establish equipotential bonding.

■ **DANGER! Improper foundation, crane falls over**

Improper foundation anchors endanger the crane stability.

Death, personal injury, or property damage are the result.

► Check the foundation anchors before erecting the tower.

► Grout foundation anchors until the top edges of the concrete and the foundation anchor plate are in a line. Before, during, and after filling the concrete, ensure that neither foundation anchors nor reinforcement slip.

► For the calculation of the foundation anchors, we considered concrete with strength grade C 25/30 as per EN 206-1/ DIN 1045-2 for the foundations.

► The tower attachment points may deviate by a maximum of 1 ‰, i.e. for a measured length of 1 meter, the permissible deviation is 1 mm.

■ **DANGER! Improper rail system, crane falls over**

Improper rail systems endanger the crane stability.

Death, personal injury, or property damage are the result.

► Execution and calculation are determined by the crane operator's structural engineer!

► Keep a safety distance of 2 - 3 m between the crane and surrounding objects!

► The foundation dimensions are determined by the permissible subsoil pressures, the type of subsoil at the construction site, and the foundation load. See ***Section 3.6.3***!

► Lay rails at excavation pits in such a way that the pit slope does not collapse.

► Check the horizontal alignment of the rail system before erecting the tower.

2.5.4.3 Checking tower and connecting elements

■ **DANGER! Hole tolerances in components exceeded, crane falls over**

Exceeded hole tolerances cause the load limits of the components to be exceeded.

Death, personal injury, or property damage are the result.

► Holes in tower elements exceeding the specified maximum hole dimensions must NOT be used any more to construct the tower!

2.5.4.4 Equipment-specific

Observe the special instructions depending on the components used.

■ **DANGER! Improper climbing equipment, crane falls over**

Improperly installed climbing equipment endangers the stability.

Death, personal injury, or property damage are the result.

► Information about climbing equipment: see separate climbing equipment description!

► Install the climbing equipment parallel to the building; the tower elements must also be installed parallel to the building!

► For climbing cranes, pay attention to the position of the arresting hooks/climbing plates!

■ **DANGER! Lateral anti-twist devices missing, crane falls over**

If there are no lateral anti-twist devices, the stability of the crane is at risk. The influence by lateral forces shifts the cross frame. Without lateral securing, it slips off the individual foundations – the crane falls over.

Death, personal injury, or property damage are the result.

► Observe the assembly instructions!

► At all corners, secure the cross frame on three sides each so that it does not move!

2.5.4.5 Assembly with external climbing equipment

■ **WARNING! Climbing equipment mounted to the tower during operation**

If the climbing equipment remains mounted to the top of the tower during operation, it endangers the crane stability.

Death, personal injury, or property damage are the result.

► The climbing equipment is only an assembly device. Do NOT leave it on the top of the tower during crane operation! After completion of the assembly, dismount the climbing equipment.

► Ask the manufacturer for static data for towers .

2.5.4.6 Pre-assembling the counter jib and assembly

■ **DANGER! Missing stay rods**

Without stay rods, the counter jib will crash down.

Death, personal injury, or property damage are the result.

► Always assemble the counter jib with guy rods.

■ **DANGER! Incorrect assembly sequence, crane falls over**

If you do not adhere to the assembly sequence, you endanger the stability.

Death, personal injury, or property damage are the result.

► Adhere to the sequence of the individual assembly steps!

► Place the required central ballast before erecting the tower and mounting the counter jib!

■ **DANGER! Interrupted assembly, crane falls over**

If you interrupt the assembly, you endanger the stability of the crane.

Death, personal injury, or property damage are the result.

► Carry out the assembly continuously from the work step "Assembling the counter jib" until completion of the work step "Inserting concrete counter ballasts"!

2.5.4.7 Pre-assembling the counter jib and assembly

■ **CAUTION! Loose trolley ropes.**

Loose trolley ropes activate the rope failure lock or collide with parts of the jib.

The jib may be damaged.

If the trolley and load hook are defective, do NOT operate the crane!

► The long trolley rope must always be sufficiently taut:

Check the tension regularly, retighten if necessary.

2.5.4.8 Installing the hoisting rope

■ **CAUTION! Risk of collision.**

Do not limit either trolley or load hook travel positions in assembly mode; they will collide with the trolley or ground.

If the trolley and load hook are defective, do NOT operate the crane!

► Do not move the load hook within the radius or on the ground.

► DO NOT move the trolley to the inner and outer mechanical limits.

■ **DANGER! RESET key switch**

Use the RESET key switch to bypass safety functions. Functions which inadmissible in regular operation are now possible.

Death, personal injury, or property damage are the result.

► Only authorized and trained personnel may operate the RESET key switch as they are aware of the risks.

■ **CAUTION! Slack rope.**

Keep the load hook in the air when lowering; otherwise the hoisting rope will slacken and not wind up accurately.

This causes damage to the hoisting rope.

► Carefully lower the load hook and move it to the ground!

2.6 Safety signaling

2.6.1 Explanation

Safety and health−hazard signaling corresponds to determined object, activity or situation−related signals providing an indication or provision relative to safety or health matters. That signaling is materialized, according to circumstances, by a **panel**, a **color**, an **audio** or **luminous signal**.

Safety signaling can be broken down into 5 categories, each identified by a color code.

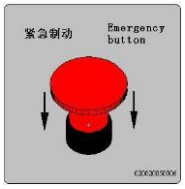
- Prohibition *(red)*
- Warning *(yellow or orange−hue yellow)*
- Mandatory *(blue)*
- Rescue and first−aid (green)
- Fire−fighting material or equipment *(red)*

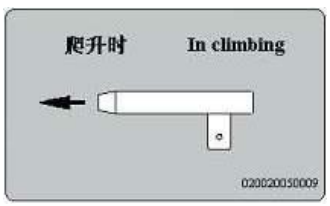
2.6.2 Terminology

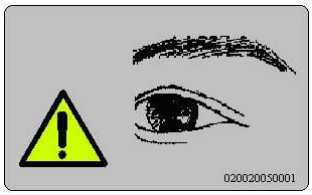
- Panel: signal providing a given indication via the combining of a geometrical shape and certain colors with a symbol or a pictogram.
  - Prohibition panel: prohibits behavior liable to generate running of a risk or provoking danger.
  - Warning panel: warns of a risk or of danger.
  - Mandatory panel: prescribes a given behavior to be adopted.
  - Rescue and first−aid panel: provides indications relative to emergency exits or to rescue and first−aid resources available.
  - Fire−fighting panel: provides indications relative to the location of fire−fighting resources and evacuation in the case of fire.
- Additional panel: panel used conjointly with another panel and providing complementary indications.
- Symbol or pictogram: image describing a situation or prescribing a given behavior to be adopted, and which is employed on a panel or a luminous surface.
  - Luminous signal: signal emitted by a device composed of transparent or translucent material, internally or back−lighted, in a way it stands out itself as a luminous surface.
  - Audio signal: a coded audible signal emitted and broadcast by an ad hoc device, without the use of a human or synthesized voice.

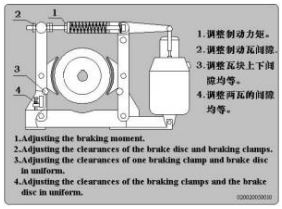
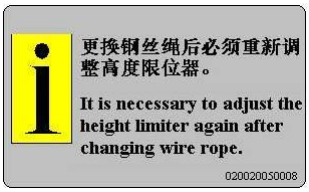
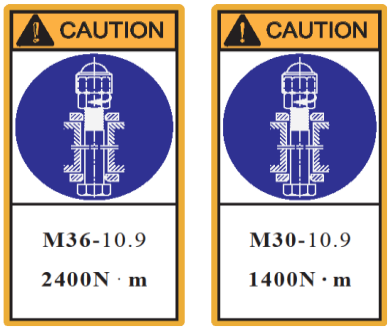
2.6.3 Signaling panels

The signaling panels below are general signals for all the crane towers. The specific panels on your tower crane may be less or more according to your special configuration.

Drawing	Instruction
	WARNING: Live parts! Electrical installation, connection work and maintenance must be done only by authorized, properly qualified personnel.
	Don’t stand under the working radius.
	Prohibit climbing!
	Danger of rolling!
	Danger of falling down! Wear and use a safety harness!
	Emergent stop

Drawing	Instruction
	Carefully read this handbook before handling the machine!
	The tower crane needs to be able to slew freely when it is out of service
	Very hot, do not touch!
	Danger of crushing!
	Insert pins while the crane climbing!

Drawing	Instruction
	Keep watching!
	WARNING: floating loads! Wear safety helmet!
	Check ropes
	Lubricate!
	Check metal structures!
	Check brakes for clearance!
	Keep safety devices workable!

Drawing	Instruction
	Adjust the brakes
	Adjust the height limiter!
	High strength connection bolt of M36 High strength connection bolt of M30
	Maximum load on maintenance cage
	Always close the hatches!
	Prohibit standing!
	Caution!

Drawing	Instruction
	Tie safety belt!

2.6.4 Audio and luminous signals

A. Audio signals

The following dangers are signaled by automatic activation of an audio alarm:

- Crane start−up: short tone.
- Activation of MSWL (maximum safe working load) cut−out or moment cut−out: continuous tone.
- Crane traveling mode: continuous dual tone during the complete duration of movement.
- Specific danger is signaled by voluntary action on the audio alarm in accordance with code defined by local regulations or by the crane manager, such as for example: moving of loads above persons, specific situations.
- Acquire knowledge of the tones and duration corresponding to each signal.

B. Luminous signals

According to the instructions or regulations on crane utilization site, luminous signals may be used to indicate specific danger:

- Operating wind speed pre−alarm (adjustable): flashing orange light.
- Pre−alarm limit: 90% of MSWL or MSWL moment:
  - GMA: flashing orange light
  - GME: orange light in control station
- Working area limiter not operating or neutralized: flashing red light.

C. Associated audio and luminous signals

According to the instructions or regulations on crane utilization site, audio signals associated to luminous signals may be used to indicate specific danger:

- Maximum operating wind speed (adjustable): 2−tone signal with flashing orange and red lights.
- (GMA) Pre−alarm limit: 95% of MSWL or MSWL moment: continuous−tone signal with flashing orange light.
- (GMA) Activation of the MSWL limiter or MSWL moment limiter: continuous signal plus 2−tone signal with flashing orange and red lights.

D. Location of safety signaling:

Positioning on the crane and references of luminous or audio panels and devices are provided in the ***Chapter 7 < SPARE PARTS >***.

2.6.5 Safety controls

The control console and the maintenance areas at winch proximity (in the case where the control console is not portable) are equipped with a mechanically−lockable red emergency stop button.

The storm wind reference speeds are determined according to the FEM 1.004 / Edition 07/2000 standard.

Pressing one of those buttons generates immediate interruption of all movements.

The emergency stop button must be used only in the case of danger and not for interrupting movements.

2.7 Storm wind speed-out of service

2.7.1 General Notes

The storm wind reference speeds are determined according to the FEM 1.004 / Edition 07/2000 standard.

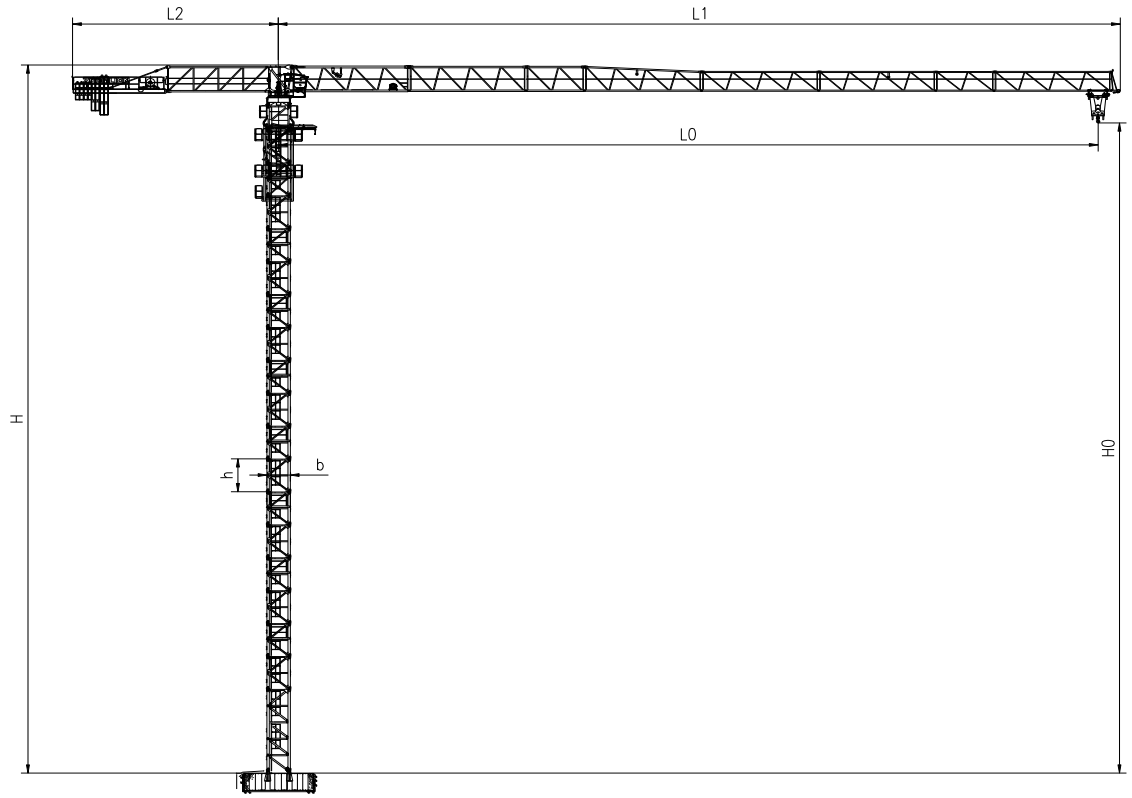
2.7.2 Speed table

Height	Wind speed	Dynamic pressure
Height 0−20 m above the ground	130 km/h (36 m/s)	$800\mathrm{N}/m^2$
Height 20−100 m above the ground	150 km/h (42 m/s)	$1100\ \mathrm{N}/m^2$
Height higher than 100 m above the ground	165 km/h (46 m/s)	$1300\ \mathrm{N}/m^2$

3 TECHNICAL DATA OF CRANE AND SITE

3.1 Overall dimensions

The dimensions of the tower crane are shown in the table below:



L0	L1	L2	Maximum working height **H0**				Maximum tower crane height **H**	b	h
			Free-standing			With attachments			
			Embedded outrigger/bolt	Stationary chassis	Travelling chassis				
70	71.7	17.5	60	60.5	61.5	265	H0+4.8	2.0	3.0
65	66.7	17.5							
60	61.7	17.5							
55	56.7	17.5							
50	51.7	17.5							
45	46.7	17.5							
40	41.7	17.5							
35	36.7	17.5							
30	31.7	17.5							

L0: Maximum trolley range **L1**: Jib side length **L2**: Counter jib side length

b: Tower section width **h**: Tower section height ***Unit: m***

3.2 Technical characteristics

3.2.1 Load charts

The following load charts shows specific rated load of **WA7025-10E** in 2/4-fall.

3.2.1.1 Load chart of trolley range at 10m~40m

Jib length (m)	Fall	Max. load (t)	Range of Max. load (m)	Trolley range (m)												
				10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	40.0
70	2	5.0	2.8~40.9	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	4	10.0	2.8~22.5	10.00	10.00	10.00	10.00	10.00	10.00	8.84	7.91	7.14	6.49	5.93	5.46	5.04
65	2	5.0	2.8~44.5	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	4	10.0	2.8~24.4	10.00	10.00	10.00	10.00	10.00	10.00	9.73	8.72	7.87	7.17	6.56	6.04	5.59
60	2	5.0	2.8~47.1	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	4	10.0	2.8~25.8	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.29	8.40	7.65	7.01	6.46	5.98
55	2	5.0	2.8~49.5	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	4	10.0	2.8~27.1	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.85	8.91	8.12	7.45	6.86	6.36
50	2	5.0	2.8~50.0	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	4	10.0	2.8~28.3	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.34	8.52	7.82	7.21	6.68
45	2	5.0	2.8~45.0	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	4	10.0	2.8~29.1	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.65	8.80	8.08	7.45	6.91
40	2	5.0	2.8~40.0	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	4	10.0	2.8~28.7	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.51	8.68	7.96	7.34	6.81
35	2	5.0	2.8~35.0	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	/	/
	4	10.0	2.8~28.3	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.33	8.51	7.81	/	/

Jib length (m)	Fall	Max. load (t)	Range of Max. load (m)	Trolley range (m)												
				10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	40.0
30	2	5.0	2.8~30.0	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	/	/	/	/
	4	10.0	2.8~27.7	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.11	/	/	/	/

3.2.1.2 Load chart of trolley range at 42.5m~70m

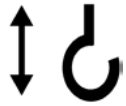
Jib length (m)	Fall	Max. load (t)	Range of Max. load (m)	Trolley range (m)												
				42.5	45.0	47.5	50.0	52.5	55.0	57.5	60.0	62.5	65.0	67.5	70.0	/
70	2	5.0	2.8~40.9	4.77	4.45	4.16	3.90	3.66	3.45	3.26	3.08	2.92	2.77	2.63	2.50	/
	4	10.0	2.8~22.5	4.68	4.35	4.06	3.80	3.57	3.36	3.16	2.99	2.82	2.67	2.54	2.41	/
65	2	5.0	2.8~44.5	5.00	4.93	4.61	4.33	4.08	3.84	3.63	3.44	3.26	3.10	/	/	/
	4	10.0	2.8~24.4	5.19	4.84	4.52	4.24	3.98	3.75	3.54	3.35	3.17	3.01	/	/	/
60	2	5.0	2.8~47.1	5.00	5.00	4.94	4.64	4.37	4.13	3.90	3.70	/	/	/	/	/
	4	10.0	2.8~25.8	5.56	5.19	4.85	4.55	4.28	4.04	3.81	3.61	/	/	/	/	/
55	2	5.0	2.8~49.5	5.00	5.00	5.00	4.94	4.66	4.40	/	/	/	/	/	/	/
	4	10.0	2.8~27.1	5.91	5.52	5.17	4.85	4.57	4.31	/	/	/	/	/	/	/
50	2	5.0	2.8~50.0	5.00	5.00	5.00	5.00	/	/	/	/	/	/	/	/	/
	4	10.0	2.8~28.3	6.22	5.80	5.44	5.11	/	/	/	/	/	/	/	/	/
45	2	5.0	2.8~45.0	5.00	5.00	/	/	/	/	/	/	/	/	/	/	/
	4	10.0	2.8~29.1	6.43	6.01	/	/	/	/	/	/	/	/	/	/	/

3.2.2 Characteristics of the crane

3.2.2.1 The overall characteristics

<table>
<tr><td>Tower crane working grade</td><td colspan="9">A4</td></tr>
<tr><td rowspan="2">Mechanisms working grade</td><td colspan="3">Hoisting mechanism</td><td colspan="3">Slewing mechanism</td><td colspan="3">Trolleying mechanism</td></tr>
<tr><td colspan="3">M4</td><td colspan="3">M5</td><td colspan="3">M4</td></tr>
<tr><td>Rated hoisting moment (kN·m)</td><td colspan="9">2500</td></tr>
<tr><td>Maximum hoisting moment (kN·m)</td><td colspan="9">2910</td></tr>
<tr><td rowspan="2">Maximum tower height (m)</td><td colspan="3">Free-standing</td><td colspan="3">Free-standing</td><td colspan="3" rowspan="2">With attachments</td></tr>
<tr><td colspan="2">Stationary outrigger</td><td>Stationary chassis</td><td colspan="2">Travelling chassis</td></tr>
<tr><td colspan="2">60</td><td>60.5</td><td colspan="2">61.5</td><td colspan="3">265</td></tr>
<tr><td rowspan="2">Working radius (m)</td><td colspan="5">Minimum</td><td colspan="4">Maximum</td></tr>
<tr><td colspan="5">2.8</td><td colspan="4">70</td></tr>
<tr><td>Jib length (m)</td><td>70</td><td>65</td><td>60</td><td>55</td><td>50</td><td>45</td><td>40</td><td>35</td><td>30</td></tr>
<tr><td>Counter jib length (m)</td><td colspan="9">17.5</td></tr>
<tr><td>Counter ballast weight (t)</td><td>20.8</td><td>19.5</td><td>19.5</td><td>19.5</td><td>18.3</td><td>17.8</td><td>15.8</td><td>14.0</td><td>12.8</td></tr>
<tr><td>Maximum load (t)</td><td colspan="9">10</td></tr>
<tr><td>Power supply</td><td colspan="9">~380V (±10%) / 50Hz</td></tr>
<tr><td>Hoisting speed (m/min)</td><td colspan="9">0~95</td></tr>
<tr><td>Slewing speed (r/min)</td><td colspan="9">0~0.8</td></tr>
<tr><td>Trolley speed (m/min)</td><td colspan="9">0~75</td></tr>
<tr><td>Travelling speed (m/min)</td><td colspan="9">0~25</td></tr>
<tr><td>Total power (kW) (without climbing mechanism)</td><td colspan="9">57.5+2×5.2</td></tr>
</table>

3.2.2.2 Hoisting mechanism characteristics

	Type	H37FC25-530B
	Maximum traction (N)	30000
Rope	Specification	6×29FI+IWR-14-1870 / 35×7-14-1870
	Reference weight (kg/m)	0.902
	Maximum line speed (m/min)	190
Drum	Rope roll layers	6
	Maximum capacity (m)	530
Motor	Type	YZPFME225M-4-Z
	Power (kW)	37
Reducer	Type	P250T240-2W(BLZ)
	Reduction ratio	39.91
Coupling	Type	GR48-105-M2-Z30-KC
Brake	Type	SPZ600
	Brake moment (N·m)	500

3.2.2.3 Slewing mechanism characteristics

	Type		S75CA-130LB12/14A S75CN-130LB12/14A
Motor	Type		YTRVF132M2-4F1/B/BM1 YTRVF132M2-4F2/B/BM1
	Power (kW)		7.5×2
Reducer	Type		XX5-130.195LB-12/14
	Reduction ratio		195
	Pinion	Teeth (z)	14
		Module (m)	12

3.2.2.4 Trolley mechanism characteristics

	Type	T55FC70-b(D)
	Maximum traction (N)	12100
	Trolley travelling range (m)	70
Rope	Specification	6x19-9.3-1700-Ⅱ-sZ
	Reference weight (kg/m)	0.305
	Maximum line speed (m/min)	50
Drum	Bottom diameter (mm)	Φ520
	Rotate speed (r/min)	31.7
Motor	Type	YVFE132S-4B5(HJ)
	Power (kW)	5.5
	Rotate speed (r/min)	1428
Reducer	Type	XX2-15.43
	Ratio	43
	Equivalent ratio	44

3.2.2.5 Climbing mechanism

Pump station	Type	BZ11-31.5F
	Flux (l·min)	19
	Working stress (MPa)	31.5
	Oil tank capacity (L)	110
Motor	Type	YE2-160M-4V1
	Power (kW)	11
Climbing hydraulic cylinder	Type	YG180/125-2160/1640-31.5
	Cylinder diameter (mm)	180
	Rod diameter (mm)	125
	Installing distance (mm)	2160
	Travelling distance (mm)	1640
	Maximum hoisting force (t)	80.5
	Hoisting speed (m/min)	0.69

3.2.2.6 Travelling mechanism

Working grade		M3
Travelling speed (m/min)		0~25
Travelling wheel diameter (mm)		400
Motor	Type	YTXZ112M2-2B
	Power (kW)	5.2×2
	Bake moment (N·m)	40
Reducer	Type	PX25 (or C2738980)
	Reduction ratio	140.21
Working temperature (℃)		-20~40

3.3 Mast composition

3.3.1 Outrigger stationary tower crane

Working height (m)	Rung ladder		Incline ladder	
	L68G23	L68A4	L68G23-C	L68A1A
24	1	5	1	5
27	1	6	1	6
30	1	7	1	7
33	1	8	1	8
36	1	9	1	9
39	1	10	1	10
42	1	11	1	11
45	1	12	1	12
48	1	13	1	13
51	1	14	1	14
54	1	15	1	15
57	1	16	1	16
60	1	17	1	17

3.3.2 Stationary chassis tower crane

Working height (m)	Rung ladder		Incline ladder	
	L68B7A	L68A4	L68B7A-C	L68A1A
24.5	1	5	1	5
27.5	1	6	1	6
30.5	1	7	1	7
33.5	1	8	1	8
36.5	1	9	1	9
39.5	1	10	1	10
42.5	1	11	1	11
45.5	1	12	1	12
48.5	1	13	1	13
51.5	1	14	1	14
54.5	1	15	1	15
57.5	1	16	1	16
60.5	1	17	1	17

3.3.3 Travelling chassis tower crane

Working height (m)	Rung ladder		Incline ladder	
	L68B7A	L68A4	L68B7A-C	L68A1A
25.5	1	5	1	5
28.5	1	6	1	6
31.5	1	7	1	7
34.5	1	8	1	8
37.5	1	9	1	9
40.5	1	10	1	10
43.5	1	11	1	11
46.5	1	12	1	12
49.5	1	13	1	13
52.5	1	14	1	14
55.5	1	15	1	15
58.5	1	16	1	16
61.5	1	17	1	17

When assembling tower section, please strictly follow the operation instruction. Tower section L68A1A, L68A4, L68B7A and L68B7A-C use inner assemble method.

3.4 Dimensions and weights of parts for transportation

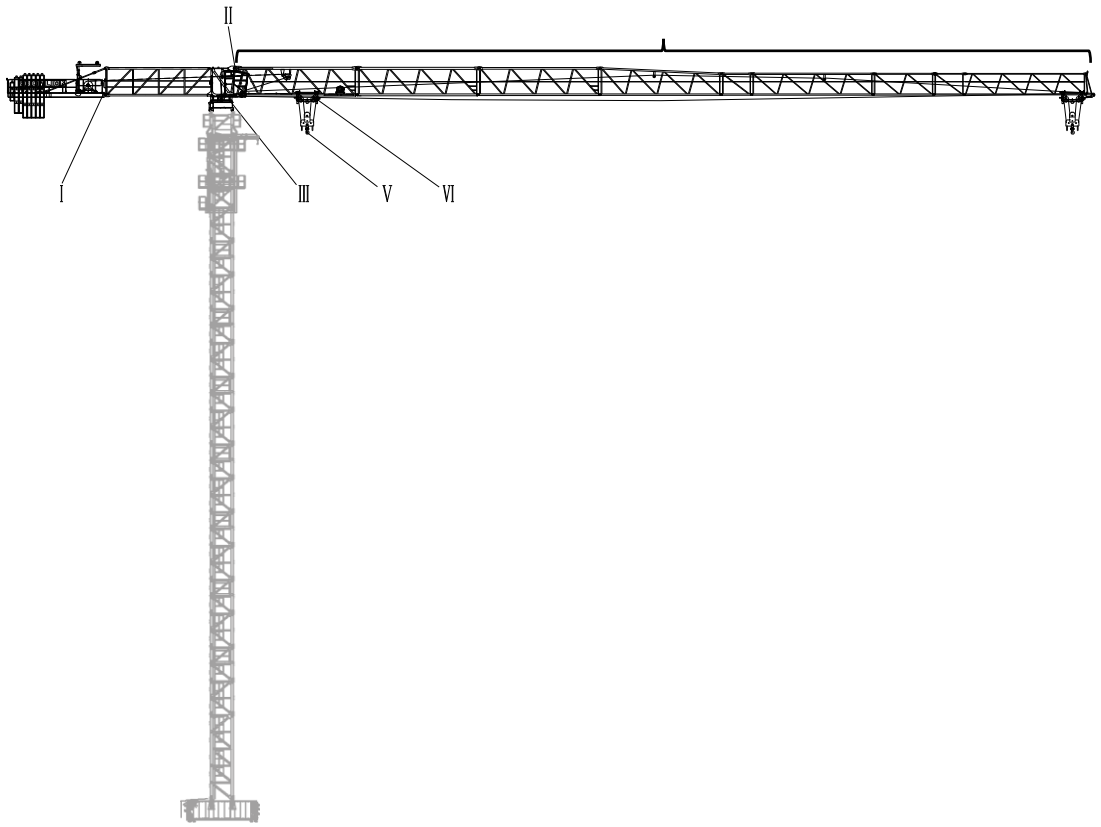
3.4.1 Matters need attentions of transportation

The components of tower crane have been taken apart into many delivery units in order to facilitate the packing and adapting to the means of transportation.

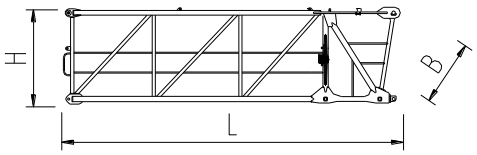
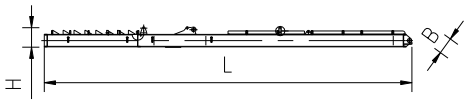
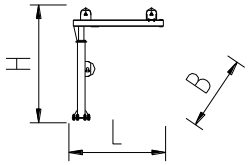
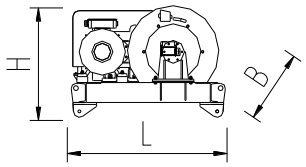
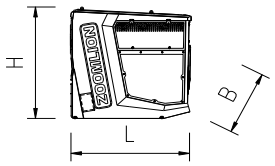
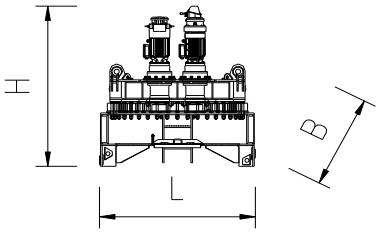
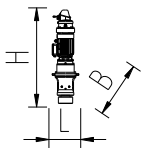
1) All components must be well securely fixed during the means of transportation.
2) Light delivery units must be put on the heavier ones.
3) In order to prevent damage to the painted surface, the cushions or wooden segregation boards should be set between the delivery sets.
4) It must be ensured that no parts of tower crane are in direct contact with the ground when unloading, so as to prevent sand and oil etc., into the holes of the structure.
5) Do not use inappropriate means of transportation to move the parts of tower crane, such as bulldozers or elevators. The weight and dimension of all parts of ZOOMLION tower crane are described in detail in later chapters.
6) Before transport the tower crane, to make sure the safe transportation of all the auxiliary equipment.
7) Check whether the transportation ties are tight or not.
8) Check the strapping of cargos for transportation.
9) When the carrier vehicle drives on the public streets, please obey the relevant laws.
10) When the carrier vehicle passes the underground tunnel, bridge and tunnel, please pay attention to have enough space.

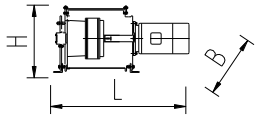
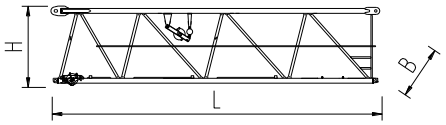
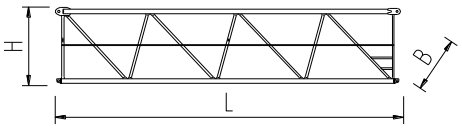
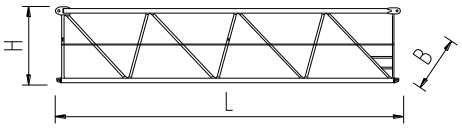
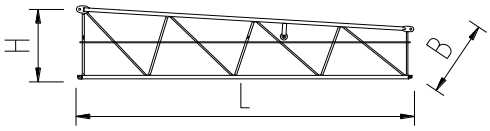
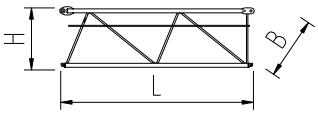
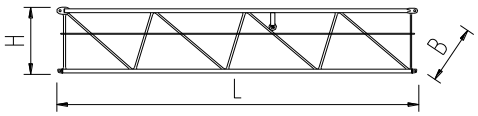
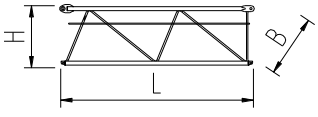
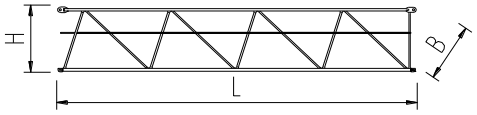
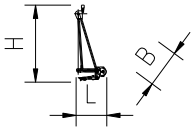
3.4.2 Slewing parts

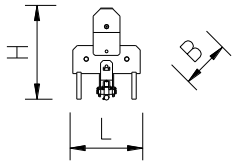
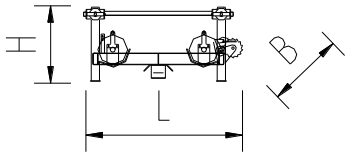
3.4.2.1 Overview



3.4.2.2 Dimensions and weights of the slewing parts

Part	Sketch / Designation	L(m)	B(m)	H(m)	G(kg)	Qty
I	 **Front counter jib**	11.0	1.27	2.49	3497	1
I	 **Rear counter jib**	8.08	1.49	0.57	2147	1
I	 **Derrick**	2.03	0.40	2.44	260	1
II	 **Hoisting mechanism**	1.95	1.05	0.84	1105	1
III	 **Cabin**	2.33	1.25	2.25	400	1
III	 **Slewing unit (Including turntable, slewing ring, slewing support, slewing mechanisms)**	1.76	2.23	2.30	5300	1
III	 **Slewing mechanism**	0.42	0.42	1.48	351	1
		0.42	0.42	1.33	340	1

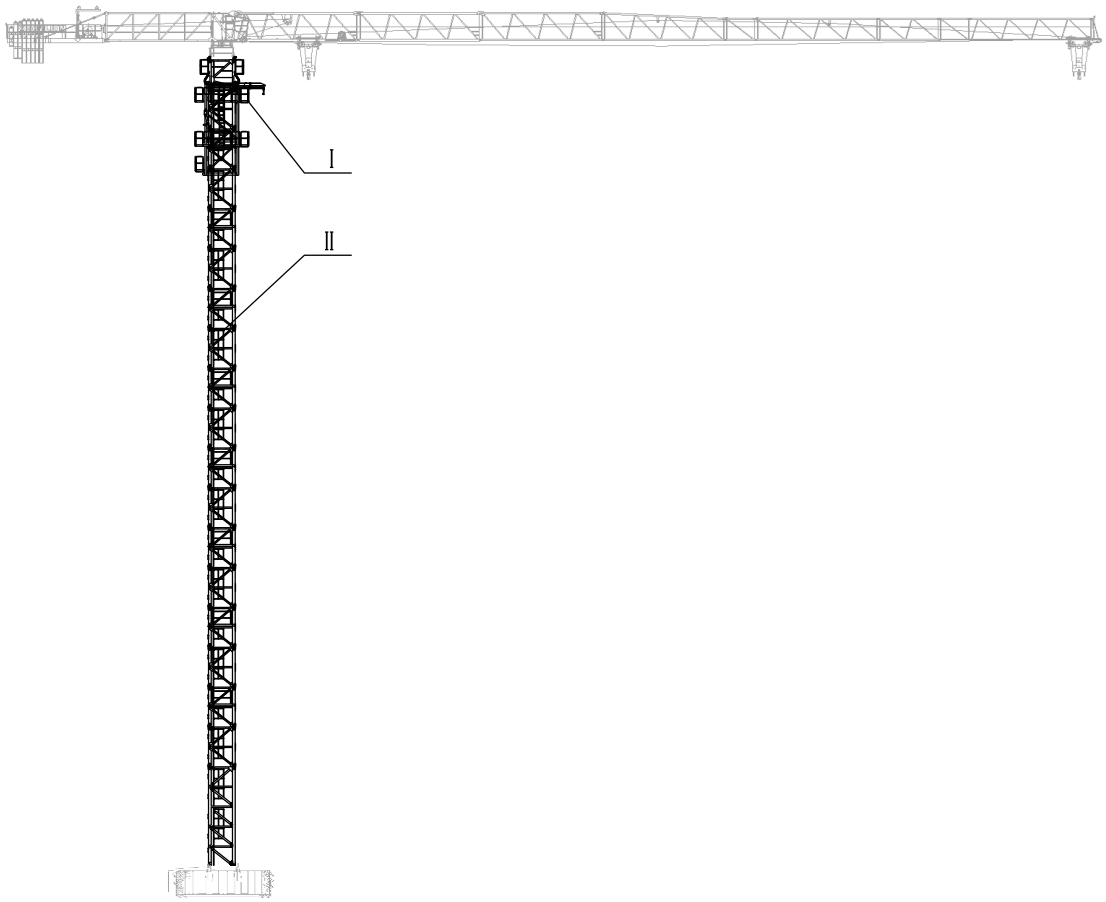
Part	Sketch / Designation	L(m)	B(m)	H(m)	G(kg)	Qty
Ⅳ	 Trolley mechanism	1.16	0.73	0.60	291	1
Ⅳ	 Jib Ⅰ	10.28	1.15	2.48	2596	1
Ⅳ	 Jib Ⅱ	10.23	1.15	2.38	1811	1
Ⅳ	 JibⅢ	10.22	1.15	2.38	1364	1
Ⅳ	 JibⅣ	10.20	1.15	2.33	1128	1
Ⅳ	 Jib Ⅴ	5.16	1.15	1.83	527	1
Ⅳ	 JibⅥ	10.17	1.15	1.87	808	1
Ⅳ	 JibⅦ	5.16	1.15	1.83	320	1
Ⅳ	 JibⅧ	10.15	1.15	1.83	517	1
Ⅳ	 Jib end	0.87	1.15	2.06	88	1

Part	Sketch / Designation	L(m)	B(m)	H(m)	G(kg)	Qty
V	 **Hook**	1.07	0.36	1.78	413	1
VI	 **Trolley**	2.05	1.39	1.04	376	1

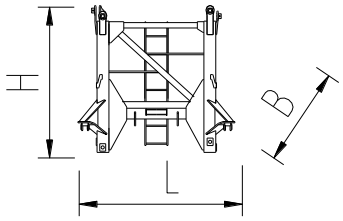
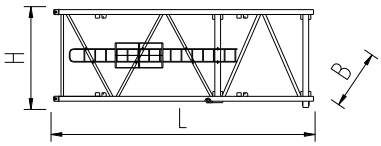
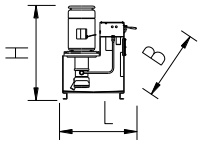
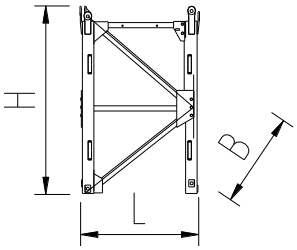
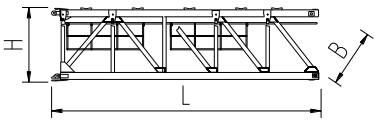
☆**Tolerance on the weight: ±5%.**

3.4.3 Mast parts

3.4.3.1 Overview



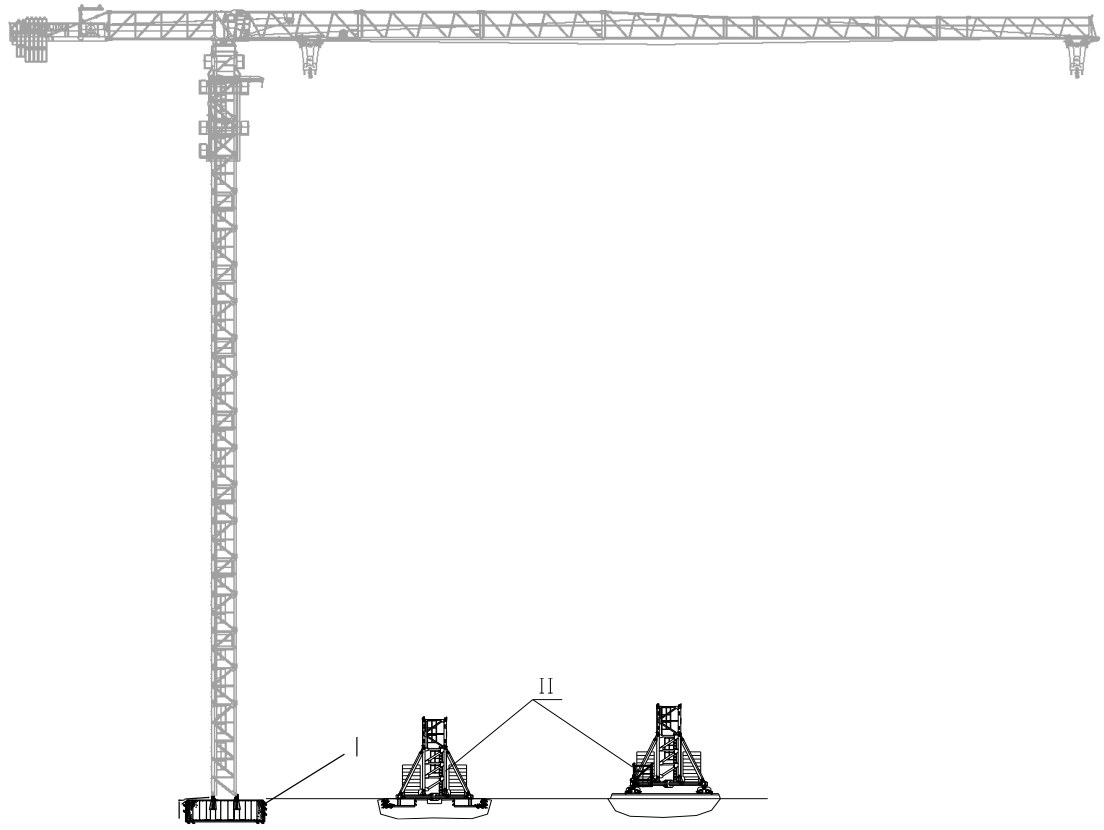
3.4.3.2 Dimensions and weights of the mast parts

Part	Code	Sketch / Designation	L(m)	B(m)	H(m)	G(kg)	Qty
Ⅰ	L68C3C	 Transition section	2.61	2.52	2.26	1476	1
Ⅰ	WA7527-20D.11D	 Climbing equipment	6.91	2.67	2.80	3979	1
Ⅰ	BZ11-31.5F	 Pump station	1.00	0.72	0.45	240	1
Ⅱ	L68A4	 Tower section	2.10	2.10	3.27	1610	17
Ⅱ	L68B7A		2.10	2.10	3.27	1800	1
Ⅱ	L68A1A		2.10	2.10	3.27	1708	17
Ⅱ	L68B7A-C		2.10	2.10	3.27	1900	1
Ⅱ	L68G23	 Base tower section	7.77	2.10	2.10	4200	1
	L68G23-C		7.77	2.10	2.10	4268	1

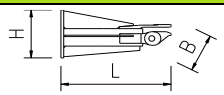
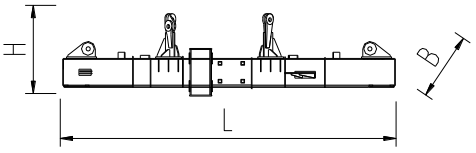
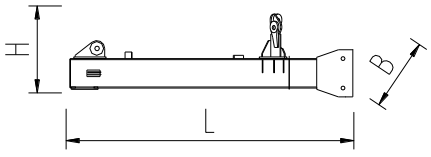
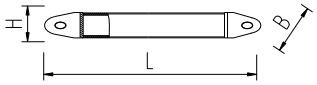
☆Tolerance on the weight: ±5%.

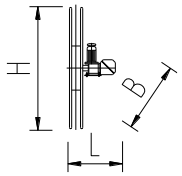
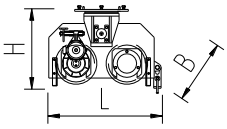
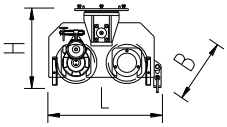
3.4.4 Base parts

3.4.4.1 Overview



3.4.4.2 Dimensions and weights of the base parts

Part	Sketch / Designation	L (m)	B (m)	H (m)	G (kg)	Qty
I	 Single outrigger	1.19	0.45	0.45	185	4
II	 Whole beam	8.94	0.90	1.38	2190	1
II	 Half beam	4.33	0.42	1.27	1060	2
II	 Strut	5.19	0.29	0.28	420	4

Part	Sketch / Designation	L (m)	B (m)	H (m)	G (kg)	Qty
Ⅱ	 **Cable**	0.85	2.20	2.20	750	1
Ⅱ	 **Powered wheel bogie**	1.25	1.35	0.90	820	2
Ⅱ	 **Idler wheel bogie**	1.25	0.60	0.90	680	2

☆**Tolerance on the weight: ±5%.**

3.5 Auxiliary lifting equipment

3.5.1 General notes

The minimum characteristics of the auxiliary lifting equipment are determined by:

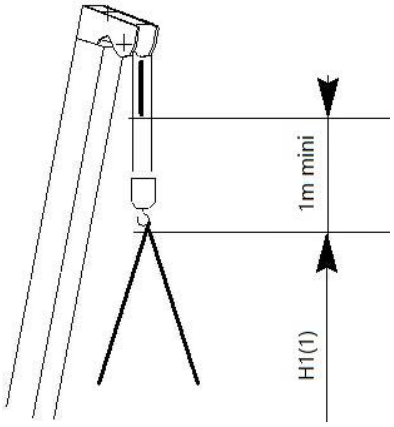
- The hoisting height of the jib
- The weight of the jib
- A minimum radius of 10 m from the slewing axis of the auxiliary of the auxiliary lifting equipment.

3.5.2 Hook height

The hook height of height of the auxiliary lifting equipment (H1) is equal to the hook height (H2) of the crane to be erected plus X m depending on the packages.

The H2 height is given with respect to the ground support level of the crane.

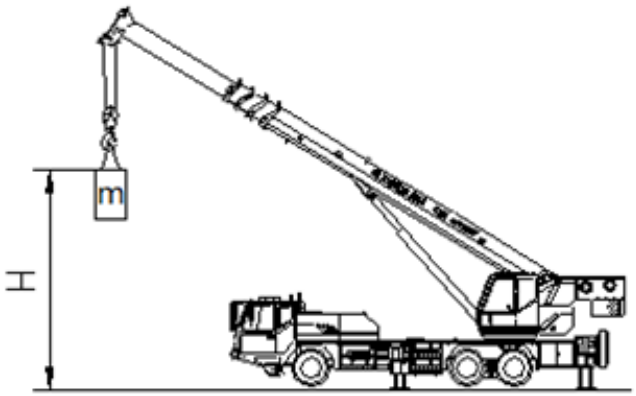
If the auxiliary lifting equipment does not work at the same level as the erection area of the crane, or due to special site conditions, adjust the height and the radius to determine correctly the characteristics of the auxiliary lifting equipment.



H1 must not be obtained in the upper limit switch position of the auxiliary lifting equipment.

3.5.2.1 Erection by means of a mobile crane

The crane is completely erected to its free-standing height by means of the mobile of the mobile crane.



No.	Designation	Weight (t)	Lifting height H (m)		
			Outrigger stationary type	Stationary chassis type	Travelling chassis type
1	Powered/idler wheel bogie	0.9	-	-	1.2
2	Whole beam	2.2	-	0.9	1.7
3	Half beam	1.1×2	-	0.9	1.7
4	Base tower section	4.1	-	5.4	6.3
5	Chassis tie bar	0.2×4	-	0.9	1.7
6	Strut	0.4×4	-	5.4	6.2
7	Central ballast YZ3900	3.9×4	-	1	1.8
8	Central ballast YZ4500	4.5×22*	-	4.1	4.9
9	Base tower section	4.2	8.5	-	-
10	Climbing unit (including climbing equipment, transition section, erection platform, mounting device, cylinder, pump station, base tower section)	11.0	20.0	16.9	17.8
11	Slewing unit (including turntable, slewing mechanism, slewing ring, slewing support, cabin, electric control cabinet)	6.50	22.9	19.8	20.7
12	Front counter jib	3.50	22.9	19.8	20.7
13	Rear counter jib (including hoisting mechanism, platforms, railings, etc.)	5.40	22.9	19.8	20.7
14	The first counter ballast	3.0	25.9	22.8	23.7

No.	Designation		Weight (t)	Lifting height H (m)		
				Outrigger stationary type	Stationary chassis type	Travelling chassis type
15	Jib assembly (including trolley, trolley mechanism, etc.)	70m	9.90	22.9	19.8	20.7
		65m	9.58			
		60m	9.38			
		55m	9.06			
		50m	8.53			
		45m	8.25			
		40m	7.73			
		35m	6.89			
		30m	6.36			
16	The rest counter ballasts	70m	17.8	25.9	22.8	23.7
		65m	16.5			
		60m	16.5			
		55m	16.5			
		50m	15.3			
		45m	14.8			
		40m	12.8			
		35m	11.0			
		30m	9.8			

☆**Tolerance on the weight: ±5%**

***Adjust the quantities of YZ4500 according to *Section 3.8.1*.**

3.6 Data sheet

3.6.1 Hoisting rope

DATA SHEET – HOISTING ROPE

Rope identification	1090101163 (35W×7-14-1870)
Maximum Load	30kN
Minimum breaking load	132kN
Construction	35Wx7
Number of external wires	7
Core：	Steel core
Rope diameter	14mm
Strength of wire	1870MPa
Stranding: **ZS (Right-hand regular lay)** **ZZ (Right-hand langs lay)**	ZS
Weight per meter	0.902 kg/m

3.6.2 Trolley rope

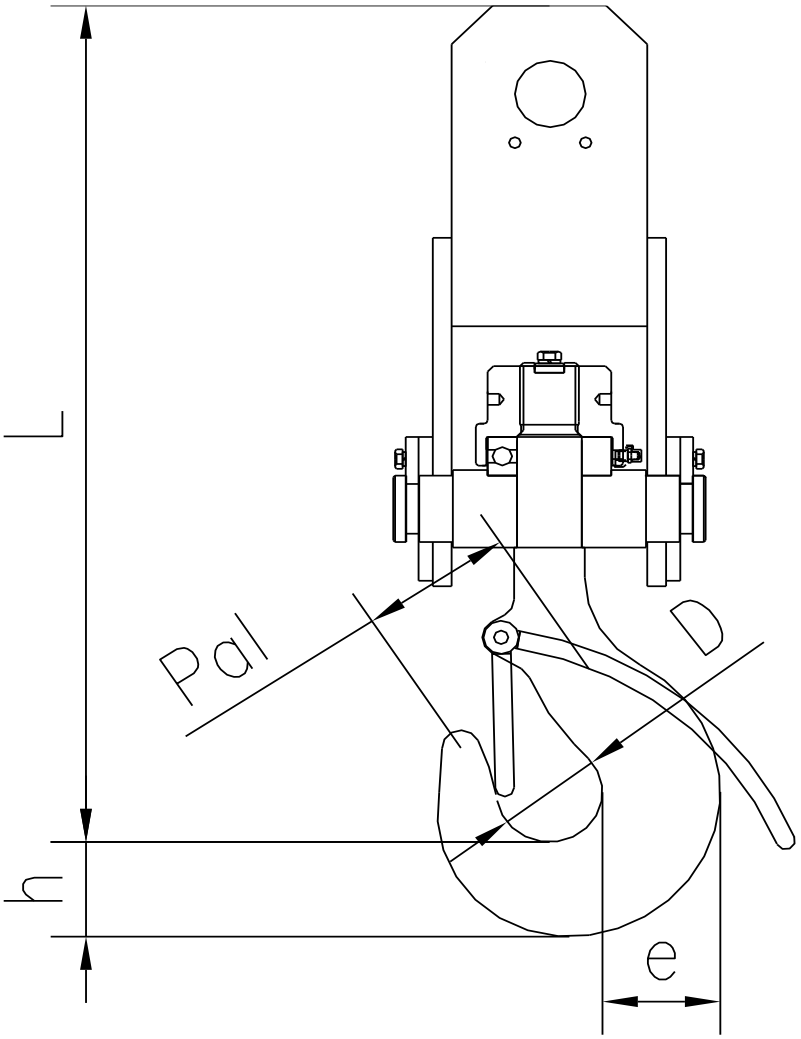
DATA SHEET – TROLLEY ROPE

Rope identification	1090100080 (6×19-9.3-1700-Ⅱ-ZS)
Maximum load	12.1kN
Minimum breaking load	46.495kN
Construction	6×19
Number of external wires	6
Core：	Steel
Rope diameter	9.3
Strength of wire	1700MPa
Stranding: **sZ(Right-hand regular lay)** **zZ(Right-hand langs lay)**	sZ
Weight per meter	0.3045

Hoisting rope is configured as rotary resistance rope. In addition, the following requirements must be met: (D is the theoretical diameter of the rope)

- The minimum breaking tension of the hoisting rope is not less than **132kN**, and the trolley rope minimum breaking tension of the variable amplitude rope is not less **46.495KN**;
- For the hoisting rope and the trolley rope, the diameter of any section is between 1.02d and 1.04d. The noncircular error is within 0.03d.
- Anti-torsion performance of hoisting rope is not more than 360°.
- The lateral pressure stability of the hoisting rope is not more than 0.01d.
- The diameter shrinkage of the hoisting rope is not more than 0.01d.

3.6.3 Load hook



Hook identification	000209606A1702300
Model number	8
Class	P
Length (L)	756 mm
Nominal diameter (D)	90 mm
Weight	69 kg
Greasing	Yes
Passage with hook safety path (Pal)	130 mm
Dimension h	85.5 mm
Dimension e	100 mm

3.7 Counter ballast

3.7.1 General notes

The Counter ballast comprises several reinforced concrete blocks. Their combination allows the different weights to be obtained, which are proper to each jib length used. There are three types: The PHZ3000R(J), PHZ2500T(J), PHZ1300P(J) blocks, weight 3000 kg, 2500 kg and 1300 kg; they are directly placed on the counter jib.

3.7.2 Configuration

Jib length	(Jib side → Counter jib side) 8 counter ballast slots (t)								
	The first	The rest							Total
70m	3.0	3.0	3.0	3.0	2.5	2.5	2.5	1.3	20.8
65m	3.0	3.0	3.0	3.0	2.5	2.5	2.5	/	19.5
60m	3.0	3.0	3.0	3.0	2.5	2.5	2.5	/	19.5
55m	3.0	3.0	3.0	3.0	2.5	2.5	2.5	/	19.5
50m	3.0	3.0	3.0	3.0	2.5	2.5	1.3	/	18.3
45m	3.0	3.0	3.0	2.5	2.5	2.5	1.3	/	17.8
40m	3.0	3.0	3.0	3.0	2.5	1.3	/	/	15.8
35m	3.0	3.0	3.0	2.5	2.5	/	/	/	14.0
30m	3.0	3.0	3.0	2.5	1.3	/	/	/	12.8

3.7.3 Assembly drawing and spare part list of counter ballasts

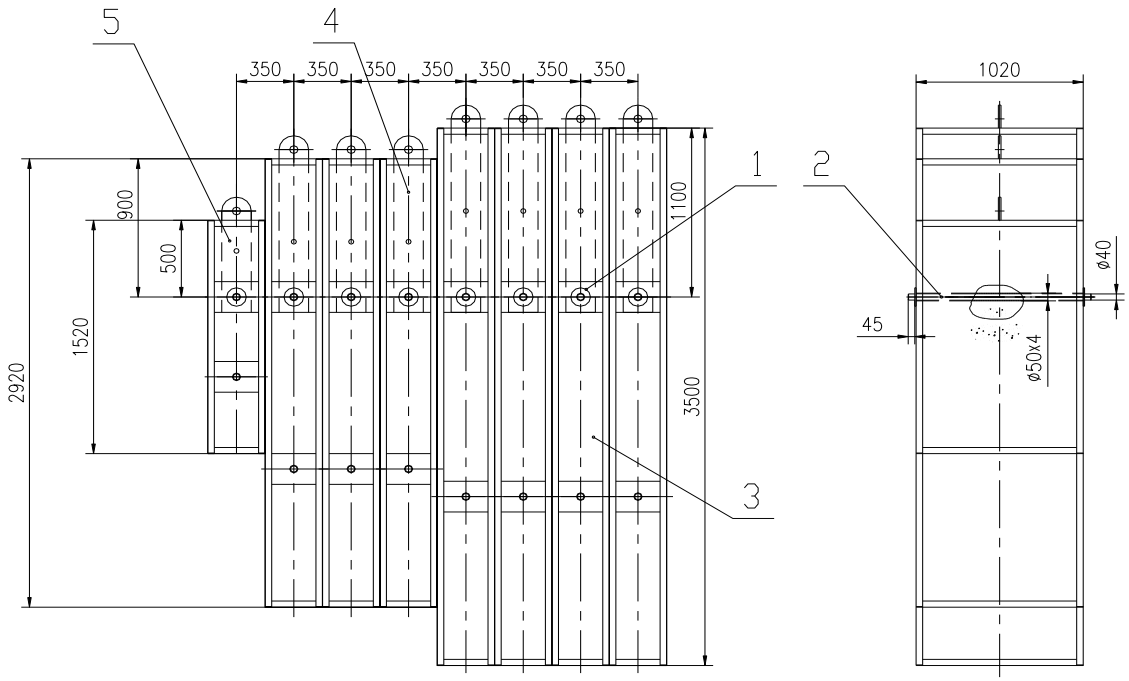


Fig. 3-1 Assembly drawing of **WA7025-10/12(Abroad)-PHZ (000271799GT010000)**

Table 3-1 Spare part list of counter ballasts

No.	Order No.	Code	Designation	Specification	Qty	Material
1	000270399BT010010	T6513-PHZXZ	Counter ballast pin		16	Weldment
2	000280599AT010001		Steel pipe	φ50×4-1020	8	Q235B
3	000209915F0030000	PHZ3000R(J)	Counter ballast 3.0t		4	Reinforced Concrete
4	000209915C0025000	PHZ2500T(J)	Counter ballast 2.5t		3	Reinforced Concrete
5	000209915J0013000	PHZ1300P(J)	Counter ballast 1.3t		1	Reinforced Concrete

☆ **Generally, the counter ballast pins and steel tubes are provided by ZOOMLION, the counter ballasts are made by users.**

Each counter ballast matches 2 counter ballast pins and one steel pipe.

Paint the counter ballasts with yellow and black for warning.

3.7.4 Fabrication

The ballast blocks must be carried out according to the following drawings. It is recommended to observe the outer dimensions of the blocks and the functional dimensions, especially the position of the suspension holes, the position of the raising device and its dimensions.

The reinforcement of the blocks including the raising device will be determined and carried out by the crane user to avoid the crumbling and dislocation of the blocks when handling and during crane work.

3.7.4.1 Technical requirements

1) **Welding rod: E4303;**
2) **Weld the steel tube and Part 6, Part 6 and Part 5, Part 6 and Part 8, Part 4 and Part 5 together by spot welding;**
3) **After the spot welding of the rebar net, place it in the outside frame (assembly of Part 1, 2, 9), then weld the outside frame firmly, finally weld the rebar net to the outside frame by short rebars;**
4) **Ensure the overall dimensions are 350×1020 when welding the outside frame; when pouring the concrete, don't pour it beyond the angle steel edges of the outside frame;**
5) **Fit and weld the Part 3 to the outside frame firmly, so to fix the steel tube and Part 7;**
6) **Weigh the concrete after poured well, the weight tolerance shall be 0~+2%, and the concrete strength can't be lower than C20 (200#), and the density shall be 2.4 t/m^3;**
7) **The dimensions of Part 4, 5 are all overall dimensions;**
8) **All parts of the drawings are provided by user. (or contact us for providing);**
9) **Make two striking weight marks on the two sides of the top of each counter ballast.**

3.7.4.2 Steel

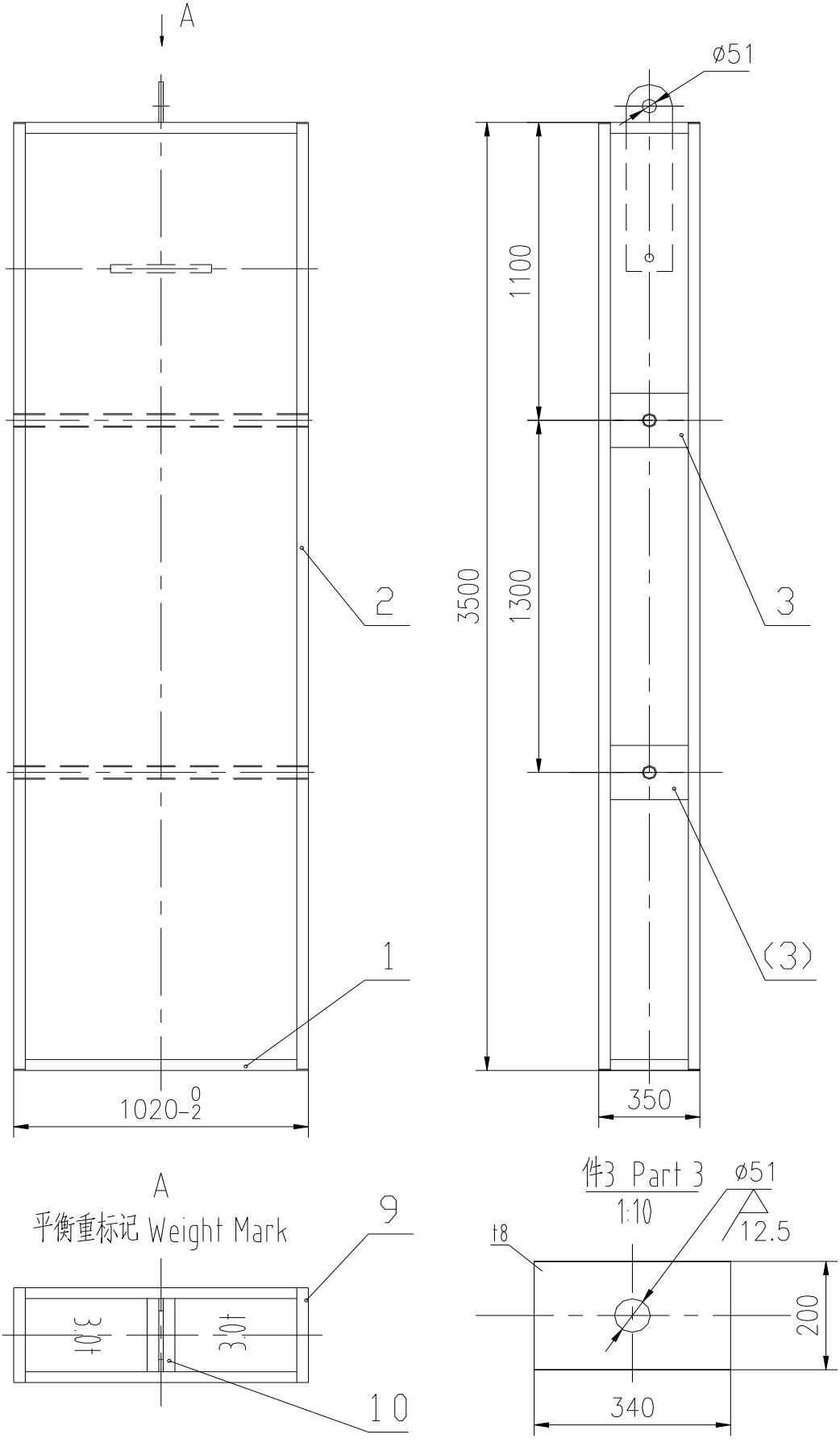
Es: Longitudinal modulus of elasticity of steel: 200000 N/mm2 i.e. 200000MPa

Type 1: Reinforcement with high adherence obtained by hot−rolling of natural high−carbon steel.

Quality: Fe E 40 i.e. fe=400MPa

If the above rules are not applicable, refer to the rules applied in the user country.

3.7.4.3 Making PHZ3000R(J)



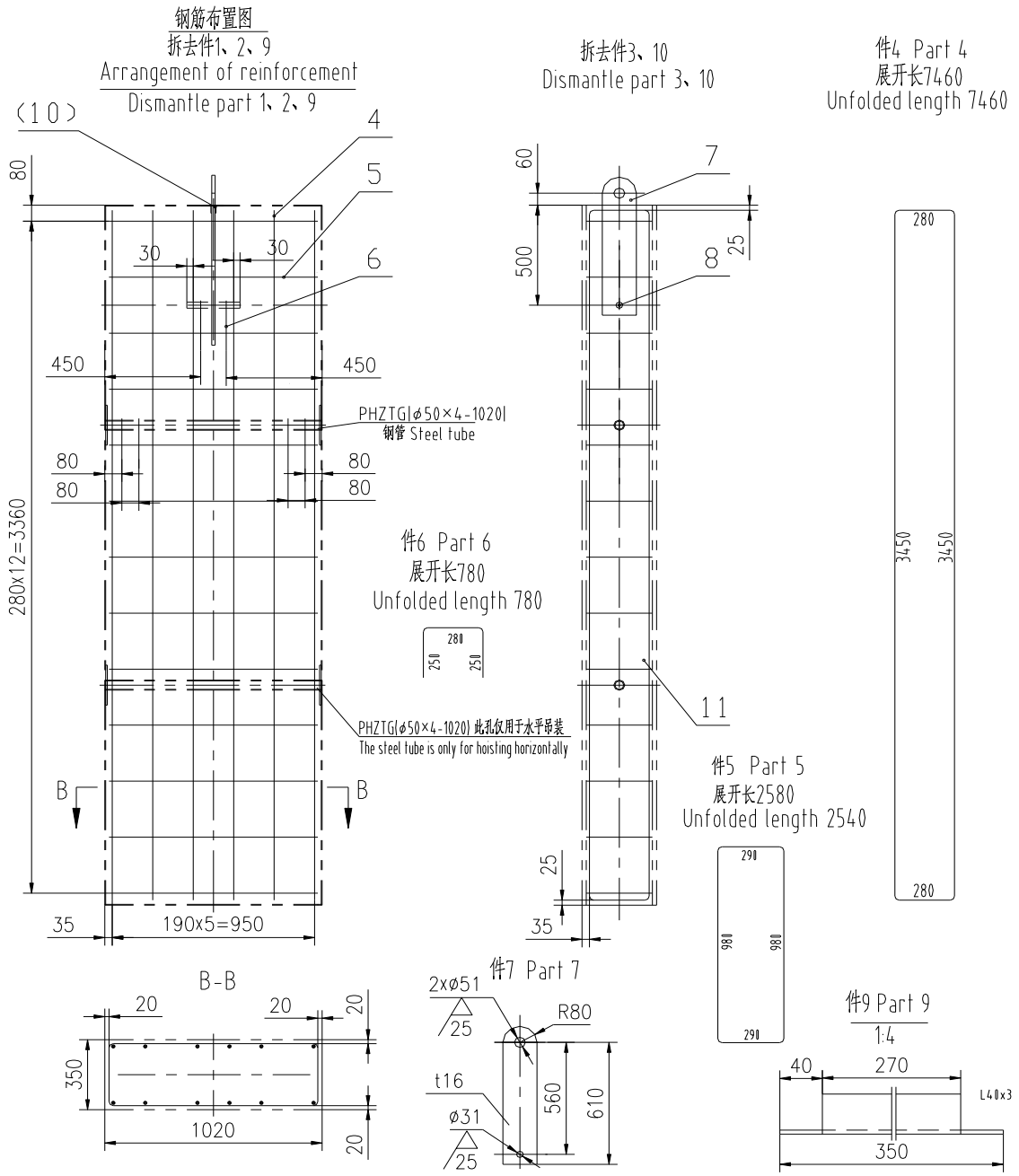
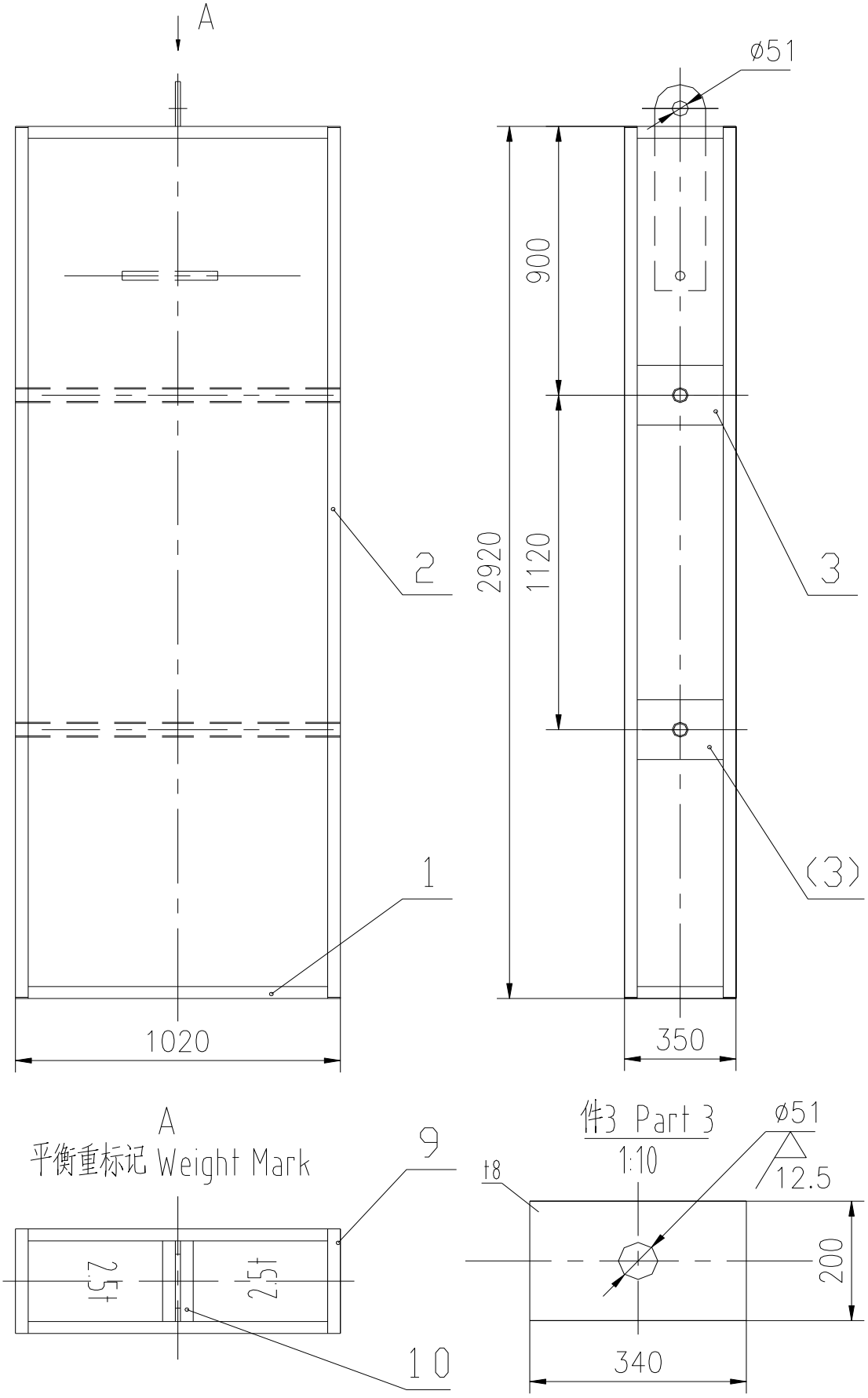


Fig. 3-2 Counter ballast PHZ3000R(J)

Table 3-2 Spare part list of PHZ3000R(J)

No.	Designation	Specification	Qty	Material	Remarks
1	Angle Steel	L40×3-940	4	Q235B	
2	Angle Steel	L40×3-3494	4	Q235B	
3	Fixed Plate	t8	4	Q235B	
4	Rebar	Φ8	6	HPB300	
5	Rebar	Φ6	13	HPB300	
6	Rebar	Φ8	6	HPB300	
7	Ear Board	t16	1	Q355B	
8	Round Steel	Φ30-250	1	Q355B	
9	Angle Steel	L40×3	4	Q235B	
10	Angle Steel	L40×3-290	2	Q235B	
11	Concrete		1		

3.7.4.4 Making PHZ2500T(J)



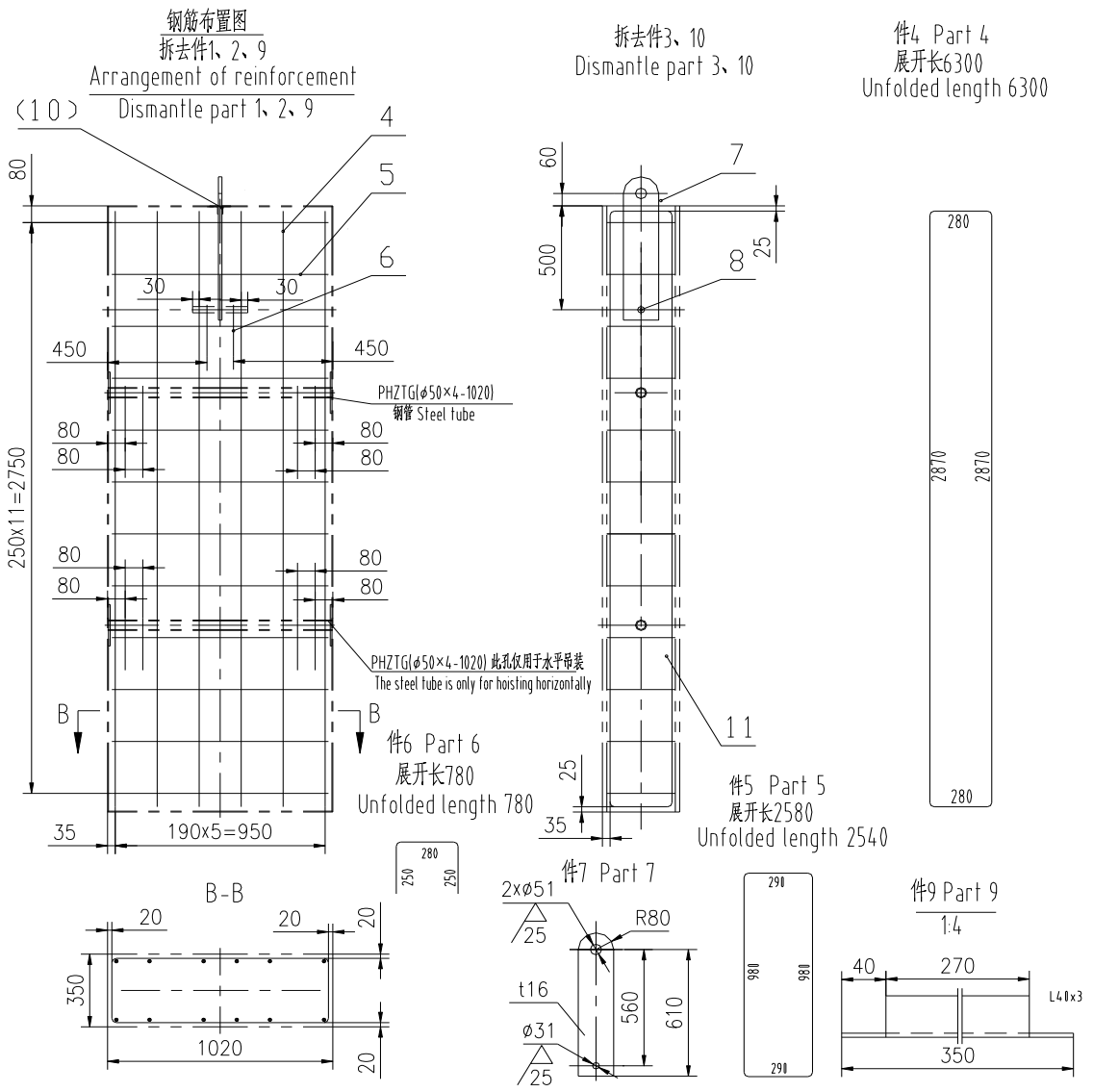
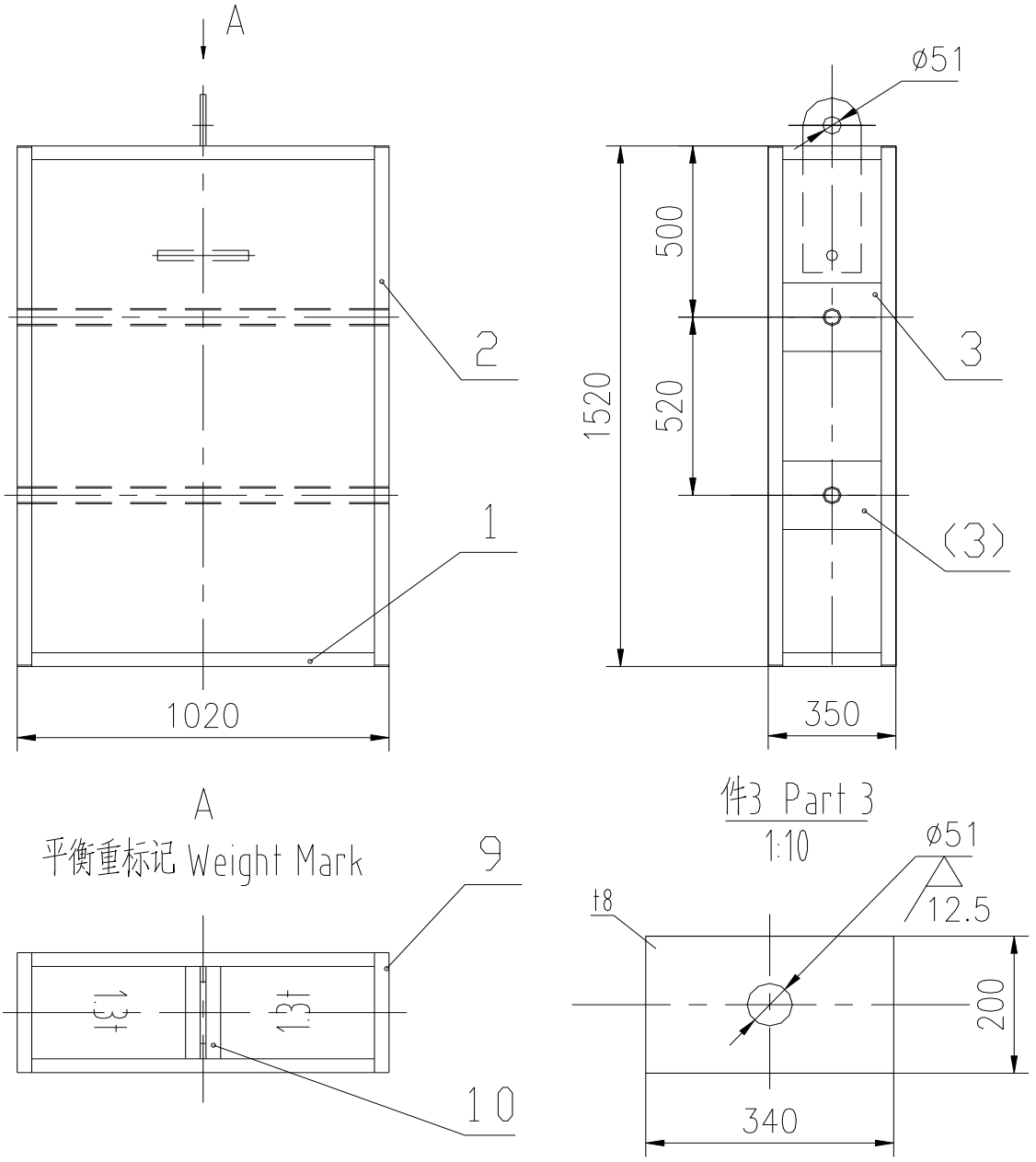


Fig. 3-3 Counter ballast PHZ2500T(J)

Table 3-3 Spare part list of PHZ2500T(J)

No.	Designation	Specification	Qty	Material	Remarks
1	Angle Steel	L40×3-940	4	Q235B	
2	Angle Steel	L40×3-2914	4	Q235B	
3	Fixed Plate	t8	4	Q235B	
4	Rebar	Φ8	6	HPB300	
5	Rebar	Φ6	12	HPB300	
6	Rebar	Φ8	6	HPB300	
7	Ear Board	t16	1	Q355B	
8	Round Steel	Φ30-250	1	Q355B	
9	Angle Steel	L40×3	4	Q235B	
10	Angle Steel	L40×3-290	2	Q235B	
11	Concrete		1		

3.7.4.5 Making PHZ1300P(J)



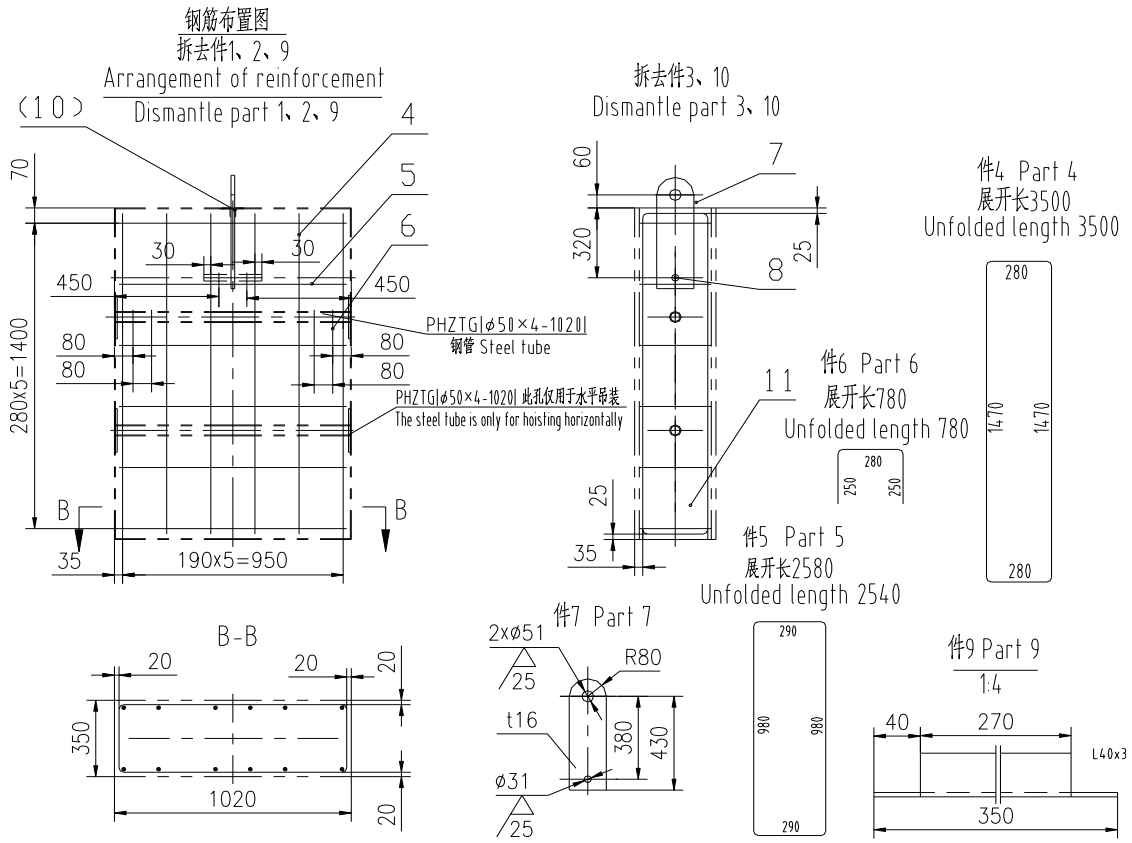


Fig. 3-4 Counter ballast PHZ1300P(J)

Table 3-4 Spare part list of PHZ1300P(J)

No.	Designation	Specification	Qty	Material	Remarks
1	Angle Steel	L40×3-940	4	Q235B	
2	Angle Steel	L40×3-1514	4	Q235B	
3	Fixed Plate	t8	4	Q235B	
4	Rebar	Φ8	6	HPB300	
5	Rebar	Φ6	6	HPB300	
6	Rebar	Φ8	6	HPB300	
7	Ear Board	t16	1	Q355B	
8	Round Steel	Φ30-250	1	Q355B	
9	Angle Steel	L40×3	4	Q235B	
10	Angle Steel	L40×3-290	2	Q235B	
11	Concrete		1		

3.8 Central ballast

Chassis stationary and travelling tower crane need configure central ballast.

3.8.1 Configuration

The tower crane has two types of central ballast: YZ3900(3.9t) and YZ4500(4.5t).

Table 3-5 Central ballast configuration for different height

Qty. of sections (Exclude chassis)	Working height /m		Weight/t	YZ3900 Qty	YZ4500 Qty
	Stationary	Travelling			
1+5	24.5	25.5	51.6	4	8
1+6	27.5	28.5	51.6	4	8
1+7	30.5	31.5	51.6	4	8
1+8	33.5	34.5	51.6	4	8
1+9	36.5	37.5	60.6	4	10
1+10	39.5	40.5	60.6	4	10
1+11	42.5	43.5	69.6	4	12
1+12	45.5	46.5	69.6	4	12
1+13	48.5	49.5	78.6	4	14
1+14	51.5	52.5	87.6	4	16
1+15	54.5	55.5	105.6	4	20
1+16	57.5	58.5	105.6	4	20
1+17	60.5	61.5	105.6	4	20

3.8.2 Assembly drawing and spare part list of central ballasts

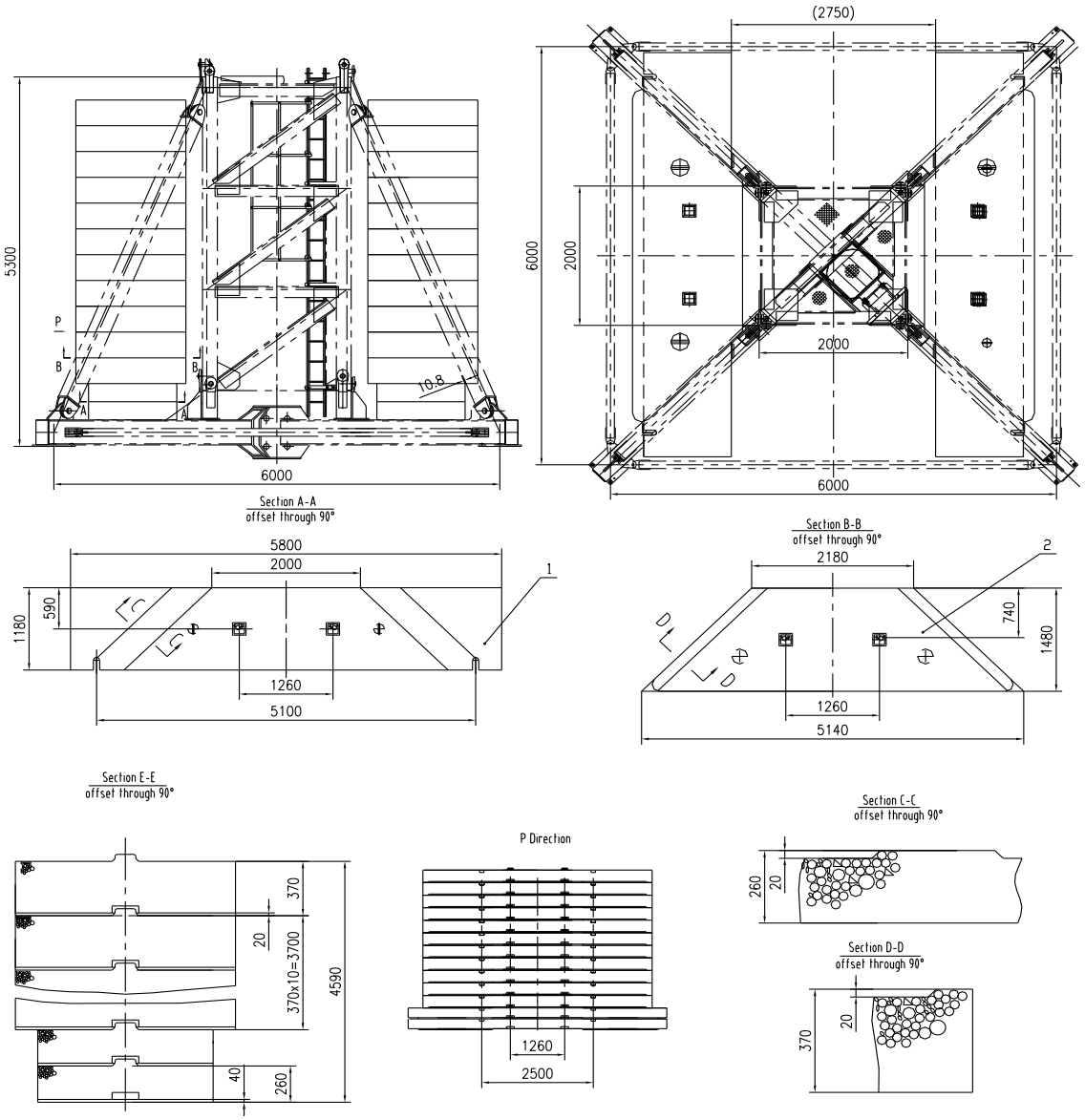


Fig. 3-5 Assembly drawing of **WA7025-12E-YZ (000281799BT020000)**

Table 3-6 Spare part list of central ballasts

No.	Order No.	Code	Designation	Specification	Qty	Material
1	000209932A0039000	YZ3900	Central ballast 3.9t		4	Reinforced Concrete
2	000209932A0045000	YZ4500	Central ballast 4.5t		22*	Reinforced Concrete

☆ ***Adjust the quantities of YZ4500 according to *Section 3.8.1*.**

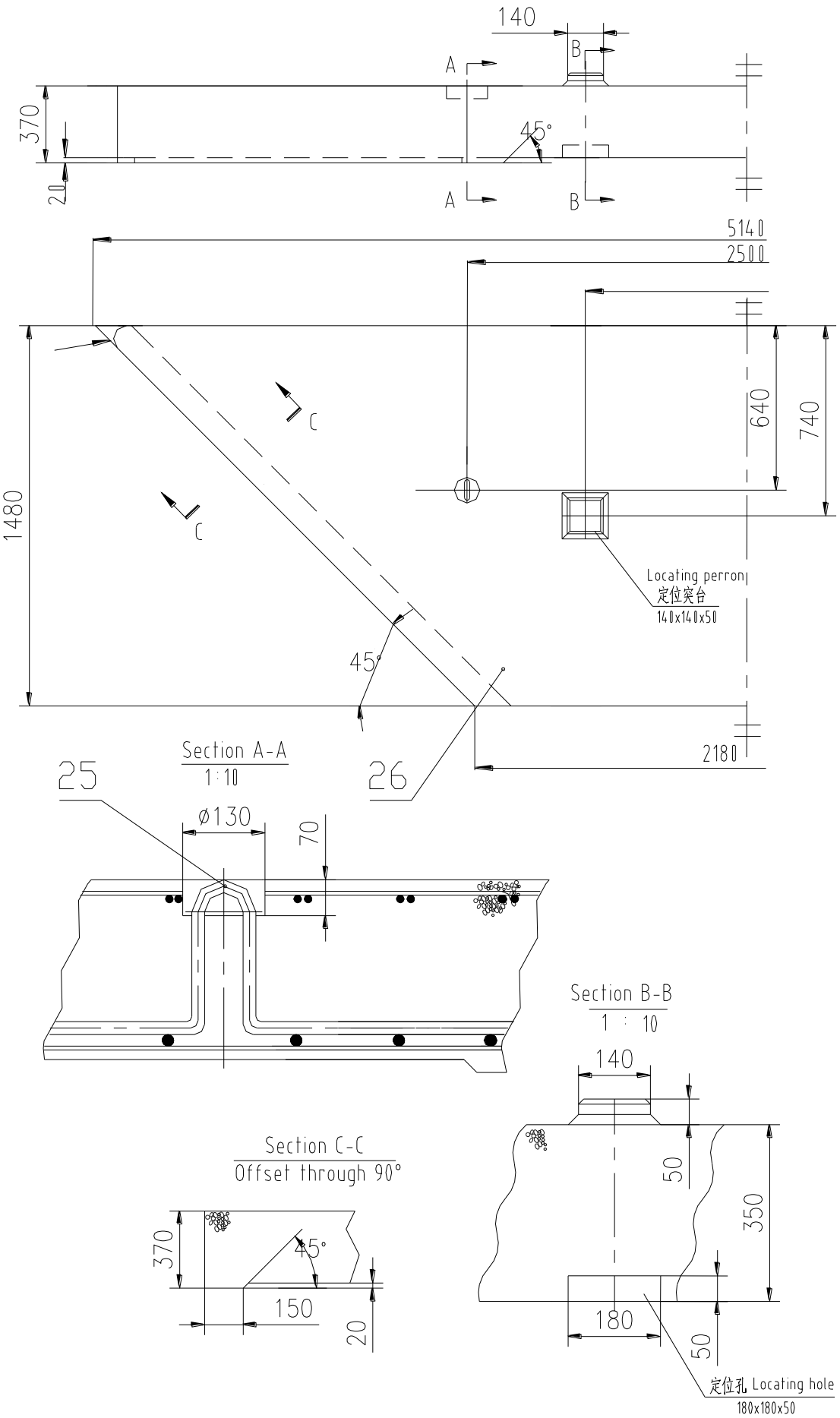
3.8.2.1 Technical requirements

1) The protrusions of YZ3900 must be placed on the cross beam symmetrically;
2) The YZ4500 must be placed on the middle of YZ3900, notice to assemble the protrusions according to the drawing above, don’t assemble them in opposite order;
3) When installing the central ballasts, use the location holes and location perrons to locate ballasts. Centre line of locating perrons of lower ballast must coincide with center line of location hole of the ballast above.

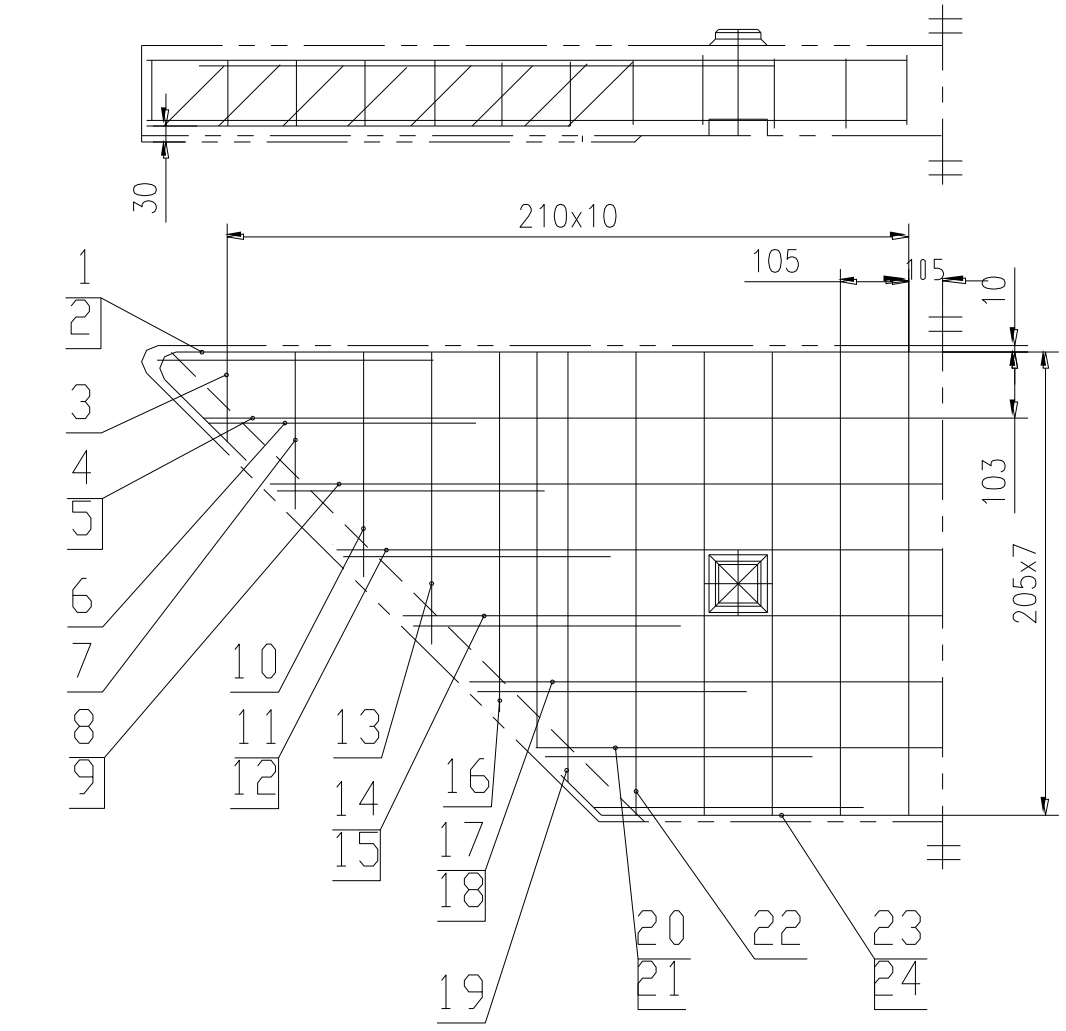
3.8.3 Fabrication

3.8.3.1 Center Ballast YZ4500

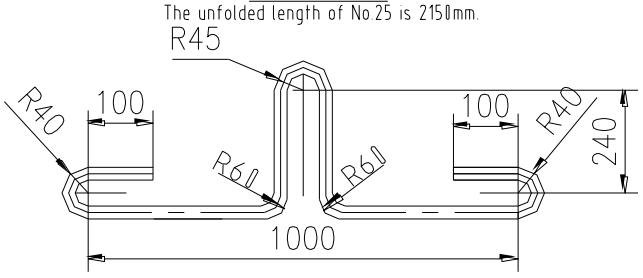
- The perron, which supports the whole weight of the centre ballast, must be made smoothing.
- The No.2,5,9,12,15,18,21,24 are below reinforements, they have the same diameter Φ16. The No.1,4,8,11,14,17,20,23 are upper reinforements, they have the same diameter Φ12. Don't mistake using.
- The concrete strength is C30. Stamped concrete, the curing period of the counter ballast must not be less than 14 days after pouring.
- The positions of the locating perron(140x140x50) and the locating hole (180x180x50) must be correct.


140
B
A
370
45°
20
A
B
5140
2500
640
740
1480
C
C
Locating perron
定位突台
140x140x50
45°
2180
Section A-A
1:10
25
26
ø130
70
Section B-B
1 : 10
140
50
350
180
50
Section C-C
Offset through 90°
370
45°
150
20
定位孔 Locating hole
180x180x50

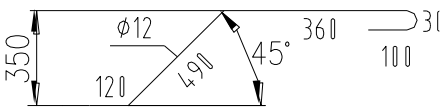
配 筋 图
arrangement of reinforcement



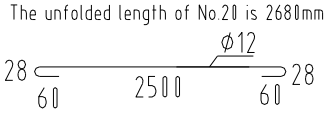
件25展开长2150
The unfolded length of No.25 is 2150mm.



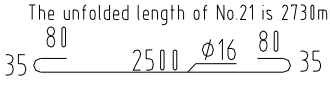
件6展开长 1100
The unfolded length of No.6 is 1100mm.



件20展开长2680
The unfolded length of No.20 is 2680mm.

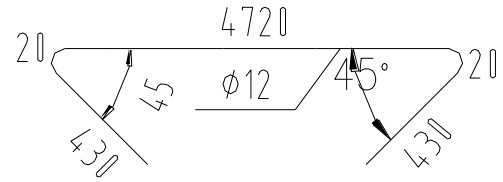


件21展开长2730
The unfolded length of No.21 is 2730mm.



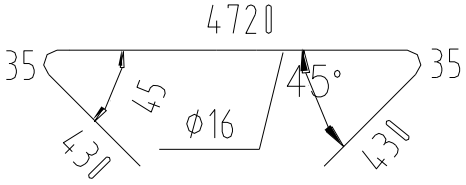
件1 展开长 5620

The unfolded length of No.1 is 5620mm.



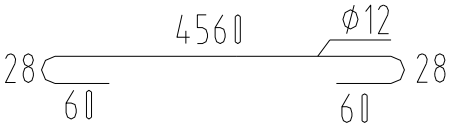
件2 展开长 5650

The unfolded length of No.2 is 5650mm.



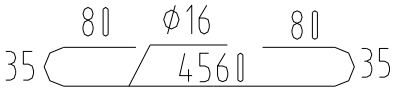
件4 展开长 4740

The unfolded length of No.4 is 4740mm.



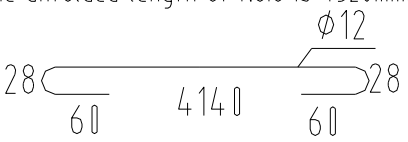
件5 展开长 4790

The unfolded length of No.5 is 4790mm.



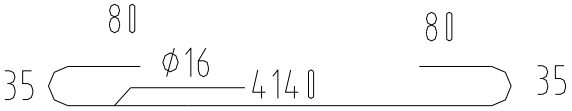
件8 展开长 4320

The unfolded length of No.8 is 4320mm.



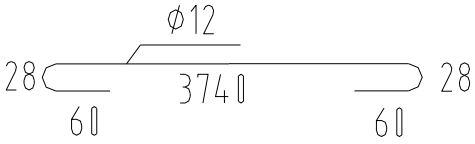
件9 展开长 4370

The unfolded length of No.9 is 4370mm.



件11 展开长3920

The unfolded length of No.11 is 3920mm.



件12 展开长3970

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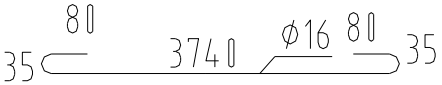
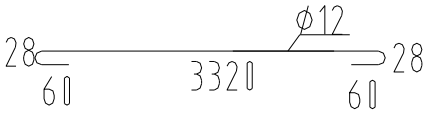


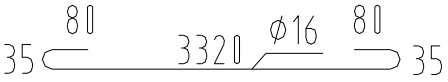
件14 展开长3500

The unfolded length of No.14 is 3500mm.



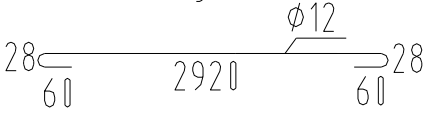
件15 展开长3550

The unfolded length of No.15 is 3550mm.



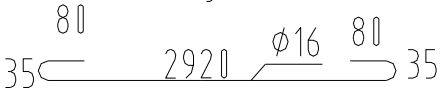
件17 展开长3100

The unfolded length of No.17 is 3100mm.



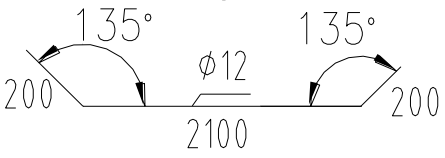
件18 展开长3150

The unfolded length of No.18 is 3150mm.



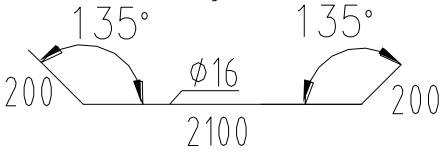
件23 展开长2500

The unfolded length of No.23 is 2500mm.



件24 展开长2500

The unfolded length of No.24 is 2500mm.



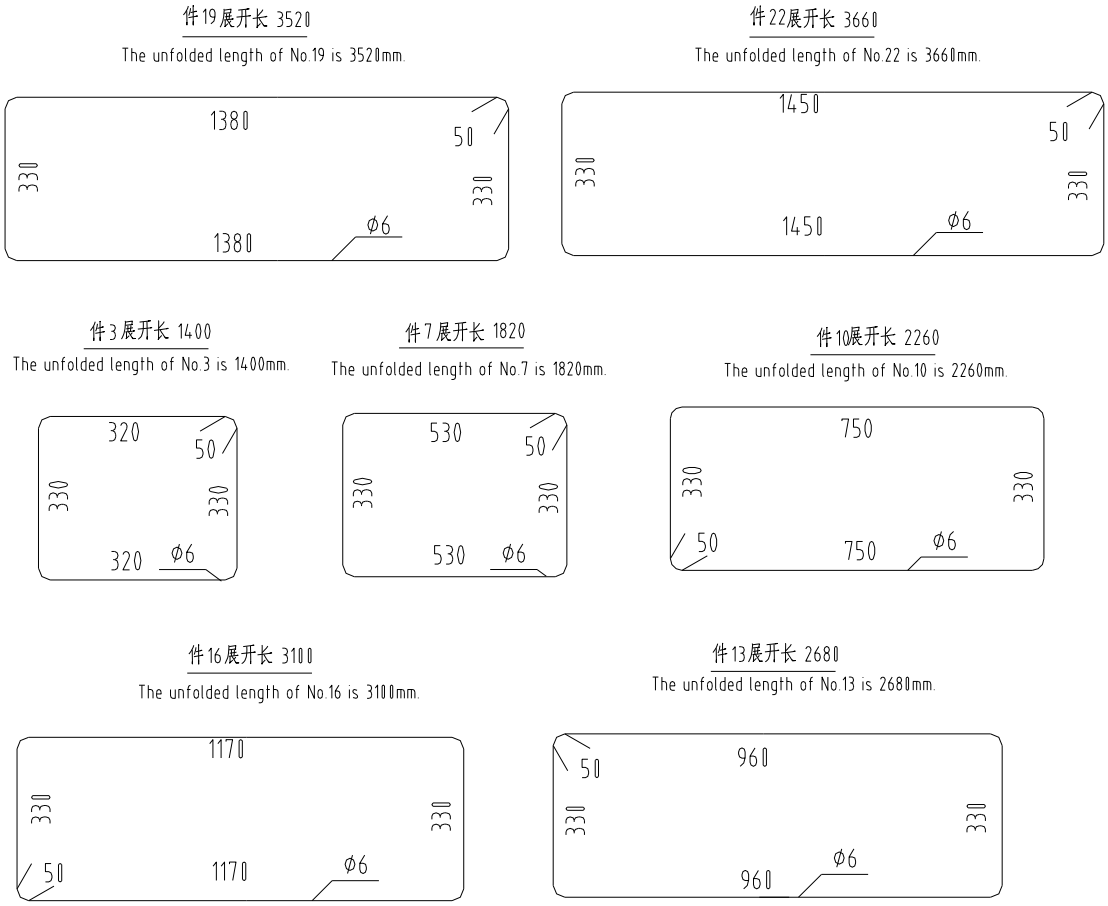


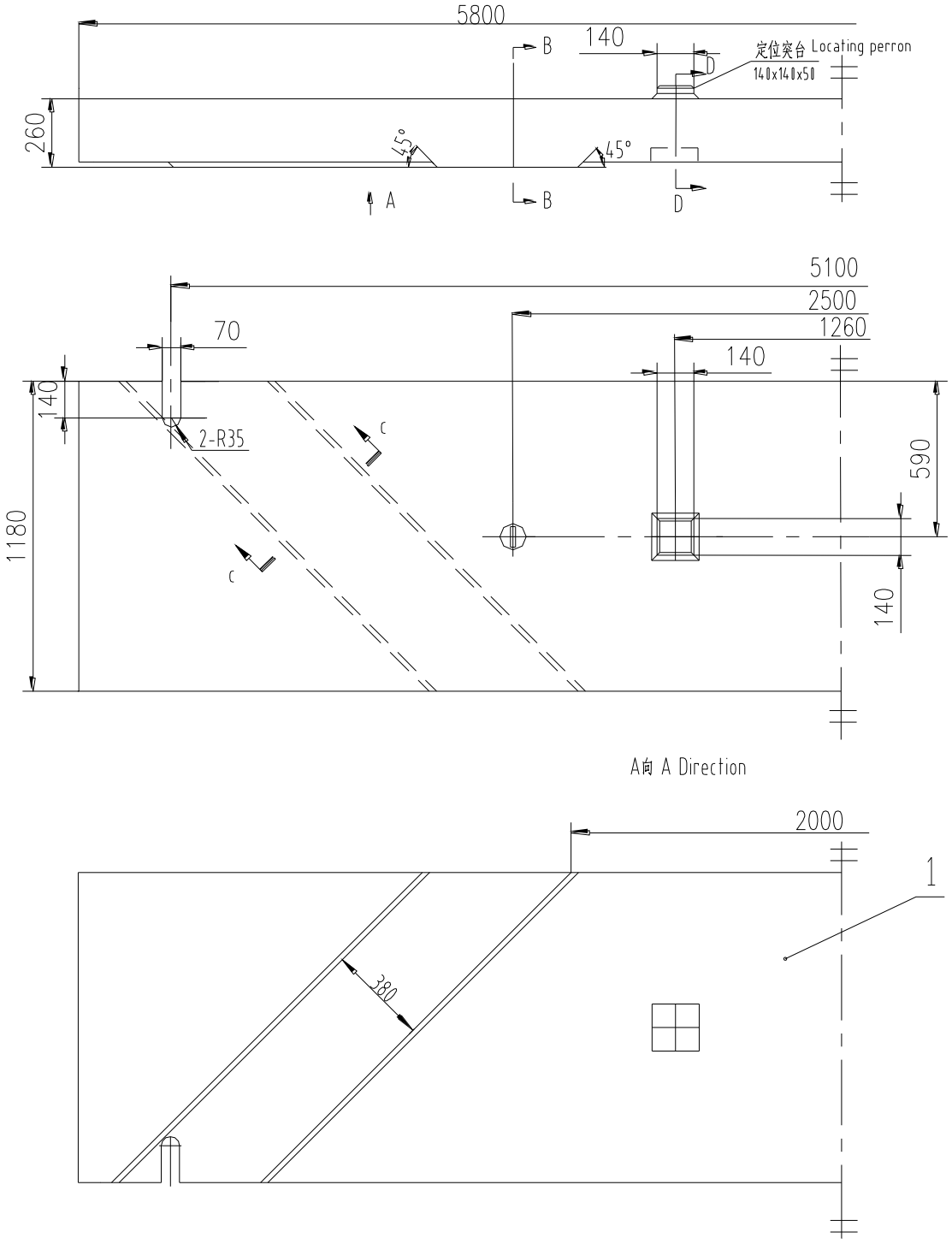
Fig. 3-6 Center Ballast YZ4500

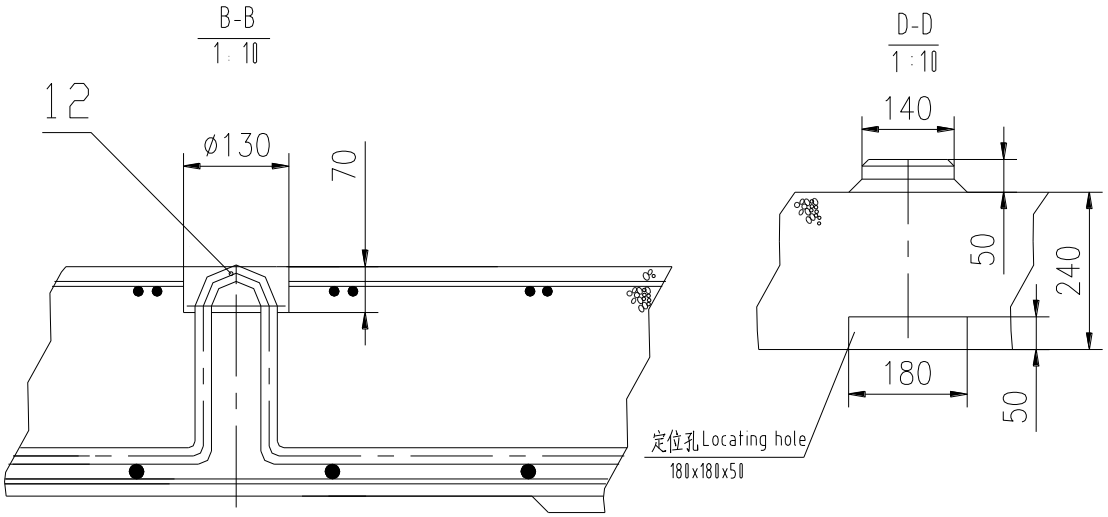
Table 3-7 Spare parts of Center Ballast YZ4500

No.	Designation	Specification	Qty	Material
1	Reinforcement	Φ12-3500	1	HPB235
2	Below reinforcement	Φ16-3550	1	HPB235
3	Hooped reinforcement (1)	Φ6-3100	2	HPB235
4	Reinforcement	Φ12-3100	1	HPB235
5	Below reinforcement	Φ16-3150	1	HPB235
6	Additional reinforcement	Φ6-3520	2	HPB235
7	Hooped reinforcement (2)	Φ12-2680	1	HPB235
8	Reinforcement	Φ16-2730	1	HPB235
9	Below reinforcement	Φ6-3660	10	HPB235
10	Hooped reinforcement (3)	Φ12-2500	1	HPB235
11	Reinforcement	Φ16-2140	1	HPB235
12	Below reinforcement	Φ20-2150	2	Q235B
13	Hooped reinforcement (4)		1	C30
14	Reinforcement	Φ12-3500	1	HPB235
15	Below reinforcement	Φ16-3550	1	HPB235
16	Hooped reinforcement (5)	Φ6-3100	2	HPB235
17	Reinforcement	Φ12-3100	1	HPB235
18	Below reinforcement	Φ16-3150	1	HPB235
19	Hooped reinforcement (6)	Φ6-3520	2	HPB235
20	Reinforcement	Φ12-2680	1	HPB235
21	Below reinforcement	Φ16-2730	1	HPB235
22	Hooped reinforcement (7)	Φ6-3660	10	HPB235
23	Reinforcement	Φ12-2500	1	HPB235
24	Below reinforcement	Φ16-2140	1	HPB235

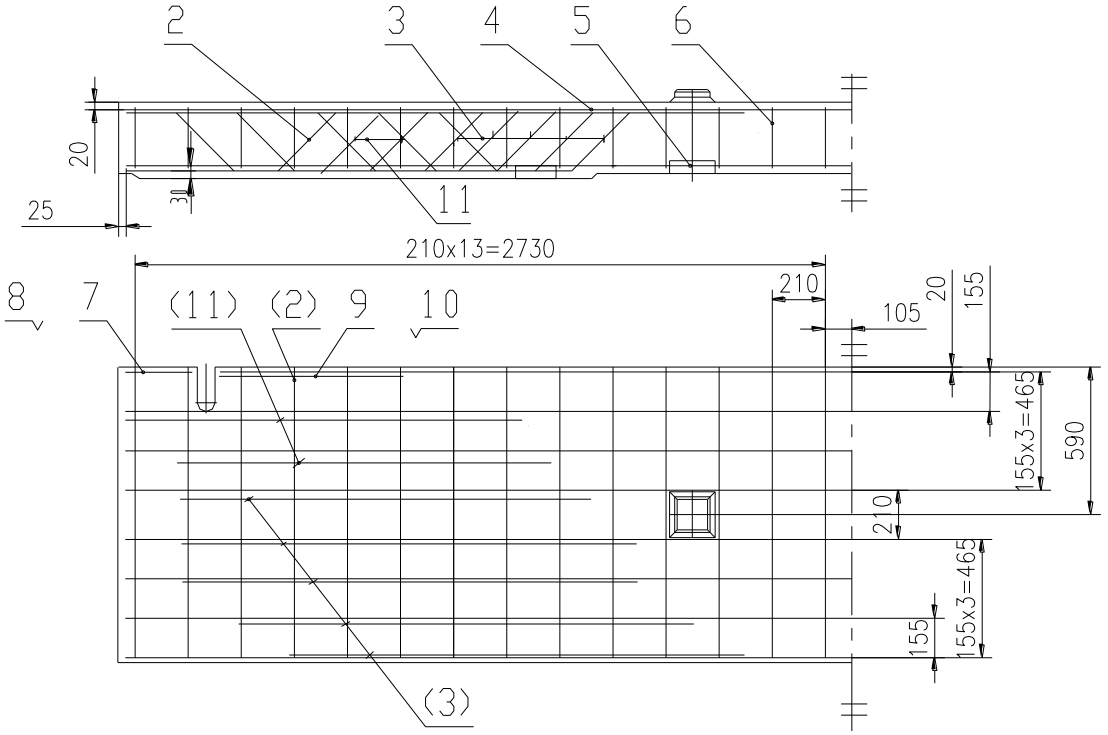
3.8.3.2 Center Ballast YZ3900

- The perron, which width and depth is 380×20mm, supports the whole weight of the ballast, and must be made smoothing.
- The concrete strength is C30. Stamped concrete, the curing period of the Ballast must not be less than 14 days after pouring.
- The positions of the locating perron(140×140×50) and the locating hole(180×180×50) must be correct.

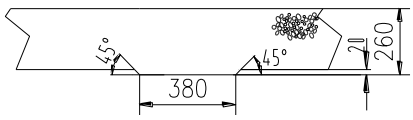




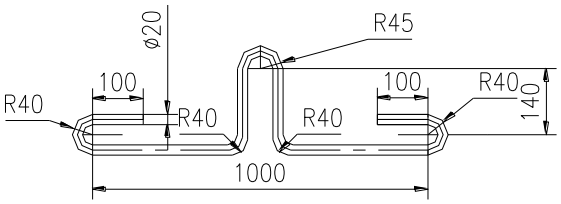
配筋图
arrangement of reinforcement



C-C旋转C-C Section
Offset through 90°



件12展开长 1950
The unfolded length of No.12 is 1950mm.



件9展开长5160

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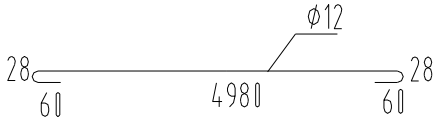
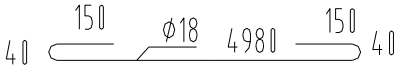


件10展开长5360

The unfolded length of No.10 is 5360mm.



件2展开长1110

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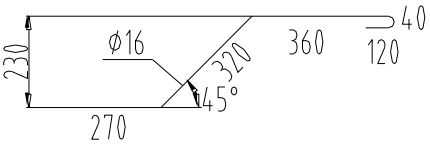

件11展开长1910

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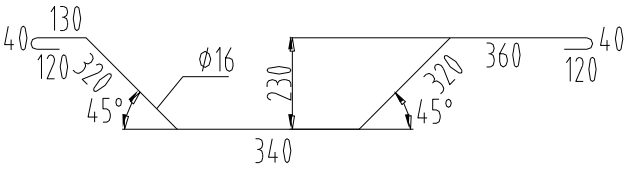

件4展开长5916

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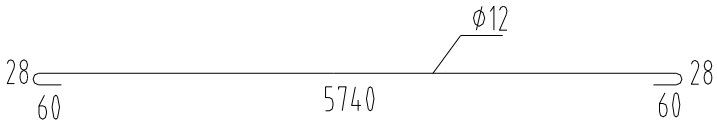

件3展开长2020

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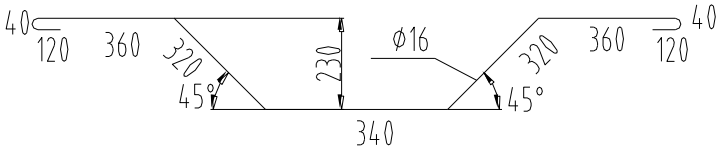

件5展开长 6120

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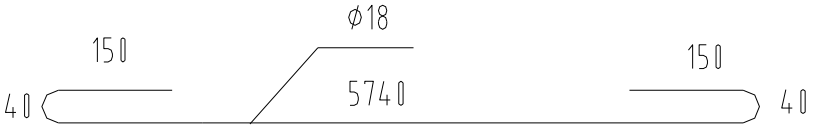

件6展开长2820

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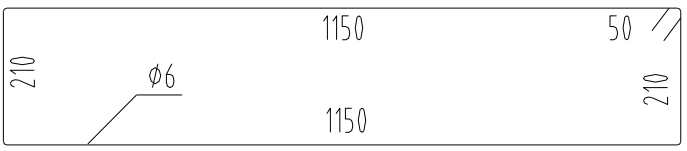


Fig. 3-7 Center Ballast YZ3900

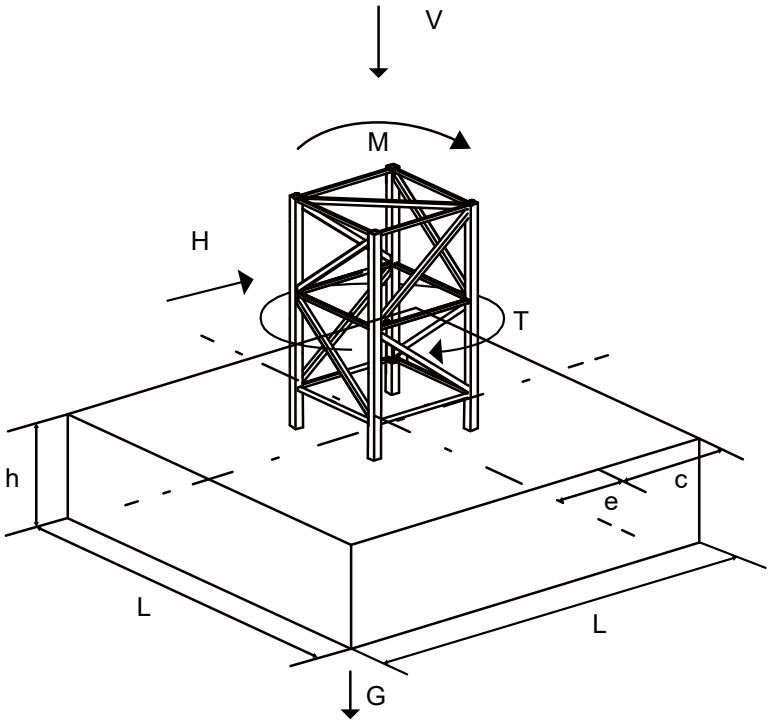
Table 3-8 Spare parts of Center Ballast YZ3900

No.	Designation	Specification	Qty	Material
1	Concrete		1	C30
2	Additional reinforcement (1)	Φ16-1100	2	HPB235
3	Additional reinforcement (2)	Φ16-2020	10	HPB235
4	Upper reinforcement (1)	Φ12-5916	7	HPB235
5	Below reinforcement (1)	Φ18-6120	7	HPB235
6	Hooped reinforcement	Φ6-2820	24	HPB235
7	Upper reinforcement (2)	Φ12-300	2	HPB235
8	Below reinforcement (2)	Φ18-300	2	HPB235
9	Upper reinforcement (2)	Φ16-5160	1	HPB235
10	Additional reinforcement (4)	Φ18-5360	1	HPB235
11	Additional reinforcement (4)	Φ16-1790	4	HPB235
12	Lifting ear	Φ20-1950	2	Q235B

3.9 Foundation

3.9.1 Calculating method

- Calculate of eccentricity



As the figure, the stability condition of tower crane as the following:

$$e = \frac{M + H * h}{V + G} \leq \frac{L}{3}$$

In the formula:

e-eccentricity, that is the distance between the resultant ground reaction and the base center, m;

G—the gravity of the concrete foundation, kN.

- Calculation of earth bearing pressure

Earth endurance should not exceed the maximum permissible stress of the ground!

Earth endurance checking formula:

$$\sigma_B = \frac{2 * (V + G)}{3 * L * c} \leq \sigma_{Bp}$$

$$c = \frac{L}{2} - e$$

In the formula:

σ_B—Calculation the com pressive stress on the ground, MPa;

σ_{Bp}—Allowable compressive stress on the ground, MPa: It shall be determined by the situation officed investigation and foundation treatment.

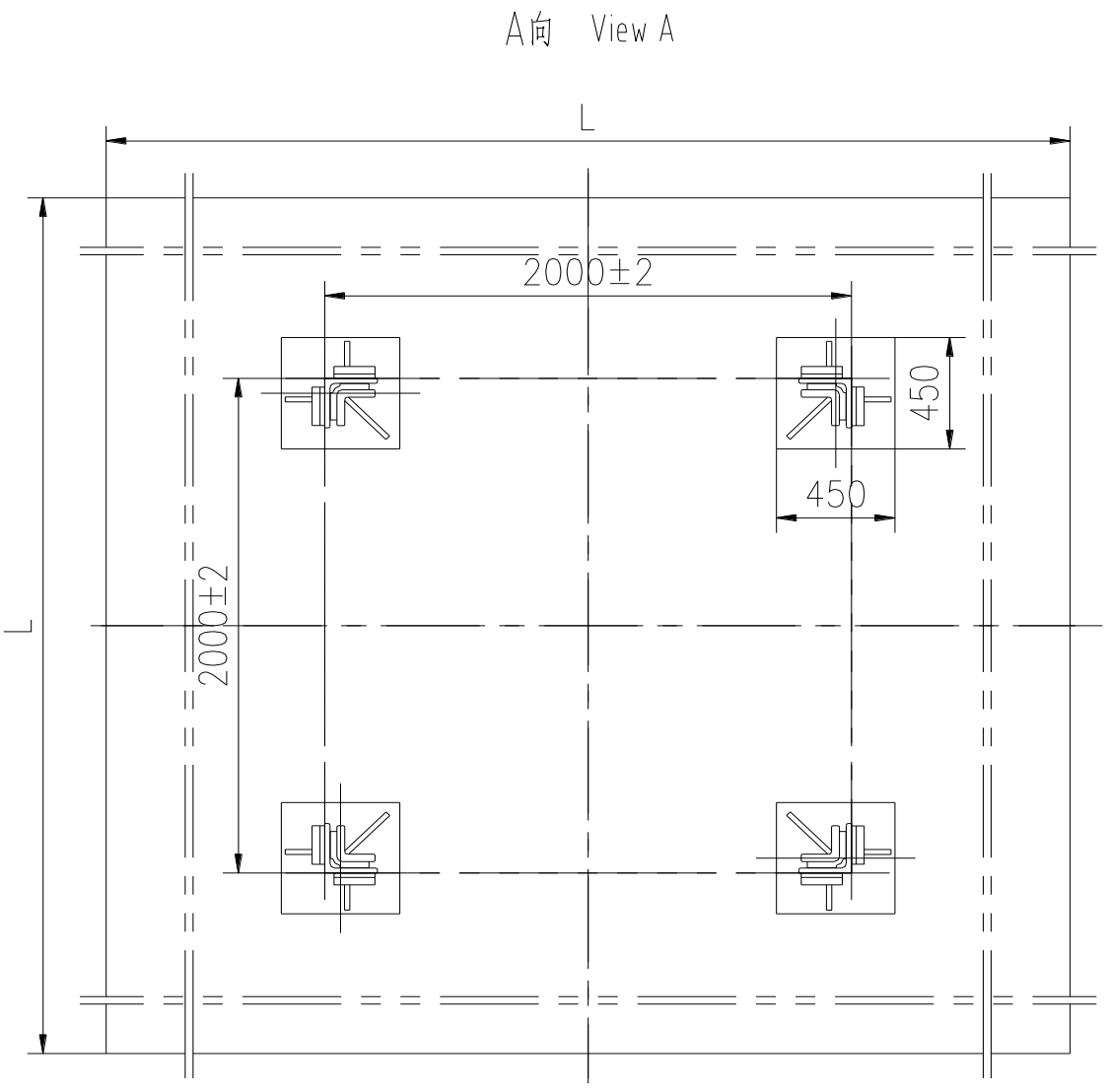
3.9.2 Foundation of stationary outrigger tower crane

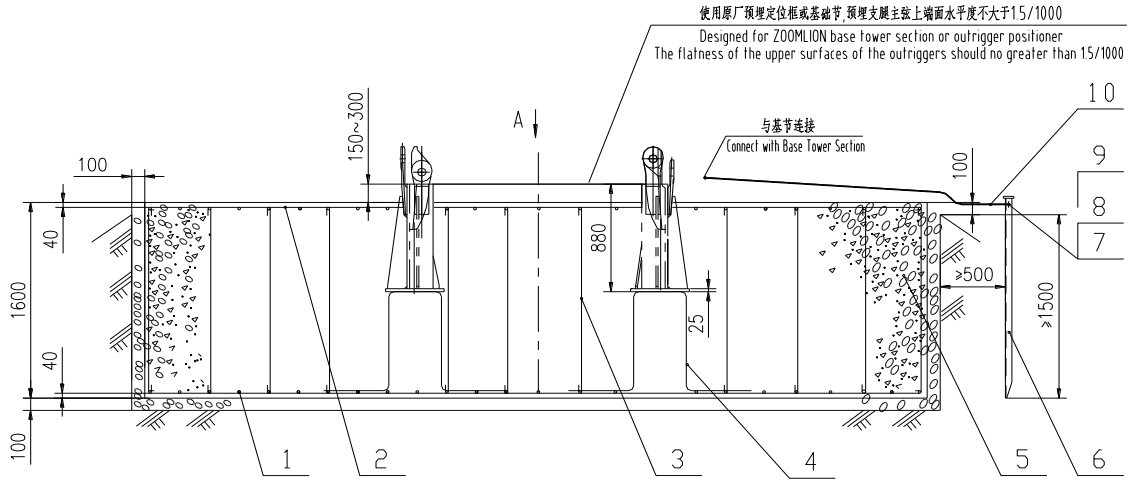
The ground foundation is the precondition to ensure safe operation of the crane. It is made of reinforced concrete as shown in Fig. 3-8. Basic requirements are shown as follows:

- Excavate a trench to hard formation until the ground bearing pressure accords with the value in the following table, and make the bottom level. And then backfill and tamp 100mm gravel stratum. After making formwork or laying bricks for the side walls, pour concrete into pre-made reinforced rod net. The concrete block surface should be 100mm higher than neighboring ground for the drainage of storm water, then removal the formwork and backfill the neighboring ground with gravels.
- The depth of the concrete cover of the main reinforcement is 40mm. Fix the embedded anchors on the locating reinforcement bar and make sure that the verticality of the embedded anchors centerlines and horizontal plane is less than 1.5/1000. Concrete filling rate around the embedded anchors must be over 95%.
- The concrete strength grade shall be no less than C35. The curing duration of concrete is more than 15 days.
- If it is difficult to pass through the anchor, the main reinforcing rod can be turned aside, but must not be reduced or cut off.
- No.6 which must drive 1.5m into the ground. Not connected with the steel reinforcement of the building foundations.
- The No.10 is insulated copper cable with at least 16mm^2.
- This foundation is supposed to be applied for WA7025-10E/WA7025-12E tower crane with the standard free-standing height of 60m and for WA7025-10E/WA7025-12E tower crane which is attached to the building and in accordance with the requirement in the user's manual. The load on the foundation can be found in the user's manual. The load-bearing capacity of the foundation, the dimension L of the foundation and the layout of the reinforcement are all designed in accordance with the standard FEM. The foundation can be produced under instruction of the following table, the adjustment according to the actual situation is also allowed:

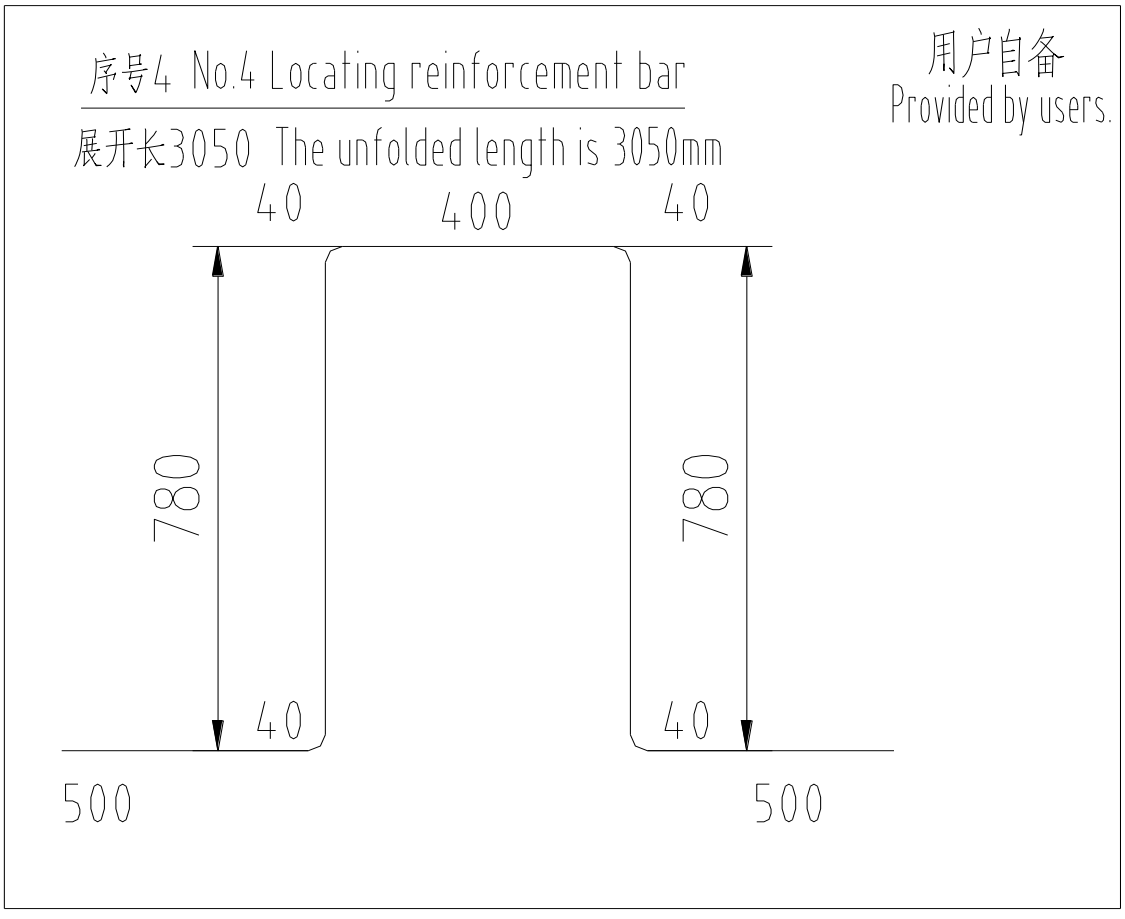
L	Main reinforcement A/B	a (mm)	Ground resistance (MPa)	Concrete volume (m^3)	Weight (t)	Qty. of No.3
7000	Lengthwise and crosswise: 35×Φ25	6920	0.20	78.4	188.2	324
7500	Lengthwise and crosswise: 38×Φ25	7420	0.16	90	216	361
8000	Lengthwise and crosswise: 40×Φ25	7920	0.13	102.4	246	400

If the modified bearing capacity of foundation is less than 0.1 MPa, the pile foundation must be adopted. The pile foundation can also be adopted, when the block foundation cannot be produced as above due to the size limitation or other inevitable reasons.




使用原厂预埋定位框或基础节,预埋支腿主弦上端面水平度不大于1.5/1000
Designed for ZOOMLION base tower section or outrigger positioner
The flatness of the upper surfaces of the outriggers should no greater than 1.5/1000
与基节连接
Connect with Base Tower Section
150~300
A
100
40
1600
40
100
880
25
100
10
9
8
7
≥500
≥1500
1
2
3
4
5
6


序号1、序号2
No.1 and No.2 Main Reinforcement.
用户自备 Provided by users.
R25
15d
a
R25
15d


序号4 No.4 Locating reinforcement bar
展开长3050 The unfolded length is 3050mm
用户自备
Provided by users.
40
400
40
780
780
40
40
500
500

序号3 No.3 Reinforcement bar

用户自备 Provided by users.

展开长1720 The unfolded length is 1810mm

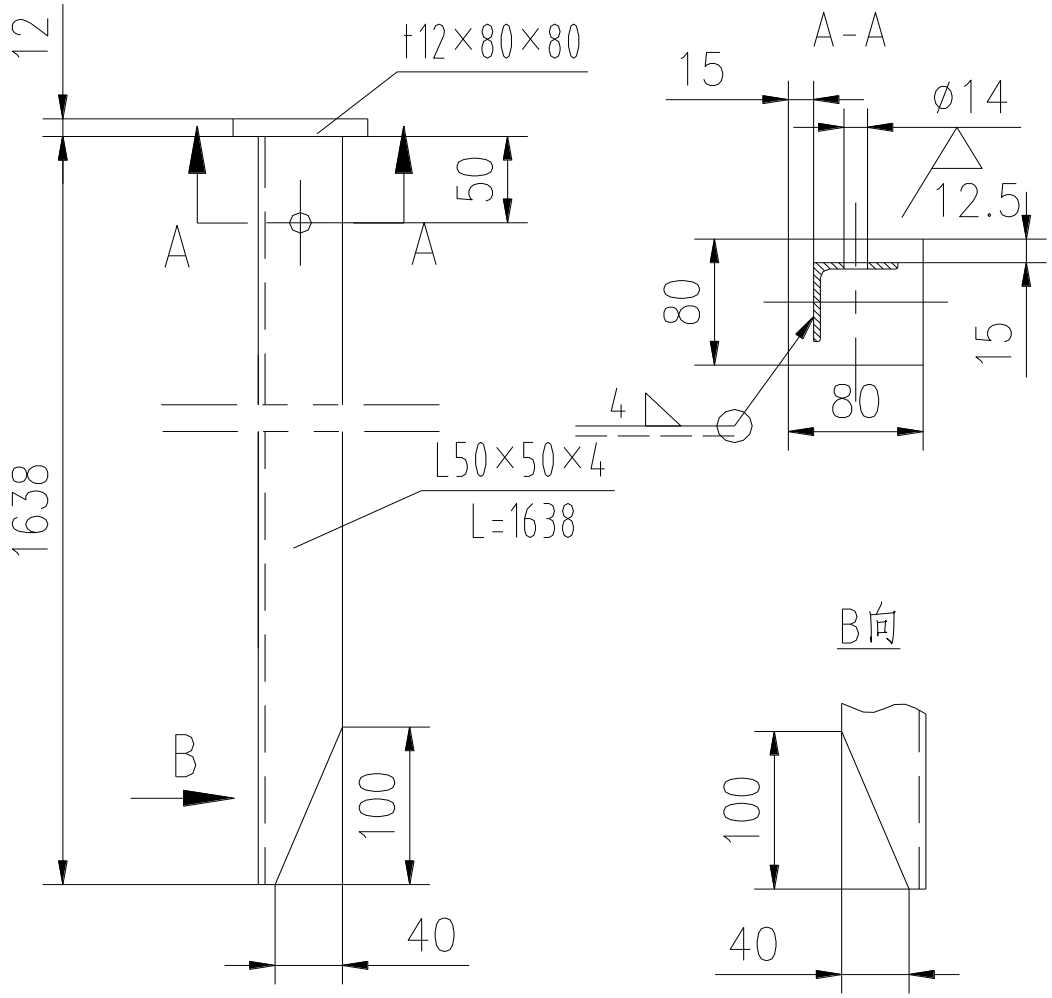
序号6 No.6 Earthing rod

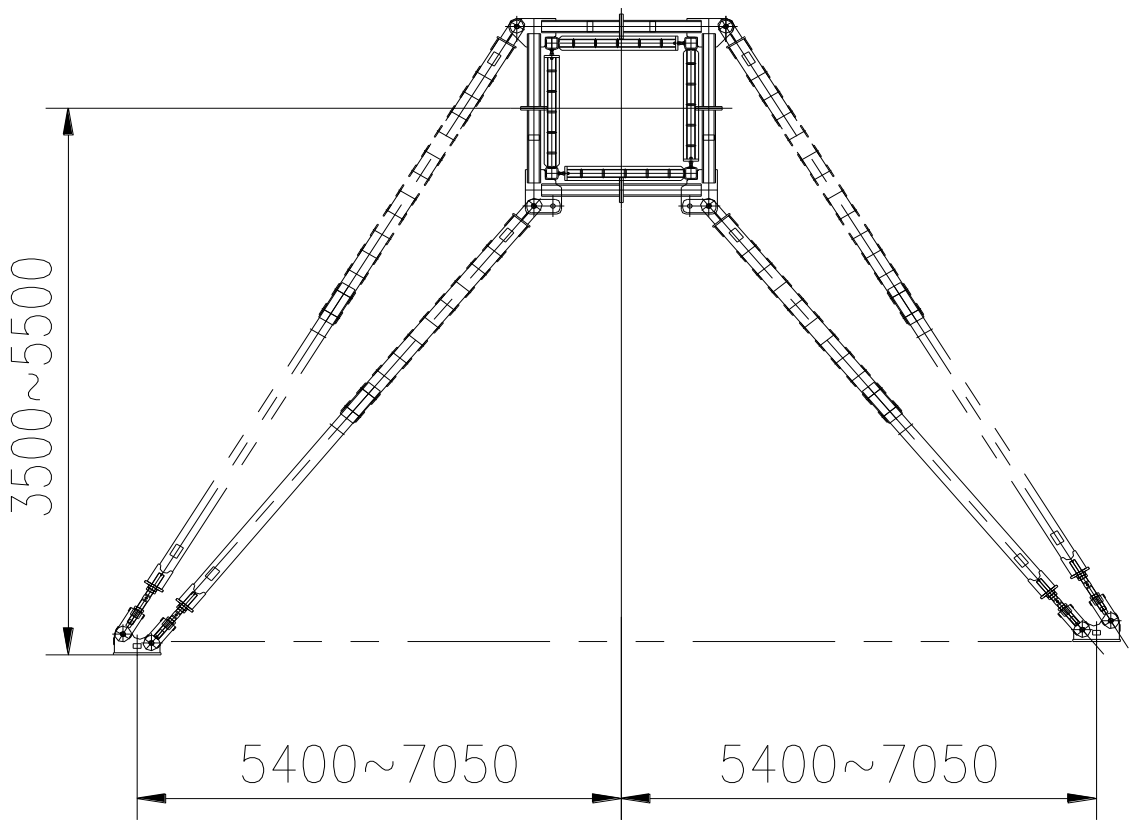
1:5

用户自备，可从我公司订购

Provided by users.

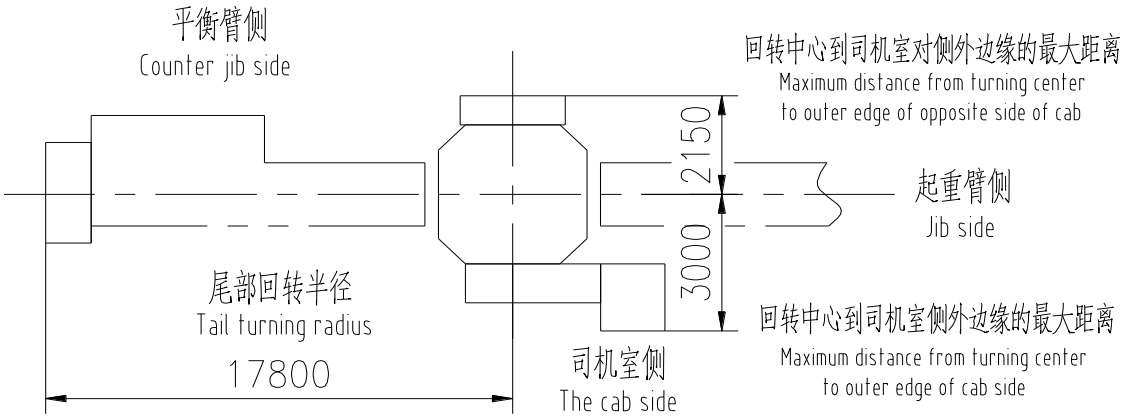
Can be ordered from ZOOMLION.





建议可伸缩式附着架安装示意图

Recommended standard retractable anchored graph



塔机俯视示意图

Vertical view of tower crane

Fig. 3-8 The foundation for stationary outrigger tower crane

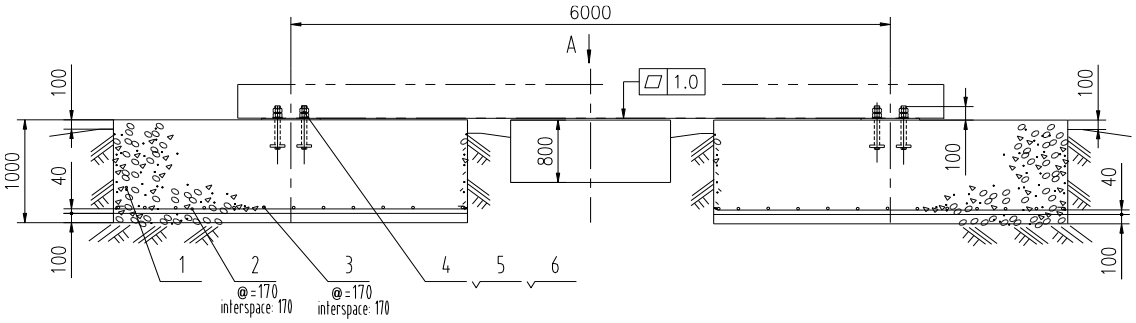
Table 3-9 Spare part list of stationary outrigger tower crane foundation

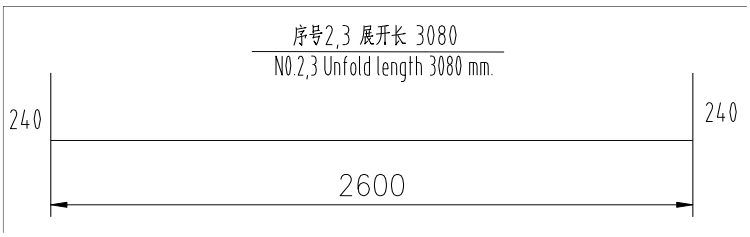
No.	Description	Specification	Qty	Material	Remarks
1	Main Reinforcement A	Φ25	70	HRB400	
2	Main Reinforcement B	Φ25	70	HRB400	
3	Reinforcement Bar	Φ12-1720	324	HPB300	
4	Locating Reinforcement Bar	Φ25-3050	8	HRB400	
5	Concrete		1	C35	
6	Earthing Rod		1	Weldment	
7	Bolt	M12×40-8.8	1		
8	Washer	12	1	65Mn	
9	Nut	M12-8	1		
10	Earthing Cable		1		

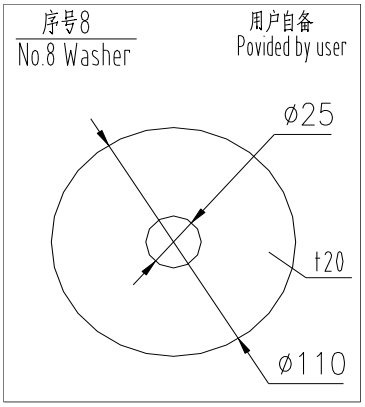
3.9.3 Foundation of stationary chassis tower crane

Make the foundation of stationary chassis tower crane according to the technical requirements and drawings below:

- Foundation must be dug to original soil. the foundation load-bearing capacity is more than 0.2Mpa. Carry out leveling and refilling 100mm pebbles and tamping them before rebar binding, then place concrete the concrete surface is more 100mm higher than the foundation around it for better water drainage. If concrete placing within form, refill pebbles and tamp them for torsion resistance after form dismantling.
- 40mm main rebar protection layer. Ground bolts to be embedded at the above-shown position through pallets holes. Embedment positions shall be concrete, and filling rate around pallets is >95%.
- Concrete grade C35, curing period longer than 15 days.
- Foundation pit 1200×1200×800, with water drainage pipe at the pit bottom.
- No.10 must be inserted into the ground for at least 1.5m. Not connected with the steel reinforcement of the building foundations.
- The No.9 is insulated copper cable with at least 16mm^2.
- The foundation is fit for WA7025-10E/WA7025-12E tower crane.
- All materials and parts should be provided by user.







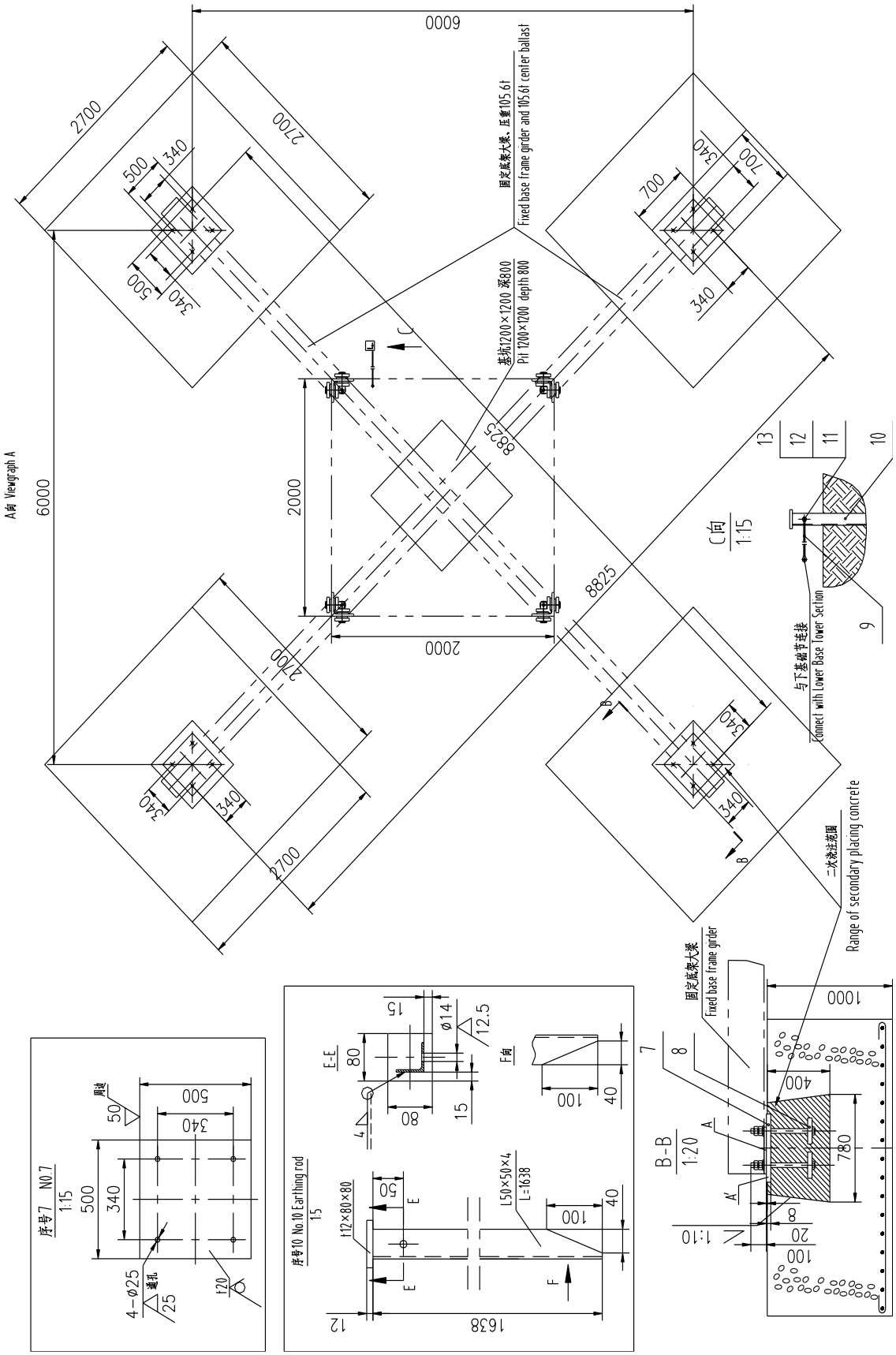


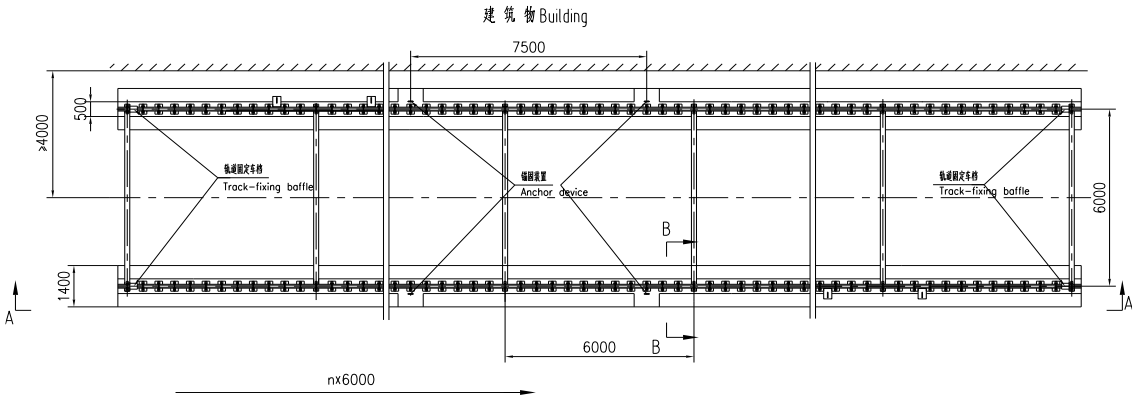
Fig. 3-9 The foundation of stationary chassis tower crane

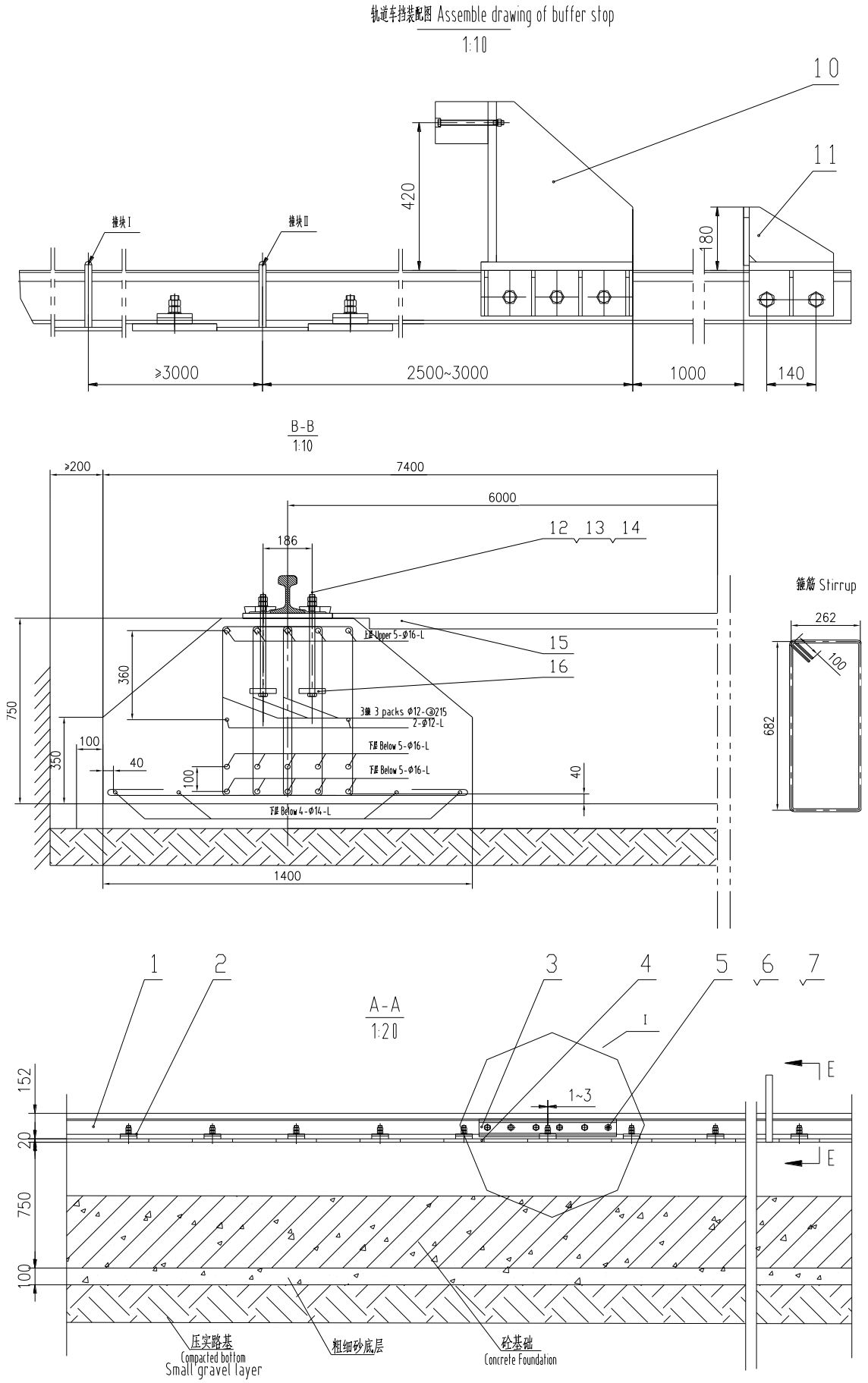
Table 3-10 Spare part list of stationary chassis crane foundation

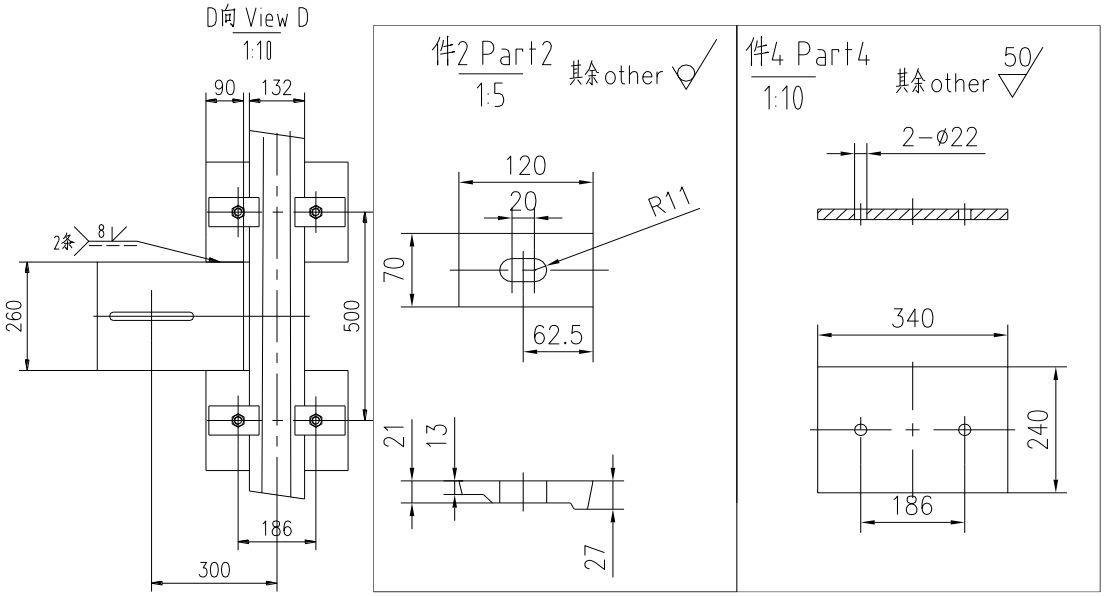
No.	Description	Code	Specification	Qty	Material
1	Concrete			4	C35
2	Rebar		φ16-3080	60	HRB400
3	Rebar		φ16-3080	60	HRB400
4	Bolt	GB/T5782-2000	M24×300-8.8	16	
5	Nut	GB/T6170-2000	M24-8	32	
6	Washer	GB/T97.1-2002	24-200HV	16	
7	Pallet		t20	4	Q235B
8	Washer		t20	16	Q235B
9	Earthing cable			1	
10	Earthing rods			1	焊件
11	Bolt	GB/T5783-2000	M12×40-8.8	1	
12	Spring washer	GB/T93-1987	12	1	65Mn
13	Nut	GB/T6170-2000	M12-8	1	

3.9.4 Foundation of travelling chassis tower crane

- The ground foundation must be tamped solid, its bearing pressure must be larger than 0.2MPa;
- During working, users should check the track on time: The distance error of 2 tracks is less than ±5mm; Track height error in the same section is less than 5mm; The longitudinal error of the track height is less than 1/1000, The total height error is less than 10mm.
- The joints of two tracks should be staggered upon 1500mm.
- The buffer stop must be set at the end of the track according to the specific situation of building site, the buffer for the travel limit switch must be set on the site shown in the drawing, travel limit test should be done in advance to ensure its safety in the process of working.
- The rails must be earthed at both ends. If the rail track is more than 20m long, additional earthing points should be installed every 20 meters. If there are no other earthing devices available one earthing rod which must be driven at least 1.5m into the ground will suffice for each point. The earth resistance must be less than 4Ω.
- There must be placed a connection link between two rails.
- The account in the specification sheet is counted base on the track which is 100m.
- The degree of finish of the machining face is $\nabla 50$ .The degree of finish of the machining hole is $\nabla 12.5$.
- The length of cable is the distance which from the fixed point to the further track end plus 15m.
- Setting 4 anchoring boards outside of the rail track. The boards are used for fixing the crane when the wind speed is higher;
- Manufacturing and locating method of the board are shown in the drawing to the drawing, the
- location of the equipment based on the practical situation; the user can also take some other
- effective and safe methods to anchor;
- The main reinforcements on the drawing are twisted steel (HRB335), the hoop reinforcements are twisted steel (HPB235).




轨道车挡装配图 Assemble drawing of buffer stop
1:10
10
11
420
180
撞块 I
撞块 II
≥3000
2500~3000
1000
140
B-B
1:10
≥200
7400
6000
12 13 14
186
15
16
360
750
350
100
40
100
40
1400
箍筋 Stirrup
262
100
682
A-A
1:20
1 2 3 4 5 6 7
I
1~3
E
E
152
20
750
100
压实路基
Compacted bottom
Small gravel layer
粗细砂底层
砼基础
Concrete Foundation


D向 View D
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90
132
2条
8
260
500
186
300
件2 Part2
1:5
其余other
120
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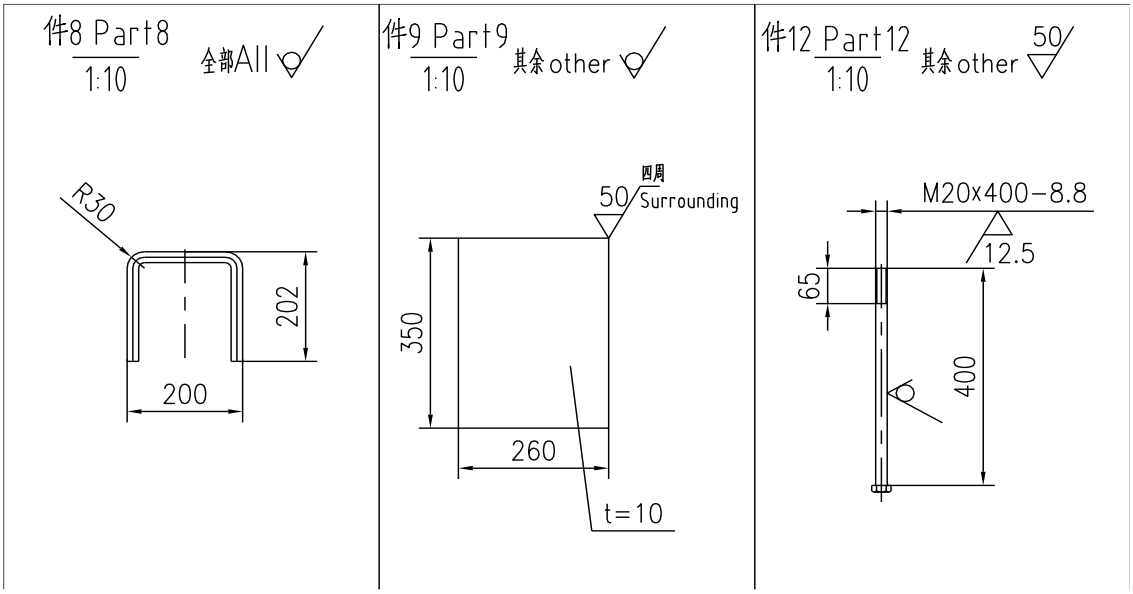
R11
70
62.5
21
13
27
件4 Part4
1:10
其余other
50
2-ø22
340
240
186


件8 Part8
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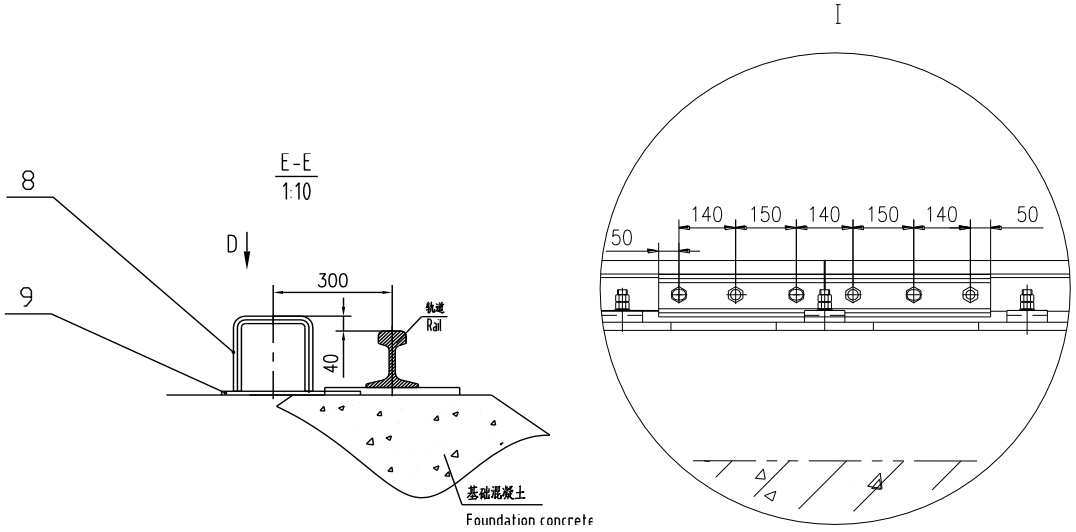
R30
202
200
件9 Part9
1:10
其余other
四周
50
Surrounding
350
260
t=10
件12 Part12
1:10
其余other
50
M20x400-8.8
12.5
65
400


E-E
1:10
8
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轨道
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40
基础混凝土
Foundation concrete
I
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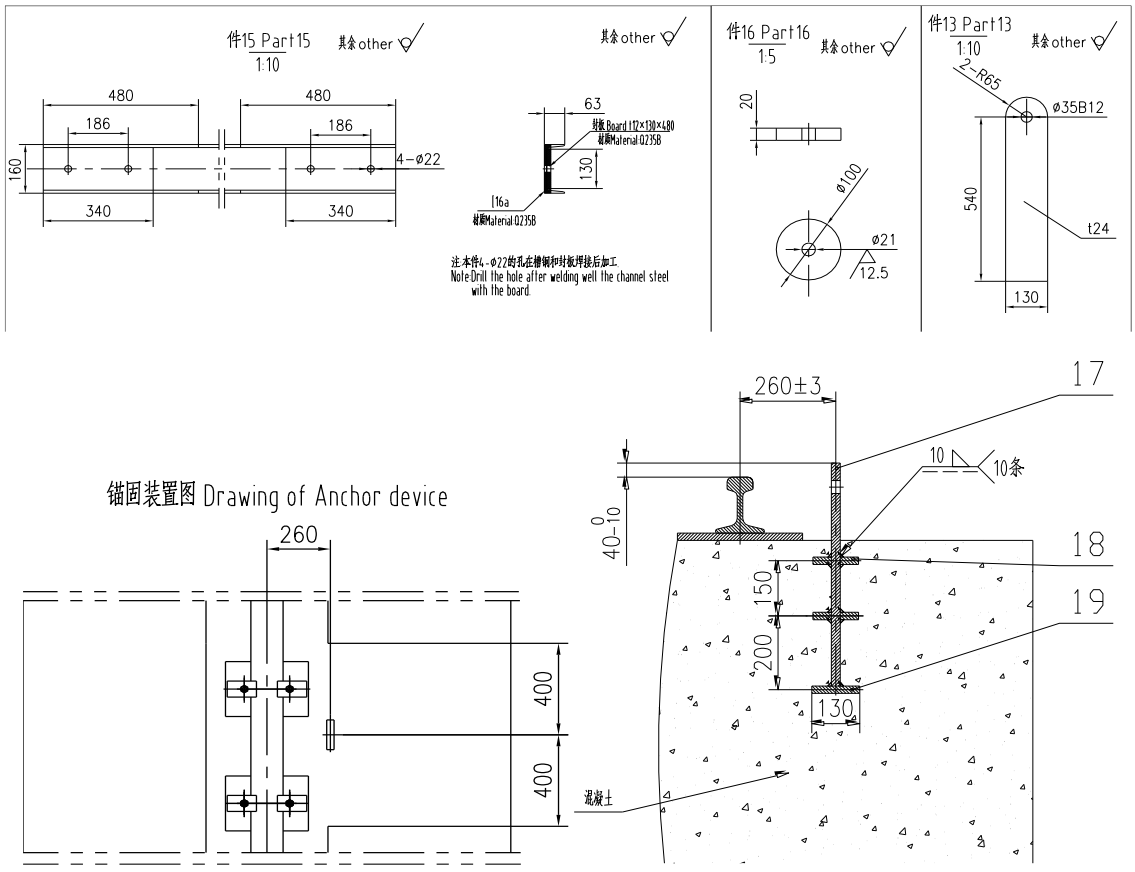
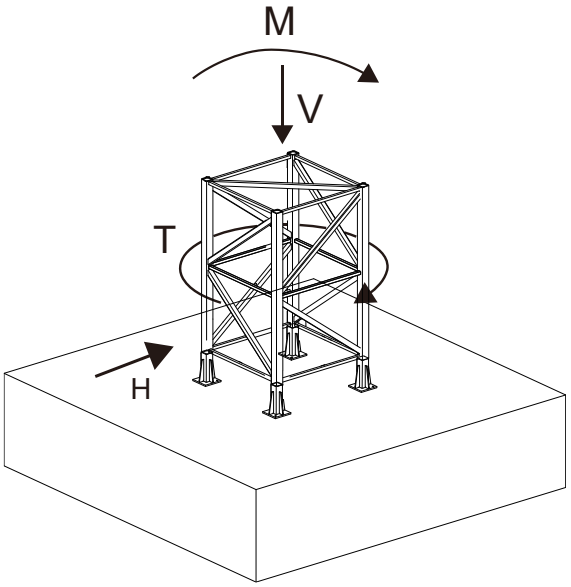


Fig. 3-10 The foundation for travelling chassis tower crane

Table 3-11 Spare part list of travelling chassis tower crane foundation

No.	Description	Specification	Qty	Material
1	Rail	50kg/m	16	U71Mn
2	Press plate		804	Q235B
3	Fishplate		28	B7
4	Base plate	t20-240×340	368	Q235B
5	Bolt	M24×160-8.8	84	
6	Nut	M24-10	168	
7	Washer	24-200HV	168	
8	Bumper	Φ20	4	Q235B
9	Base plate	t10-260×350	4	Q235B
10	Slip bumper		4	Weldment
11	Stop bumper		4	Weldment
12	Embedded bolt	M20-8.8	804	
13	Nut	M20-8	1608	
14	Washer	20-200HV	804	
15	Channel steel	[16a-6340	17	Weldment
16	Plate	t20	804	Q235B
17	Ear plate	t24	4	Q235B
18	Plate A	t20-50×130	16	Q235B
19	Plate B	t20-130×130	4	Q235B

3.9.5 Loads on foundation of outrigger stationary tower crane



T Torque **M** Bending moment **H** Horizontal force **V** Vertical force

- *The description of **Qty. of sections** is: quantities of base tower section L68G23-C/L68G23 + tower section L68A1A/L68A4.*
- *The maximum loads appear at the maximum free-standing height in service state. The tower crane with attachment, the moment, horizontal force, torque mainly transmitted to the building by the attachment frame, the load on the foundation no additional.*

3.9.5.1 Loads on foundation for 70m jib

Table 3-12 Loads on foundation for 70m jib

Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2285.0	22.8	782.8	758.2
		Out of service	-1123.7	89.7	624.5	0.0
1+6	27.0 m	In service	2374.7	24.3	798.5	758.2
		Out of service	-1130.4	96.3	640.2	0.0
1+7	30.0 m	In service	2474.3	25.7	814.2	758.2
		Out of service	-1138.1	102.8	655.9	0.0
1+8	33.0 m	In service	2582.9	27.2	829.9	758.2
		Out of service	1282.8	109.3	671.6	0.0
1+9	36.0 m	In service	2701.1	28.7	845.6	758.2
		Out of service	1634.1	115.8	687.2	0.0
1+10	39.0 m	In service	2829.5	30.2	861.2	758.2
		Out of service	2010.6	122.3	702.9	0.0
1+11	42.0 m	In service	2968.8	31.7	876.9	758.2
		Out of service	2413.4	128.9	718.6	0.0
1+12	45.0 m	In service	3119.9	33.1	892.6	758.2
		Out of service	2844.1	135.4	734.3	0.0
1+13	48.0 m	In service	3283.9	34.6	908.3	758.2
		Out of service	3304.3	141.9	750.0	0.0
1+14	51.0 m	In service	3461.7	36.1	924.0	758.2
		Out of service	3796.0	148.4	765.6	0.0
1+15	54.0 m	In service	3654.9	37.6	939.6	758.2
		Out of service	4321.2	154.9	781.3	0.0
1+16	57.0 m	In service	3865.0	39.1	955.3	758.2
		Out of service	4882.7	161.5	797.0	0.0
1+17	60.0 m	In service	4093.9	40.6	971.0	758.2
		Out of service	5483.3	168.0	812.7	0.0

3.9.5.2 Loads on foundation for 65m jib

Table 3-13 Loads on foundation for 65m jib

Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2515.4	22.9	765.4	693.5
		Out of service	-1117.1	89.7	608.7	0.0
1+6	27.0 m	In service	2606.8	24.4	781.1	693.5
		Out of service	-1123.6	96.3	624.3	0.0
1+7	30.0 m	In service	2708.5	25.9	796.7	693.5
		Out of service	-1131.1	102.8	640.0	0.0
1+8	33.0 m	In service	2819.4	27.3	812.4	693.5
		Out of service	1288.4	109.3	655.7	0.0
1+9	36.0 m	In service	2940.2	28.8	828.1	693.5
		Out of service	1639.4	115.8	671.4	0.0
1+10	39.0 m	In service	3071.3	30.3	843.8	693.5
		Out of service	2015.4	122.3	687.1	0.0
1+11	42.0 m	In service	3213.7	31.8	859.5	693.5
		Out of service	2417.6	128.9	702.7	0.0
1+12	45.0 m	In service	3368.2	33.3	875.1	693.5
		Out of service	2847.3	135.4	718.4	0.0
1+13	48.0 m	In service	3535.7	34.7	890.8	693.5
		Out of service	3306.3	141.9	734.1	0.0
1+14	51.0 m	In service	3717.5	36.2	906.5	693.5
		Out of service	3796.4	148.4	749.8	0.0
1+15	54.0 m	In service	3914.9	37.7	922.2	693.5
		Out of service	4319.6	154.9	765.5	0.0
1+16	57.0 m	In service	4129.5	39.2	937.9	693.5
		Out of service	4878.5	161.5	781.1	0.0
1+17	60.0 m	In service	4363.2	40.7	953.5	693.5
		Out of service	5475.9	168.0	796.8	0.0

3.9.5.3 Loads on foundation for 60m jib

Table 3-14 Loads on foundation for 60m jib

Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2562.1	22.9	763.4	582.0
		Out of service	-1239.4	89.7	606.9	0.0
1+6	27.0 m	In service	2653.9	24.4	779.1	582.0
		Out of service	-1246.5	96.3	622.6	0.0
1+7	30.0 m	In service	2756.0	25.9	794.8	582.0
		Out of service	-1254.8	102.8	638.2	0.0
1+8	33.0 m	In service	2867.5	27.4	810.5	582.0
		Out of service	-1264.2	109.3	653.9	0.0
1+9	36.0 m	In service	2988.8	28.8	826.2	582.0
		Out of service	1512.6	115.8	669.6	0.0
1+10	39.0 m	In service	3120.6	30.3	841.8	582.0
		Out of service	1887.1	122.3	685.3	0.0
1+11	42.0 m	In service	3263.7	31.8	857.5	582.0
		Out of service	2287.6	128.9	701.0	0.0
1+12	45.0 m	In service	3418.9	33.3	873.2	582.0
		Out of service	2715.5	135.4	716.6	0.0
1+13	48.0 m	In service	3587.3	34.8	888.9	582.0
		Out of service	3172.4	141.9	732.3	0.0
1+14	51.0 m	In service	3770.0	36.2	904.6	582.0
		Out of service	3660.0	148.4	748.0	0.0
1+15	54.0 m	In service	3968.4	37.7	920.2	582.0
		Out of service	4180.6	154.9	763.7	0.0
1+16	57.0 m	In service	4184.1	39.2	935.9	582.0
		Out of service	4736.5	161.5	779.4	0.0
1+17	60.0 m	In service	4419.0	40.7	951.6	582.0
		Out of service	5330.6	168.0	795.0	0.0

3.9.5.4 Loads on foundation for 55m jib

Table 3-15 Loads on foundation for 55m jib

Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2527.0	22.9	760.0	526.2
		Out of service	-1431.1	89.7	603.8	0.0
1+6	27.0 m	In service	2618.3	24.4	775.7	526.2
		Out of service	-1439.3	96.3	619.4	0.0
1+7	30.0 m	In service	2719.9	25.8	791.3	526.2
		Out of service	-1448.8	102.8	635.1	0.0
1+8	33.0 m	In service	2830.7	27.3	807.0	526.2
		Out of service	-1459.6	109.3	650.8	0.0
1+9	36.0 m	In service	2951.2	28.8	822.7	526.2
		Out of service	-1471.9	115.8	666.5	0.0
1+10	39.0 m	In service	3082.2	30.3	838.4	526.2
		Out of service	1686.0	122.3	682.2	0.0
1+11	42.0 m	In service	3224.4	31.8	854.1	526.2
		Out of service	2083.9	128.9	697.8	0.0
1+12	45.0 m	In service	3378.6	33.3	869.7	526.2
		Out of service	2508.8	135.4	713.5	0.0
1+13	48.0 m	In service	3545.8	34.7	885.4	526.2
		Out of service	2962.4	141.9	729.2	0.0
1+14	51.0 m	In service	3727.1	36.2	901.1	526.2
		Out of service	3446.3	148.4	744.9	0.0
1+15	54.0 m	In service	3924.0	37.7	916.8	526.2
		Out of service	3962.7	154.9	760.6	0.0
1+16	57.0 m	In service	4138.0	39.2	932.5	526.2
		Out of service	4513.8	161.5	776.2	0.0
1+17	60.0 m	In service	4371.0	40.7	948.1	526.2
		Out of service	5102.6	168.0	791.9	0.0

3.9.5.5 Loads on foundation for 50m jib

Table 3-16 Loads on foundation for 50m jib

Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2572.6	22.9	741.4	457.9
		Out of service	-1503.3	89.7	586.8	0.0
1+6	27.0 m	In service	2663.8	24.4	757.0	457.9
		Out of service	-1511.6	96.3	602.5	0.0
1+7	30.0 m	In service	2765.2	25.9	772.7	457.9
		Out of service	-1521.3	102.8	618.2	0.0
1+8	33.0 m	In service	2875.7	27.4	788.4	457.9
		Out of service	-1532.3	109.3	633.9	0.0
1+9	36.0 m	In service	2996.0	28.8	804.1	457.9
		Out of service	-1544.8	115.8	649.5	0.0
1+10	39.0 m	In service	3126.5	30.3	819.8	457.9
		Out of service	1608.9	122.3	665.2	0.0
1+11	42.0 m	In service	3268.1	31.8	835.4	457.9
		Out of service	2005.2	128.9	680.9	0.0
1+12	45.0 m	In service	3421.6	33.3	851.1	457.9
		Out of service	2428.1	135.4	696.6	0.0
1+13	48.0 m	In service	3587.9	34.8	866.8	457.9
		Out of service	2879.3	141.9	712.3	0.0
1+14	51.0 m	In service	3768.2	36.2	882.5	457.9
		Out of service	3360.4	148.4	727.9	0.0
1+15	54.0 m	In service	3963.7	37.7	898.2	457.9
		Out of service	3873.3	154.9	743.6	0.0
1+16	57.0 m	In service	4176.0	39.2	913.8	457.9
		Out of service	4420.3	161.5	759.3	0.0
1+17	60.0 m	In service	4406.8	40.7	929.5	457.9
		Out of service	5004.1	168.0	775.0	0.0

3.9.5.6 Loads on foundation for 45m jib

Table 3-17 Loads on foundation for 45m jib

Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2594.5	22.9	732.9	400.7
		Out of service	-1571.2	89.7	579.2	0.0
1+6	27.0 m	In service	2685.7	24.4	748.6	400.7
		Out of service	-1579.8	96.3	594.9	0.0
1+7	30.0 m	In service	2786.9	25.9	764.3	400.7
		Out of service	-1589.7	102.8	610.5	0.0
1+8	33.0 m	In service	2897.4	27.4	780.0	400.7
		Out of service	-1601.1	109.3	626.2	0.0
1+9	36.0 m	In service	3017.4	28.8	795.7	400.7
		Out of service	-1613.9	115.8	641.9	0.0
1+10	39.0 m	In service	3147.8	30.3	811.3	400.7
		Out of service	-1628.4	122.3	657.6	0.0
1+11	42.0 m	In service	3289.1	31.8	827.0	400.7
		Out of service	1932.3	128.9	673.3	0.0
1+12	45.0 m	In service	3442.3	33.3	842.7	400.7
		Out of service	2354.0	135.4	688.9	0.0
1+13	48.0 m	In service	3608.2	34.8	858.4	400.7
		Out of service	2803.5	141.9	704.6	0.0
1+14	51.0 m	In service	3788.0	36.3	874.1	400.7
		Out of service	3282.7	148.4	720.3	0.0
1+15	54.0 m	In service	3982.9	37.7	889.7	400.7
		Out of service	3793.5	154.9	736.0	0.0
1+16	57.0 m	In service	4194.4	39.2	905.4	400.7
		Out of service	4338.0	161.5	751.7	0.0
1+17	60.0 m	In service	4424.3	40.7	921.1	400.7
		Out of service	4918.8	168.0	767.3	0.0

3.9.5.7 Loads on foundation for 40m jib

Table 3-18 Loads on foundation for 40m jib

Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2621.2	23.0	705.7	328.2
		Out of service	-1467.4	89.7	554.4	0.0
1+6	27.0 m	In service	2711.9	24.4	721.4	328.2
		Out of service	-1475.0	96.3	570.1	0.0
1+7	30.0 m	In service	2812.4	25.9	737.1	328.2
		Out of service	-1483.9	102.8	585.8	0.0
1+8	33.0 m	In service	2922.0	27.4	752.7	328.2
		Out of service	-1493.9	109.3	601.4	0.0
1+9	36.0 m	In service	3041.0	28.9	768.4	328.2
		Out of service	-1505.4	115.8	617.1	0.0
1+10	39.0 m	In service	3170.0	30.4	784.1	328.2
		Out of service	1643.2	122.3	632.8	0.0
1+11	42.0 m	In service	3309.8	31.8	799.8	328.2
		Out of service	2038.7	128.9	648.5	0.0
1+12	45.0 m	In service	3461.1	33.3	815.5	328.2
		Out of service	2460.4	135.4	664.2	0.0
1+13	48.0 m	In service	3624.8	34.8	831.1	328.2
		Out of service	2909.8	141.9	679.8	0.0
1+14	51.0 m	In service	3802.0	36.3	846.8	328.2
		Out of service	3388.5	148.4	695.5	0.0
1+15	54.0 m	In service	3993.8	37.8	862.5	328.2
		Out of service	3898.2	154.9	711.2	0.0
1+16	57.0 m	In service	4201.7	39.3	878.2	328.2
		Out of service	4441.2	161.5	726.9	0.0
1+17	60.0 m	In service	4427.2	40.7	893.9	328.2
		Out of service	5019.8	168.0	742.6	0.0

3.9.5.8 Loads on foundation for 35m jib

Table 3-19 Loads on foundation for 35m jib

Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2524.3	22.9	677.3	252.3
		Out of service	-1469.8	89.7	528.6	0.0
1+6	27.0 m	In service	2613.3	24.4	693.0	252.3
		Out of service	-1477.1	96.3	544.2	0.0
1+7	30.0 m	In service	2711.8	25.9	708.6	252.3
		Out of service	-1485.5	102.8	559.9	0.0
1+8	33.0 m	In service	2818.9	27.4	724.3	252.3
		Out of service	-1495.0	109.3	575.6	0.0
1+9	36.0 m	In service	2935.1	28.9	740.0	252.3
		Out of service	-1505.9	115.8	591.3	0.0
1+10	39.0 m	In service	3061.0	30.3	755.7	252.3
		Out of service	1638.2	122.3	607.0	0.0
1+11	42.0 m	In service	3197.1	31.8	771.4	252.3
		Out of service	2032.6	128.9	622.6	0.0
1+12	45.0 m	In service	3344.2	33.3	787.0	252.3
		Out of service	2452.9	135.4	638.3	0.0
1+13	48.0 m	In service	3503.1	34.8	802.7	252.3
		Out of service	2900.4	141.9	654.0	0.0
1+14	51.0 m	In service	3674.8	36.3	818.4	252.3
		Out of service	3376.7	148.4	669.7	0.0
1+15	54.0 m	In service	3860.3	37.7	834.1	252.3
		Out of service	3883.4	154.9	685.4	0.0
1+16	57.0 m	In service	4060.9	39.2	849.8	252.3
		Out of service	4422.6	161.5	701.0	0.0
1+17	60.0 m	In service	4278.2	40.7	865.4	252.3
		Out of service	4996.4	168.0	716.7	0.0

3.9.5.9 Loads on foundation for 30m jib

Table 3-20 Loads on foundation for 30m jib

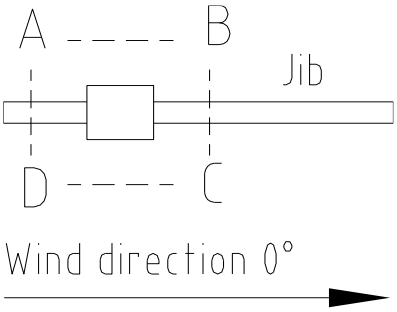
Qty. of sections	Working height	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	24.0 m	In service	2439.3	22.9	658.7	214.0
		Out of service	-1457.4	89.7	511.6	0.0
1+6	27.0 m	In service	2527.1	24.4	674.3	214.0
		Out of service	-1464.4	96.3	527.3	0.0
1+7	30.0 m	In service	2624.1	25.9	690.0	214.0
		Out of service	-1472.4	102.8	543.0	0.0
1+8	33.0 m	In service	2729.4	27.3	705.7	214.0
		Out of service	-1481.5	109.3	558.7	0.0
1+9	36.0 m	In service	2843.6	28.8	721.4	214.0
		Out of service	-1491.9	115.8	574.4	0.0
1+10	39.0 m	In service	2967.1	30.3	737.1	214.0
		Out of service	1649.4	122.3	590.0	0.0
1+11	42.0 m	In service	3100.6	31.8	752.7	214.0
		Out of service	2043.3	128.9	605.7	0.0
1+12	45.0 m	In service	3244.7	33.3	768.4	214.0
		Out of service	2462.9	135.4	621.4	0.0
1+13	48.0 m	In service	3400.1	34.8	784.1	214.0
		Out of service	2909.4	141.9	637.1	0.0
1+14	51.0 m	In service	3567.9	36.2	799.8	214.0
		Out of service	3384.3	148.4	652.8	0.0
1+15	54.0 m	In service	3748.9	37.7	815.5	214.0
		Out of service	3889.3	154.9	668.4	0.0
1+16	57.0 m	In service	3944.5	39.2	831.1	214.0
		Out of service	4426.2	161.5	684.1	0.0
1+17	60.0 m	In service	4155.9	40.7	846.8	214.0
		Out of service	4997.2	168.0	699.8	0.0

3.10 Corner reactions on chassis of the stationary chassis tower crane (60.5m / 61.5m)

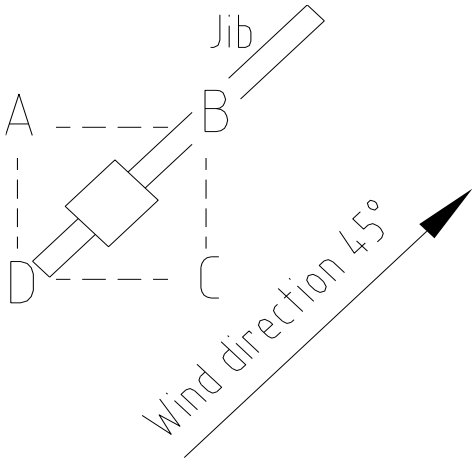
3.10.1 Description

There are two typical wind states when using the chassis tower crane as figures below. The reactions on chassis outriggers RA, RB, RC, RD are shown in the following tables.

Wind 0° to the chassis



Wind 45° to the chassis



RA Reaction on corner **A** of the chassis

RB Reaction on corner **B** of the chassis

RC Reaction on corner **C** of the chassis

RD Reaction on corner **D** of the chassis

- *In the following tables, negative numbers indicate tension and positive numbers indicate pressure.*
- *Since tower crane can rotate in 360°, every support point has the possibility to endure any load in the table above.*
- *The description of **Qty. of sections** is: quantities of tower section L68B7A-C/L68B7A + tower section L68A1A/L68A4.*

3.10.2 Corner reactions on chassis

3.10.2.1 Corner reactions for 70m jib

Table 3-21 Corner reactions for 70m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m	In service	156.0	520.7	520.7	156.0	338.3	598.1	338.3	78.5
	/25.5 m	Out of service	391.3	206.2	206.2	391.3	298.7	167.8	298.7	429.7
1+6	27.5 m	In service	153.7	530.8	530.8	153.7	342.2	611.4	342.2	73.1
	/28.5 m	Out of service	395.6	209.7	209.7	395.6	302.7	171.2	302.7	434.1
1+7	30.5 m	In service	150.8	541.5	541.5	150.8	346.2	625.7	346.2	66.6
	/31.5 m	Out of service	400.0	213.2	213.2	400.0	306.6	174.5	306.6	438.6
1+8	33.5 m	In service	147.3	552.9	552.9	147.3	350.1	641.0	350.1	59.2
	/34.5 m	Out of service	404.4	216.6	216.6	404.4	310.5	177.7	310.5	443.3
1+9	36.5 m	In service	165.2	586.9	586.9	165.2	376.1	679.3	376.1	72.8
	/37.5 m	Out of service	430.9	242.0	242.0	430.9	336.5	202.9	336.5	470.1
1+10	39.5 m	In service	160.4	599.6	599.6	160.4	380.0	696.6	380.0	63.4
	/40.5 m	Out of service	435.5	245.2	245.2	435.5	340.4	205.8	340.4	475.0
1+11	42.5 m	In service	176.9	634.9	634.9	176.9	405.9	737.0	405.9	74.9
	/43.5 m	Out of service	215.5	517.2	517.2	215.5	366.4	611.2	366.4	121.6
1+12	45.5 m	In service	170.7	649.0	649.0	170.7	409.9	756.5	409.9	63.2
	/46.5 m	Out of service	190.0	550.6	550.6	190.0	370.3	662.2	370.3	78.3
1+13	48.5 m	In service	185.7	685.9	685.9	185.7	435.8	799.4	435.8	72.3
	/49.5 m	Out of service	184.6	607.9	607.9	184.6	396.3	738.4	396.3	54.1
1+14	51.5 m	In service	199.9	723.7	723.7	199.9	461.8	843.5	461.8	80.1
	/52.5 m	Out of service	177.3	667.2	667.2	177.3	422.2	817.8	422.2	26.6
1+15	54.5 m	In service	235.2	784.5	784.5	235.2	509.8	911.1	509.8	108.5
	/55.5 m	Out of service	189.9	750.6	750.6	189.9	470.2	922.7	470.2	17.8
1+16	57.5 m	In service	225.4	802.1	802.1	225.4	513.7	936.2	513.7	91.3
	/58.5 m	Out of service	156.3	792.0	792.0	156.3	474.2	987.1	474.2	-38.8
1+17	60.5 m	In service	214.5	820.8	820.8	214.5	517.7	962.9	517.7	72.4
	/61.5 m	Out of service	120.4	835.8	835.8	120.4	478.1	1055.4	478.1	-99.2

3.10.2.2 Corner reactions for 65m jib

Table 3-22 Corner reactions for 65m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m /25.5 m	In service	132.6	535.3	535.3	132.6	334.0	620.6	334.0	47.3
		Out of service	386.8	202.7	202.7	386.8	294.8	164.6	294.8	425.0
1+6	27.5 m /28.5 m	In service	130.2	545.5	545.5	130.2	337.9	634.0	337.9	41.7
		Out of service	391.1	206.3	206.3	391.1	298.7	168.0	298.7	429.4
1+7	30.5 m /31.5 m	In service	127.2	556.4	556.4	127.2	341.8	648.5	341.8	35.0
		Out of service	395.4	209.8	209.8	395.4	302.6	171.3	302.6	433.9
1+8	33.5 m /34.5 m	In service	123.5	567.9	567.9	123.5	345.7	664.0	345.7	27.4
		Out of service	399.9	213.2	213.2	399.9	306.5	174.6	306.5	438.5
1+9	36.5 m /37.5 m	In service	141.3	602.1	602.1	141.3	371.7	702.6	371.7	40.8
		Out of service	426.4	238.6	238.6	426.4	332.5	199.7	332.5	465.3
1+10	39.5 m /40.5 m	In service	136.3	614.9	614.9	136.3	375.6	720.1	375.6	31.1
		Out of service	431.0	241.9	241.9	431.0	336.4	537.7	336.4	135.1
1+11	42.5 m /43.5 m	In service	152.6	650.5	650.5	152.6	401.6	760.8	401.6	42.3
		Out of service	211.1	513.7	513.7	211.1	362.4	607.8	362.4	117.0
1+12	45.5 m /46.5 m	In service	146.2	664.8	664.8	146.2	405.5	780.7	405.5	30.3
		Out of service	185.6	547.1	547.1	185.6	366.3	658.8	366.3	73.8
1+13	48.5 m /49.5 m	In service	160.9	702.0	702.0	160.9	431.5	823.9	431.5	39.1
		Out of service	180.2	604.4	604.4	180.2	392.3	735.0	392.3	49.6
1+14	51.5 m /52.5 m	In service	174.8	740.1	740.1	174.8	457.4	868.4	457.4	46.5
		Out of service	173.0	663.6	663.6	173.0	418.3	814.3	418.3	22.2
1+15	54.5 m /55.5 m	In service	209.8	801.1	801.1	209.8	505.5	936.5	505.5	74.5
		Out of service	185.7	746.8	746.8	185.7	466.3	919.0	466.3	13.5
1+16	57.5 m /58.5 m	In service	199.7	819.1	819.1	199.7	509.4	962.0	509.4	56.8
		Out of service	152.2	788.2	788.2	152.2	470.2	983.3	470.2	-42.9
1+17	60.5 m /61.5 m	In service	188.5	838.1	838.1	188.5	513.3	989.2	513.3	37.4
		Out of service	116.4	831.8	831.8	116.4	474.1	1051.3	474.1	-103.1

3.10.2.3 Corner reactions for 60m jib

Table 3-23 Corner reactions for 60m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m /25.5 m	In service	128.3	538.6	538.6	128.3	333.5	625.5	333.5	41.4
		Out of service	396.5	192.2	192.2	396.5	294.3	149.9	294.3	438.8
1+6	27.5 m /28.5 m	In service	125.9	548.9	548.9	125.9	337.4	639.0	337.4	35.8
		Out of service	400.8	195.7	195.7	400.8	298.3	153.3	298.3	443.2
1+7	30.5 m /31.5 m	In service	122.8	559.8	559.8	122.8	341.3	653.6	341.3	29.1
		Out of service	405.2	199.2	199.2	405.2	302.2	156.5	302.2	447.8
1+8	33.5 m /34.5 m	In service	119.1	571.3	571.3	119.1	345.2	669.1	345.2	21.4
		Out of service	409.6	202.6	202.6	409.6	306.1	159.7	306.1	452.5
1+9	36.5 m /37.5 m	In service	136.8	605.6	605.6	136.8	371.2	707.7	371.2	34.7
		Out of service	436.2	227.9	227.9	436.2	332.1	184.8	332.1	479.4
1+10	39.5 m /40.5 m	In service	131.8	618.4	618.4	131.8	375.1	725.3	375.1	25.0
		Out of service	440.9	231.1	231.1	440.9	336.0	187.6	336.0	484.3
1+11	42.5 m /43.5 m	In service	148.1	654.1	654.1	148.1	401.1	766.1	401.1	36.1
		Out of service	467.7	256.2	256.2	467.7	362.0	592.5	362.0	131.4
1+12	45.5 m /46.5 m	In service	141.6	668.4	668.4	141.6	405.0	786.0	405.0	24.0
		Out of service	195.8	536.0	536.0	195.8	365.9	643.3	365.9	88.4
1+13	48.5 m /49.5 m	In service	156.3	705.7	705.7	156.3	431.0	829.3	431.0	32.7
		Out of service	190.6	593.1	593.1	190.6	391.8	719.2	391.8	64.5
1+14	51.5 m /52.5 m	In service	170.1	743.8	743.8	170.1	457.0	873.9	457.0	40.0
		Out of service	183.5	652.2	652.2	183.5	417.8	798.3	417.8	37.3
1+15	54.5 m /55.5 m	In service	205.0	804.9	804.9	205.0	505.0	942.0	505.0	67.9
		Out of service	196.4	735.3	735.3	196.4	465.8	902.9	465.8	28.8
1+16	57.5 m /58.5 m	In service	194.9	822.9	822.9	194.9	508.9	967.6	508.9	50.1
		Out of service	163.1	776.4	776.4	163.1	469.8	966.8	469.8	-27.3
1+17	60.5 m /61.5 m	In service	183.6	842.1	842.1	183.6	512.8	994.9	512.8	30.7
		Out of service	127.5	819.8	819.8	127.5	473.7	1034.6	473.7	-87.2

3.10.2.4 Corner reactions for 55m jib

Table 3-24 Corner reactions for 55m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m /25.5 m	In service	130.3	534.9	534.9	130.3	332.6	620.6	332.6	44.6
		Out of service	411.5	175.6	175.6	411.5	293.6	126.7	293.6	460.4
1+6	27.5 m /28.5 m	In service	127.9	545.1	545.1	127.9	336.5	634.1	336.5	39.0
		Out of service	415.9	179.1	179.1	415.9	297.5	130.0	297.5	464.9
1+7	30.5 m /31.5 m	In service	124.9	556.0	556.0	124.9	340.4	648.6	340.4	32.3
		Out of service	420.3	182.5	182.5	420.3	301.4	133.2	301.4	469.6
1+8	33.5 m /34.5 m	In service	121.2	567.5	567.5	121.2	344.4	664.0	344.4	24.7
		Out of service	424.9	185.8	185.8	424.9	305.3	136.2	305.3	474.4
1+9	36.5 m /37.5 m	In service	139.0	601.7	601.7	139.0	370.3	702.5	370.3	38.1
		Out of service	451.6	211.0	211.0	451.6	331.3	161.2	331.3	501.4
1+10	39.5 m /40.5 m	In service	134.0	614.5	614.5	134.0	374.3	720.1	374.3	28.4
		Out of service	456.3	214.1	214.1	456.3	335.2	163.9	335.2	506.5
1+11	42.5 m /43.5 m	In service	150.4	650.1	650.1	150.4	400.2	760.8	400.2	39.7
		Out of service	483.2	239.1	239.1	483.2	361.2	188.6	361.2	533.8
1+12	45.5 m /46.5 m	In service	143.9	664.4	664.4	143.9	404.1	780.6	404.1	27.7
		Out of service	488.2	242.0	242.0	488.2	365.1	618.9	365.1	111.3
1+13	48.5 m /49.5 m	In service	158.7	701.6	701.6	158.7	430.1	823.8	430.1	36.5
		Out of service	206.7	575.4	575.4	206.7	391.1	694.5	391.1	87.6
1+14	51.5 m /52.5 m	In service	172.6	739.6	739.6	172.6	456.1	868.3	456.1	43.9
		Out of service	199.9	634.2	634.2	199.9	417.0	773.3	417.0	60.8
1+15	54.5 m /55.5 m	In service	207.6	800.6	800.6	207.6	504.1	936.3	504.1	71.9
		Out of service	213.1	717.0	717.0	213.1	465.1	877.4	465.1	52.7
1+16	57.5 m /58.5 m	In service	197.5	818.5	818.5	197.5	508.0	961.8	508.0	54.3
		Out of service	180.0	757.9	757.9	180.0	469.0	940.9	469.0	-3.0
1+17	60.5 m /61.5 m	In service	186.4	837.5	837.5	186.4	511.9	988.9	511.9	35.0
		Out of service	144.8	801.0	801.0	144.8	472.9	1008.2	472.9	-62.5

3.10.2.5 Corner reactions for 50m jib

Table 3-25 Corner reactions for 50m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m /25.5 m	In service	121.8	534.1	534.1	121.8	328.0	621.4	328.0	34.6
		Out of service	413.3	165.4	165.4	413.3	289.3	114.0	289.3	464.6
1+6	27.5 m /28.5 m	In service	119.5	544.3	544.3	119.5	331.9	634.8	331.9	28.9
		Out of service	417.6	168.9	168.9	417.6	293.2	117.3	293.2	469.2
1+7	30.5 m /31.5 m	In service	116.4	555.2	555.2	116.4	335.8	649.3	335.8	22.3
		Out of service	422.1	172.2	172.2	422.1	297.2	120.5	297.2	473.8
1+8	33.5 m /34.5 m	In service	112.8	566.6	566.6	112.8	339.7	664.7	339.7	14.7
		Out of service	426.6	175.5	175.5	426.6	301.1	123.5	301.1	478.7
1+9	36.5 m /37.5 m	In service	130.5	600.8	600.8	130.5	365.7	703.3	365.7	28.1
		Out of service	453.4	200.7	200.7	453.4	327.1	148.4	327.1	505.7
1+10	39.5 m /40.5 m	In service	125.6	613.6	613.6	125.6	369.6	720.8	369.6	18.5
		Out of service	458.1	203.8	203.8	458.1	331.0	151.1	331.0	510.8
1+11	42.5 m /43.5 m	In service	142.0	649.2	649.2	142.0	395.6	761.4	395.6	29.7
		Out of service	485.1	228.8	228.8	485.1	356.9	175.8	356.9	538.1
1+12	45.5 m /46.5 m	In service	135.5	663.5	663.5	135.5	399.5	781.2	399.5	17.8
		Out of service	490.1	231.7	231.7	490.1	360.9	178.1	360.9	543.6
1+13	48.5 m /49.5 m	In service	150.4	700.6	700.6	150.4	425.5	824.3	425.5	26.6
		Out of service	209.0	564.6	564.6	209.0	386.8	681.0	386.8	92.7
1+14	51.5 m /52.5 m	In service	164.3	738.6	738.6	164.3	451.4	868.8	451.4	34.1
		Out of service	202.3	623.3	623.3	202.3	412.8	759.6	412.8	66.0
1+15	54.5 m /55.5 m	In service	199.4	799.5	799.5	199.4	499.5	936.7	499.5	62.2
		Out of service	215.7	706.0	706.0	215.7	460.8	863.4	460.8	58.2
1+16	57.5 m /58.5 m	In service	189.4	817.4	817.4	189.4	503.4	962.0	503.4	44.7
		Out of service	182.9	746.6	746.6	182.9	464.7	926.7	464.7	2.8
1+17	60.5 m /61.5 m	In service	178.3	836.3	836.3	178.3	507.3	989.0	507.3	25.6
		Out of service	147.9	789.5	789.5	147.9	468.7	993.6	468.7	-56.3

3.10.2.6 Corner reactions for 45m jib

Table 3-26 Corner reactions for 45m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m /25.5 m	In service	117.9	533.8	533.8	117.9	325.9	621.8	325.9	29.9
		Out of service	417.0	157.8	157.8	417.0	287.4	104.2	287.4	470.6
1+6	27.5 m /28.5 m	In service	115.5	544.0	544.0	115.5	329.8	635.3	329.8	24.2
		Out of service	421.4	161.3	161.3	421.4	291.3	107.4	291.3	475.2
1+7	30.5 m /31.5 m	In service	112.5	554.9	554.9	112.5	333.7	649.8	333.7	17.6
		Out of service	425.8	164.7	164.7	425.8	295.2	110.6	295.2	479.9
1+8	33.5 m /34.5 m	In service	108.9	566.4	566.4	108.9	337.6	665.2	337.6	10.0
		Out of service	430.4	167.9	167.9	430.4	299.2	113.6	299.2	484.8
1+9	36.5 m /37.5 m	In service	126.6	600.5	600.5	126.6	363.6	703.7	363.6	23.4
		Out of service	457.1	193.1	193.1	457.1	325.1	138.5	325.1	511.8
1+10	39.5 m /40.5 m	In service	121.7	613.3	613.3	121.7	367.5	721.2	367.5	13.8
		Out of service	461.9	196.2	196.2	461.9	329.1	141.2	329.1	517.0
1+11	42.5 m /43.5 m	In service	138.1	648.9	648.9	138.1	393.5	761.9	393.5	25.1
		Out of service	488.9	221.2	221.2	488.9	355.0	165.7	355.0	544.3
1+12	45.5 m /46.5 m	In service	131.6	663.1	663.1	131.6	397.4	781.6	397.4	13.1
		Out of service	493.9	224.0	224.0	493.9	358.9	168.1	358.9	549.8
1+13	48.5 m /49.5 m	In service	146.5	700.2	700.2	146.5	423.4	824.7	423.4	22.0
		Out of service	521.1	248.7	248.7	521.1	384.9	670.5	384.9	99.3
1+14	51.5 m /52.5 m	In service	160.5	738.2	738.2	160.5	449.3	869.1	449.3	29.6
		Out of service	206.5	615.3	615.3	206.5	410.9	748.9	410.9	72.8
1+15	54.5 m /55.5 m	In service	195.6	799.1	799.1	195.6	497.4	937.0	497.4	57.7
		Out of service	220.0	697.8	697.8	220.0	458.9	852.6	458.9	65.2
1+16	57.5 m /58.5 m	In service	185.6	816.9	816.9	185.6	501.3	962.3	501.3	40.3
		Out of service	187.3	738.3	738.3	187.3	462.8	915.7	462.8	10.0
1+17	60.5 m /61.5 m	In service	174.6	835.8	835.8	174.6	505.2	989.2	505.2	21.2
		Out of service	152.5	781.0	781.0	152.5	466.7	982.3	466.7	-48.8

3.10.2.7 Corner reactions for 40m jib

Table 3-27 Corner reactions for 40m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m /25.5 m	In service	108.8	529.3	529.3	108.8	319.0	618.3	319.0	19.8
		Out of service	402.3	160.2	160.2	402.3	281.2	110.0	281.2	452.4
1+6	27.5 m /28.5 m	In service	106.4	539.5	539.5	106.4	323.0	631.7	323.0	14.2
		Out of service	406.6	163.7	163.7	406.6	285.1	113.3	285.1	456.9
1+7	30.5 m /31.5 m	In service	103.4	550.3	550.3	103.4	326.9	646.1	326.9	7.6
		Out of service	411.0	167.1	167.1	411.0	289.1	116.6	289.1	461.5
1+8	33.5 m /34.5 m	In service	99.8	561.8	561.8	99.8	330.8	661.5	330.8	0.1
		Out of service	415.5	170.4	170.4	415.5	293.0	119.7	293.0	466.3
1+9	36.5 m /37.5 m	In service	117.7	595.9	595.9	117.7	356.8	699.9	356.8	13.6
		Out of service	442.2	195.7	195.7	442.2	318.9	144.7	318.9	493.2
1+10	39.5 m /40.5 m	In service	112.8	608.6	608.6	112.8	360.7	717.3	360.7	4.0
		Out of service	446.9	198.9	198.9	446.9	322.9	147.5	322.9	498.2
1+11	42.5 m /43.5 m	In service	129.3	644.1	644.1	129.3	386.7	757.9	386.7	15.5
		Out of service	473.7	224.0	224.0	473.7	348.8	172.2	348.8	525.5
1+12	45.5 m /46.5 m	In service	122.9	658.2	658.2	122.9	390.6	777.5	390.6	3.7
		Out of service	478.6	226.9	226.9	478.6	352.8	174.7	352.8	530.8
1+13	48.5 m /49.5 m	In service	137.9	695.2	695.2	137.9	416.6	820.4	416.6	12.7
		Out of service	198.0	559.4	559.4	198.0	378.7	676.9	378.7	80.6
1+14	51.5 m /52.5 m	In service	152.0	733.0	733.0	152.0	442.5	864.6	442.5	20.4
		Out of service	191.4	618.0	618.0	191.4	404.7	755.3	404.7	54.1
1+15	54.5 m /55.5 m	In service	187.3	793.8	793.8	187.3	490.5	932.2	490.5	48.8
		Out of service	204.9	700.6	700.6	204.9	452.7	859.0	452.7	46.5
1+16	57.5 m /58.5 m	In service	177.5	811.4	811.4	177.5	494.5	957.3	494.5	31.7
		Out of service	172.2	741.1	741.1	172.2	456.6	921.9	456.6	-8.7
1+17	60.5 m /61.5 m	In service	166.7	830.1	830.1	166.7	498.4	983.9	498.4	12.9
		Out of service	137.4	783.7	783.7	137.4	460.6	988.5	460.6	-67.4

3.10.2.8 Corner reactions for 35m jib

Table 3-28 Corner reactions for 35m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m /25.5 m	In service	109.5	514.4	514.4	109.5	311.9	600.1	311.9	23.8
		Out of service	396.1	153.4	153.4	396.1	274.8	103.2	274.8	446.3
1+6	27.5 m /28.5 m	In service	107.3	524.4	524.4	107.3	315.9	613.4	315.9	18.3
		Out of service	400.4	157.0	157.0	400.4	278.7	106.5	278.7	450.8
1+7	30.5 m /31.5 m	In service	104.4	535.2	535.2	104.4	319.8	627.6	319.8	11.9
		Out of service	404.8	160.4	160.4	404.8	282.6	109.8	282.6	455.4
1+8	33.5 m /34.5 m	In service	100.9	546.4	546.4	100.9	323.7	642.8	323.7	4.6
		Out of service	409.3	163.8	163.8	409.3	286.5	112.9	286.5	460.1
1+9	36.5 m /37.5 m	In service	118.9	580.4	580.4	118.9	349.7	681.0	349.7	18.3
		Out of service	435.9	189.1	189.1	435.9	312.5	138.0	312.5	487.0
1+10	39.5 m /40.5 m	In service	114.2	592.9	592.9	114.2	353.6	698.1	353.6	9.1
		Out of service	440.5	192.3	192.3	440.5	316.4	140.9	316.4	491.9
1+11	42.5 m /43.5 m	In service	130.9	628.2	628.2	130.9	379.6	738.3	379.6	20.8
		Out of service	467.3	217.4	217.4	467.3	342.4	165.7	342.4	519.1
1+12	45.5 m /46.5 m	In service	124.9	642.1	642.1	124.9	383.5	757.6	383.5	9.4
		Out of service	472.2	220.4	220.4	472.2	346.3	168.2	346.3	524.3
1+13	48.5 m /49.5 m	In service	140.1	678.8	678.8	140.1	409.4	800.1	409.4	18.8
		Out of service	192.0	552.5	552.5	192.0	372.3	669.7	372.3	74.8
1+14	51.5 m /52.5 m	In service	154.6	716.3	716.3	154.6	435.4	843.8	435.4	27.0
		Out of service	185.5	611.0	611.0	185.5	398.2	748.0	398.2	48.5
1+15	54.5 m /55.5 m	In service	190.2	776.7	776.7	190.2	483.4	910.9	483.4	56.0
		Out of service	199.1	693.4	693.4	199.1	446.3	851.5	446.3	41.1
1+16	57.5 m /58.5 m	In service	180.8	793.9	793.9	180.8	487.4	935.3	487.4	39.4
		Out of service	166.6	733.8	733.8	166.6	450.2	914.2	450.2	-13.8
1+17	60.5 m /61.5 m	In service	170.5	812.1	812.1	170.5	491.3	961.3	491.3	21.3
		Out of service	132.0	776.2	776.2	132.0	454.1	980.4	454.1	-72.2

3.10.2.9 Corner reactions for 30m jib

Table 3-29 Corner reactions for 30m jib

Qty. of sections	Working height	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
1+5	24.5 m /25.5 m	In service	111.8	502.8	502.8	111.8	307.3	585.7	307.3	28.9
		Out of service	390.9	150.2	150.2	390.9	270.5	100.3	270.5	440.7
1+6	27.5 m /28.5 m	In service	109.6	512.8	512.8	109.6	311.2	598.8	311.2	23.5
		Out of service	395.2	153.7	153.7	395.2	274.4	103.7	274.4	445.2
1+7	30.5 m /31.5 m	In service	106.8	523.4	523.4	106.8	315.1	613.0	315.1	17.3
		Out of service	399.5	157.2	157.2	399.5	278.4	107.0	278.4	449.7
1+8	33.5 m /34.5 m	In service	103.5	534.6	534.6	103.5	319.0	628.0	319.0	10.1
		Out of service	404.0	160.6	160.6	404.0	282.3	110.2	282.3	454.4
1+9	36.5 m /37.5 m	In service	121.6	568.4	568.4	121.6	345.0	666.0	345.0	24.0
		Out of service	430.6	185.9	185.9	430.6	308.3	135.3	308.3	481.2
1+10	39.5 m /40.5 m	In service	117.0	580.8	580.8	117.0	348.9	682.9	348.9	14.9
		Out of service	435.2	189.2	189.2	435.2	312.2	138.2	312.2	486.1
1+11	42.5 m /43.5 m	In service	133.9	615.9	615.9	133.9	374.9	722.9	374.9	26.9
		Out of service	462.0	214.3	214.3	462.0	338.1	163.0	338.1	513.2
1+12	45.5 m /46.5 m	In service	128.0	629.6	629.6	128.0	378.8	741.9	378.8	15.7
		Out of service	466.8	217.3	217.3	466.8	342.1	165.7	342.1	518.4
1+13	48.5 m /49.5 m	In service	143.5	666.1	666.1	143.5	404.8	784.1	404.8	25.5
		Out of service	186.9	549.2	549.2	186.9	368.0	666.8	368.0	69.3
1+14	51.5 m /52.5 m	In service	158.2	703.4	703.4	158.2	430.8	827.5	430.8	34.0
		Out of service	180.4	607.7	607.7	180.4	394.0	744.9	394.0	43.1
1+15	54.5 m /55.5 m	In service	194.1	763.5	763.5	194.1	478.8	894.2	478.8	63.4
		Out of service	194.0	690.0	690.0	194.0	442.0	848.3	442.0	35.7
1+16	57.5 m /58.5 m	In service	185.0	780.4	780.4	185.0	482.7	918.2	482.7	47.2
		Out of service	161.6	730.3	730.3	161.6	445.9	910.9	445.9	-19.0
1+17	60.5 m /61.5 m	In service	175.0	798.3	798.3	175.0	486.6	943.7	486.6	29.6
		Out of service	127.1	772.6	772.6	127.1	449.9	976.9	449.9	-77.2

3.11 Loads on travelling track of travelling tower crane

When the angle of the jib and track is 45°, the loads on the travelling track are maximum.

Table 3-30 Table of loads on travelling track

Track foundation type	In service		Out of service	
	Max pressure F1(kN)	Min pressure F1(kN)	Max pressure F1(kN)	Min pressure F1(kN)
6mGCA	1032.1	47.9	1173.3	-175.8

In the table, F1 indicates the acting force of single bogie (with two traveling wheels) on the track and foundation. 6mGCA is the type of track foundation of the travelling tower crane.

Each bogie may bear F1 because of rotation of tower crane.

3.12 Cable capacity of the cable drum of travelling tower crane

Cable drum type	Cable outer diameter (mm)	Cable capacity (m)
M822	Φ40	290

The outer diameter of YC3×35mm^2+2×10mm^2 cable is Φ40 mm

3.13 Tower anchored onto the building

When the working height of the tower crane is required to exceed its free-standing height, the tower body shall be anchored.

3.13.1 Description

The 2.0m fish plate tower mast recommend adopt retractable attachment frame YWB-FZJ2000 (000209911A2600000) is mainly consist of attachment frame, inner support column, strut rods (including strut rods double-headed screw, connecting sleeve, pin, split pin and nut.), the Foundation support constitute, as shown in Fig. 3-11.

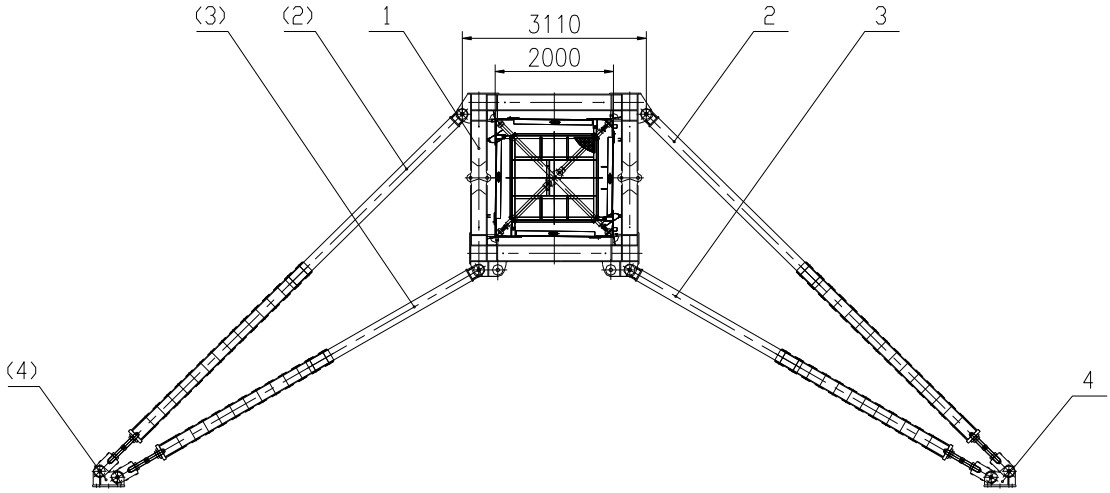


Fig. 3-11 The retractable attachment frame YWB-FZJ2000

Table 3-31 Spare parts of retractable attachment frame YWB-FZJ2000

No.	Code	Designation	Order No.	Qty
1	Attachment frame	000209911A0610000	FZK2000-YWB	1
2	Long strut rods	000209911A2701000		2
3	Short strut rods	000209911A2702000		2
4	Foundation support	000209911A0211650	FZJZ-S300/H160/260/Φ60	2

3.13.1.1 Attachment frame

Positioning dimensions of connecting pin holes on attachment frame as show in Fig. 3-12.

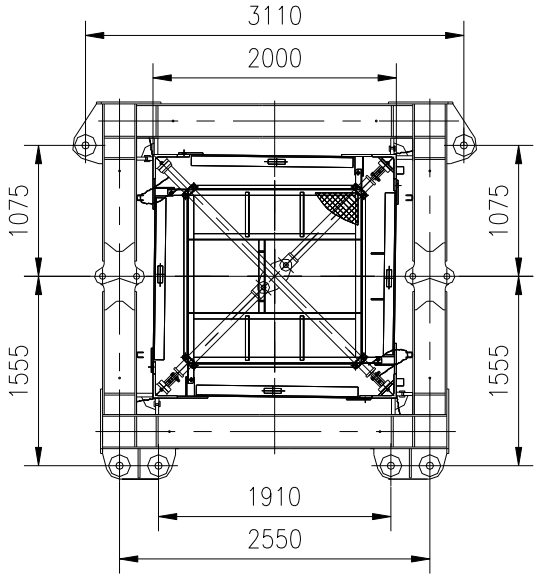


Fig. 3-12 Attachment frame

3.13.1.2 Attachment rods

The 2.0m tower mast retractable attachment frame including two long and short strut rods of each. The length of the long rod is between 4960~8600mm while the length of the short rod is between 4200~7040mm, as shown in Fig. 3-13.

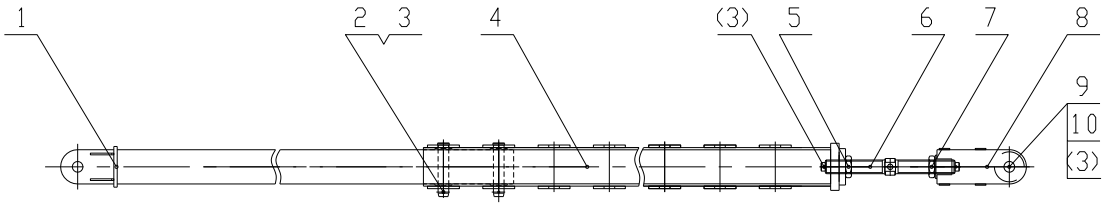


Fig. 3-13 Layout of the strut rods

Table 3-32 Spare parts of long strut rods

No.	Order No.	Code	Designation	Qty
1	000209911A2701100		Strut rods Ⅰ	1
2	000209910A1122601	XZ01C-60×270/305	Pin	2
3	1040500186	GB/T91-2000	Pivot	6
4	000209911A2701200		Strut rods Ⅱ	1
5	1040202429	GB/T6172.1-2000	Nut	1
6	000209911A0211900	FZLG-M80	Double-headed screw	1
7	1040202430	GB/T6172.1-2000	Nut	1
8	000209911A0211850	FZJT-M80-350Φ60	Threaded connector	1
9	000209910A4122401	XZ04C-60×240/300	Pin	1
10	000209911A1101001		Washer	2

Table 3-33 Spare parts of short strut rods

No.	Order No.	Code	Designation	Qty
1	000209911A2702100		Strut rods Ⅰ	1
2	000209910A1122601	XZ01C-60×270/305	Pin	2
3	1040500186	GB/T91-2000	Pivot	6
4	000209911A2702200		Strut rods Ⅱ	1
5	1040202429	GB/T6172.1-2000	Nut	1
6	000209911A0211900	FZLG-M80	Double-headed screw	1
7	1040202430	GB/T6172.1-2000	Nut	1
8	000209911A0211850	FZJT-M80-350Φ60	Threaded connector	1
9	000209910A4122401	XZ04C-60×240/300	Pin	1
10	000209911A1101001		Washer	2

3.13.1.3 Foundation support

The pin bore position on the base seat and the base plate are as follows.

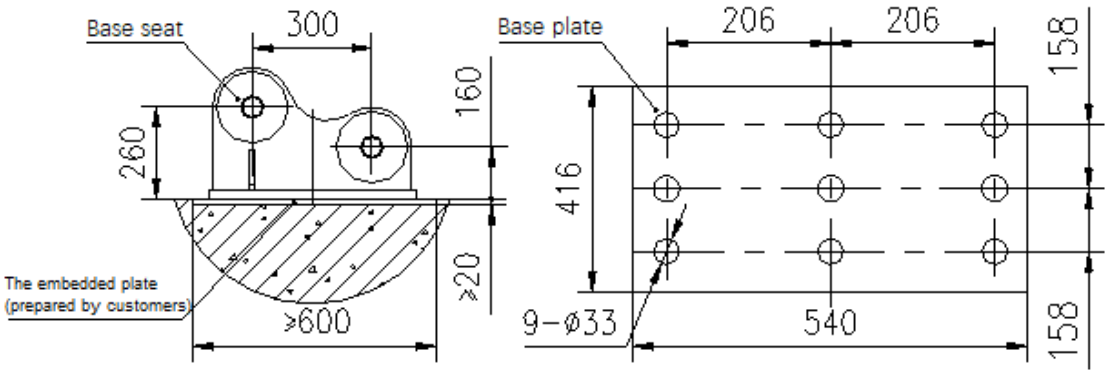


Fig. 3-14 The pin bore and the base plate

The connection between the mast-pull-frames and the building:

a) The construction organization shall design the connection between the foundation support and building according to the support force provided in the attachment arrangement from and carry out the corresponding calculation (including the calculation of the connection strength and the bearing capacity of the building).

b) If used the embedded ways, it is recommendable to use the embedded plate (prepared by customers), the material is Q355B and the thickness is no less than 25mm, length and width not less than 600×500mm.

c) The welding between foundation support and the embedded plate are recommend to use E5016 welding rod, height of weldment is 24mm, 9 of Φ33 hole plug welding.

d) If used the bolts to connect, position size of the embedded bolts according to bottom foundation support from the Fig. 3-14 to assign, M30 bolt must be more than 8.8.

3.13.2 Layout of the anchored devices

3.13.2.1 Layout form 1

As shown in the Fig. 3-15 is the layout form 1.

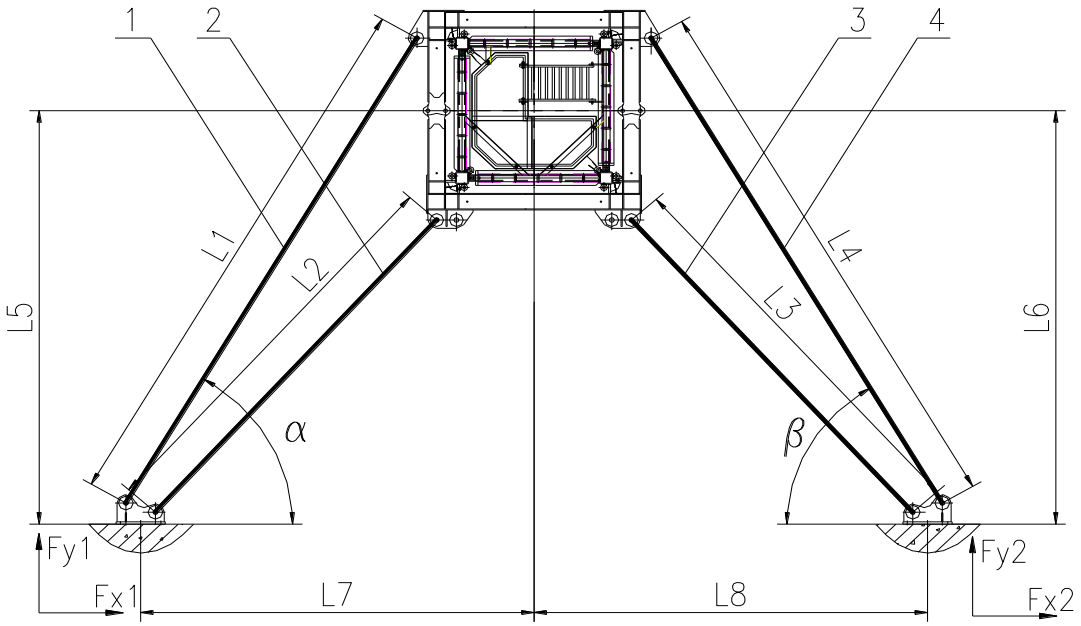


Fig. 3-15 layout form 1

(1) Strut rods A (2) Strut rods B

(3) Strut rods C (4) Strut rods D

The length of the Strut rods is L1, L2, L3, L4 respectively, the angle between the rod A, D and the building is α, β respectively, the distance between the center of the tower crane and the two sides of the building is L5 and L6, the distance between the center of the tower crane and the center of the base seat is L7 and L8. When using this form, the layout configuration must meet the following conditions:

a) α, β must meet: 35°≤α≤67°, 35°≤β≤67°;

b) L1, L2, L3, L4 must meet: two rods are 4960~8600mm, the others are 4200~7040mm.

The maximum reaction from the anchored points to the building is given below:

Fx1/kN	Fy1/kN	Fx2/kN	Fy2/kN
±525	±456	±525	±456

Some examples when L5=L6 for the form 1:

L5=L6/mm	L7/mm	L8/mm
3000	5500≤L7≤6800	5500≤L7≤6800
3500	5300≤L7≤7500	5300≤L7≤7500
4000	5000≤L7≤8000	5000≤L7≤8000
4500	4600≤L7≤7800	4600≤L7≤7800
5000	4100≤L7≤7600	4100≤L7≤7600
5500	4100≤L7≤7200	4100≤L7≤7200
6000	4300≤L7≤6600	4300≤L7≤6600
6500	4500≤L7≤5900	4500≤L7≤5900
7000	4700≤L7≤4900	4700≤L7≤4900

3.13.2.2 Layout form 2

As shown in the Fig. 3-16 is the layout form 2.

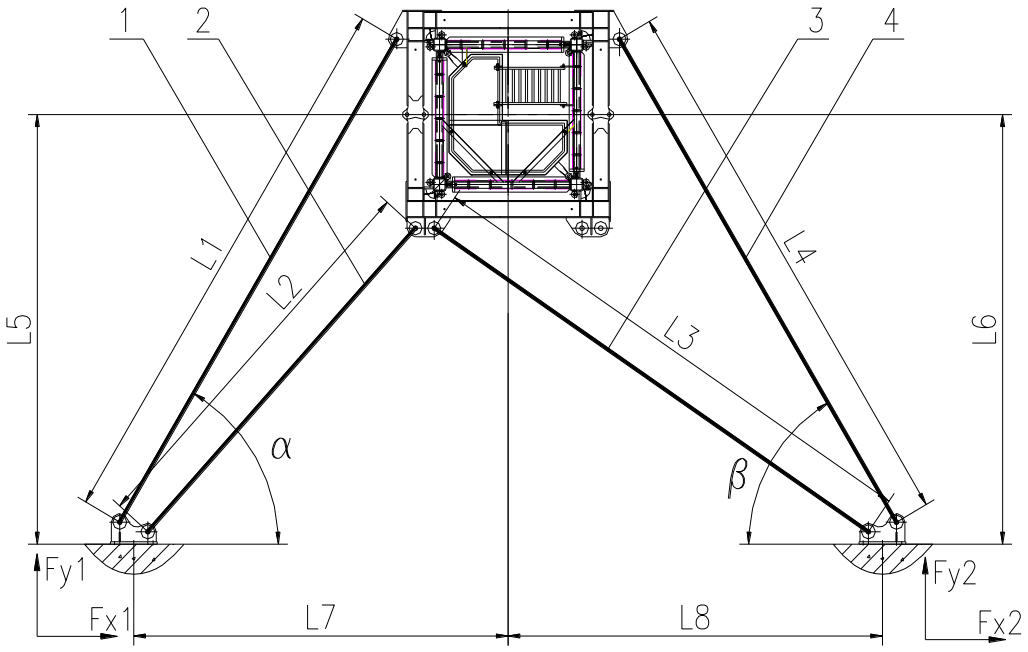


Fig. 3-16 layout form 2

(1) Strut rods A (2) Strut rods B

(3) Strut rods C (4) Strut rods D

When using this form, the layout configuration must meet the following conditions:

a) α, β must meet: 35°≤α≤78°,35°≤β≤78°;

b) L1, L2, L3, L4 must meet: two rods are 4960~8600mm, the others are 4200~7040mm.

The maximum reaction from the anchored points to the building is given below:

Fx1/kN	Fy1/kN	Fx2/kN	Fy2/kN
±512	±645	±524	±640

Some examples when L5=L6 for the form 2:

L5=L6/mm	L7/mm	L8/mm
3000	5500≤L7≤6800	4600≤L7≤6700
3500	5300≤L7≤7500	3900≤L7≤6900
4000	5000≤L7≤8000	2700≤L7≤6500
4500	4600≤L7≤7800	2500≤L7≤6000
5000	4100≤L7≤7600	2700≤L7≤5400
5500	3300≤L7≤7200	2800≤L7≤5100
6000	2900≤L7≤6600	2900≤L7≤4700
6500	3000≤L7≤5900	3000≤L7≤4300
7000	3100≤L7≤4900	3100≤L7≤3800

3.13.2.3 Layout form 3

As shown in the Fig. 3-17 is the layout form 3.

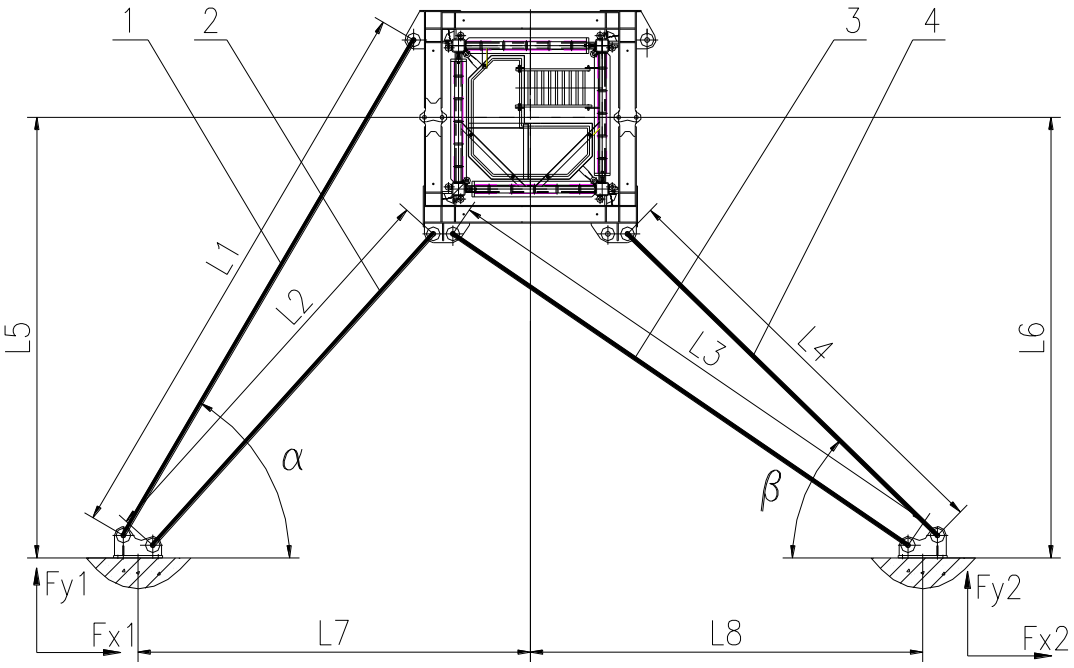


Fig. 3-17 Layout form 3

(1) Strut rods A (2) Strut rods B

(3) Strut rods C (4) Strut rods D

When using this form, the layout configuration must meet the following conditions:

a) α, β must meet: 40°≤α≤70°,42°≤β≤85°;

b) L1, L2, L3, L4 must meet: two rods are 4960~8600mm, the others are 4200~7040mm.

The maximum reaction from the anchored points to the building is given below:

Fx1/kN	Fy1/kN	Fx2/kN	Fy2/kN
±465	±664	±438	±750

Some examples when L5=L6 for the form 3

L5=L6/mm	L7/mm	L8/mm
5000	4000≤L7≤7600	3900≤L8≤4700
5500	3700≤L7≤7200	3200≤L8≤5300
6000	3900≤L7≤6600	1700≤L8≤5800
6500	4000≤L7≤5900	1500≤L8≤6300
7000	4300≤L7≤4900	1600≤L8≤5800

3.13.3 Range of the anchored devices

Range of 2.0m tower section anchored devices as show in Fig. 3-18:

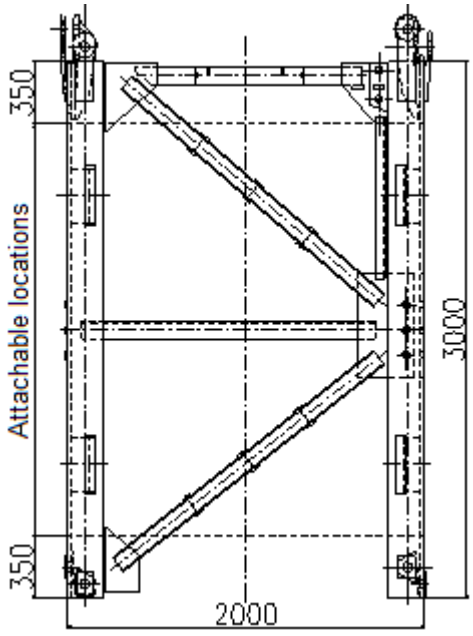


Fig. 3-18 Attachable locations on the tower section

3.13.4 Matters need attention

1) When installing the attachment frame, use the theodolite to check the verticality of the axis of the verticality of the axis of the tower mast. The vertical degree of the tower axis above the highest attachment point is 4/1000, and the vertical degree of the tower axis below the highest attachment point is 2/1000. When the deviation of the vertical degree of the tower axis does not meet requirements and the deviation is constant, the user can adjust the length of attachment rod to meet the requirements.
2) When installing the attachment frame, the flat surface of the frame beam should be kept consistent with the horizontal position as far as possible, and it should be hung on the tower section with slings such as steel rope to prevent falling.
3) The gap of attachments and height of tower above the anchored-frame should meet the operation manual of tower crane. The top two anchored-frames must be installed with inner strut rods. It is suggested that each attachment should be installed with inner strut rods.
4) When there is interference in the position of the attachment frame of the inner strut rods installation, it can adjust up and down appropriately, and the distance between the installation position and the attachment frame is within 200mm of the tower section diagonal, the inner strut rods may not be installed.
5) The Maximum allowable axial load of the single strut rod: in service is 500 kN, out of service is 550kN.
6) In this manual, the length of the strut rods refers to the distance from the pin hole of attachment frame to foundation support. When installing the attachment, the levelness of strut rods shall not exceed 1/100 of the strut rods.
7) When the gap between pin holes and pin more than 1mm, the telescopic strut is prohibited to used.
8) If none of them is satisfied, please contact our company, the force calculation can be provided according to the actual situation.

3.13.5 Three Stay bar anchored device

3.13.5.1 Layout of the three strut rods anchored devices

Layout of the three strut rods anchored devices as show in Fig. 3-19

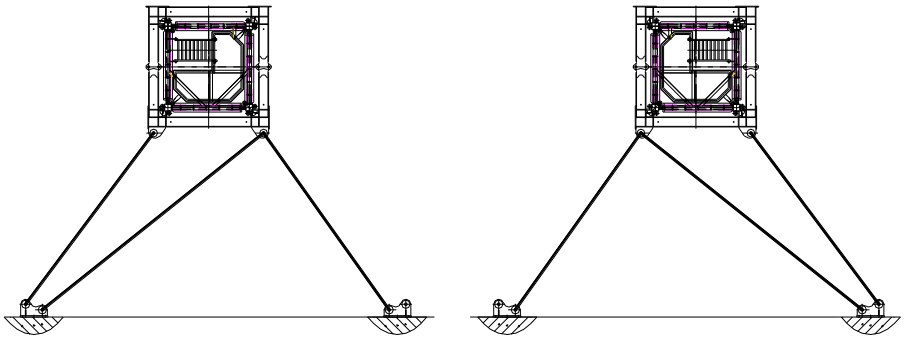
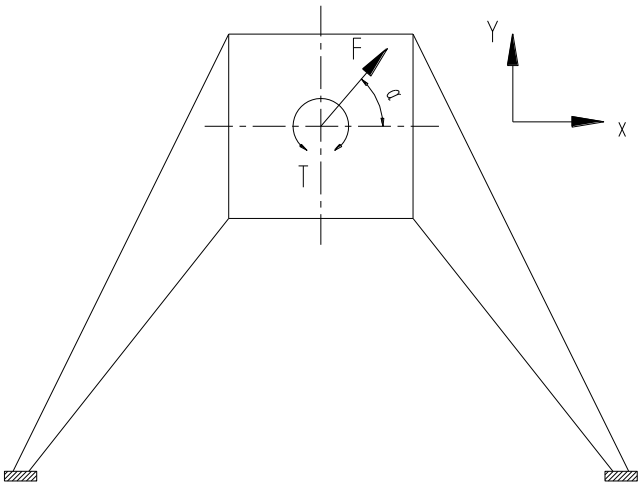


Fig. 3-19 Anchoring form

User can choose the appropriate attachment points according to the actual requirements of construction, and the attachment height, gap of attachment and height of tower above the anchored-frame should meet the requirements of this manual.

3.13.5.2 The level reaction of attachment points



F: Level reaction of attachment points; **T**:Torque; **α**:Angle of F and X axis

Fig. 3-20 Drawing of anchoring form

Table 3-34 level reaction of attachment points

Load / Service state	Level reaction /kN	Torque/kN.m
In service	190	715.8
Out of service	410	0

- User can calculate strut rod force and foundation support force according to the attachment point level reaction force
- Our company telescopic attachment is the same tower mast in the largest load model to calculate the foundation support force, as the most unfavorable state, different types of crane with the same tower mast reaction force consistent.

- *Angle α change from 0 to 360°*
- *Torque T direction is arbitrary, which may be clockwise or counterclockwise (where the out of service is 0), in the table **715.8** kN·m is the maximum torque value of the tower crane torque*

Please consult our company for out of service level reaction against typhoon.

3.13.6 Scheme of tower anchored onto building

The maximum hoisting height can reach 60m, if the hoisting height must be over 60m, it must be fastened with tie-in onto the building and mast tie frame the maximum hoisting height can reach 265m. When the height is less than 132.5m, 2-fall and 4-fall are all satisfaction for the hoisting. When the height is more than 132.5m, just 2-fall is allowed.

The tower crane anchored-to-building has the same structural layout as stationary type, only for higher hoisting height. To enhance tower crane stability and tower body rigidity, several anchors are provided along the whole height of the tower body, the crane must be equipped with several anchors. In case of the actual distance of the project not in compliance with this requirement, just contact our company for further information.

3.13.6.1 Anchored technical requirements

The tower crane anchored technical requirements as show in the following table. The height of first anchored frames h1, the height of each two Anchored frame Δh and the height of tower above the anchored-frame have given range, and the range of height change into corresponding number of tower sections, that worth noting, when the working height is over 100m, the allowable maximum height of tower above the anchored-frame can be reduce appropriately. Drawing of attachment and important dimension refer to Fig. 3-21.

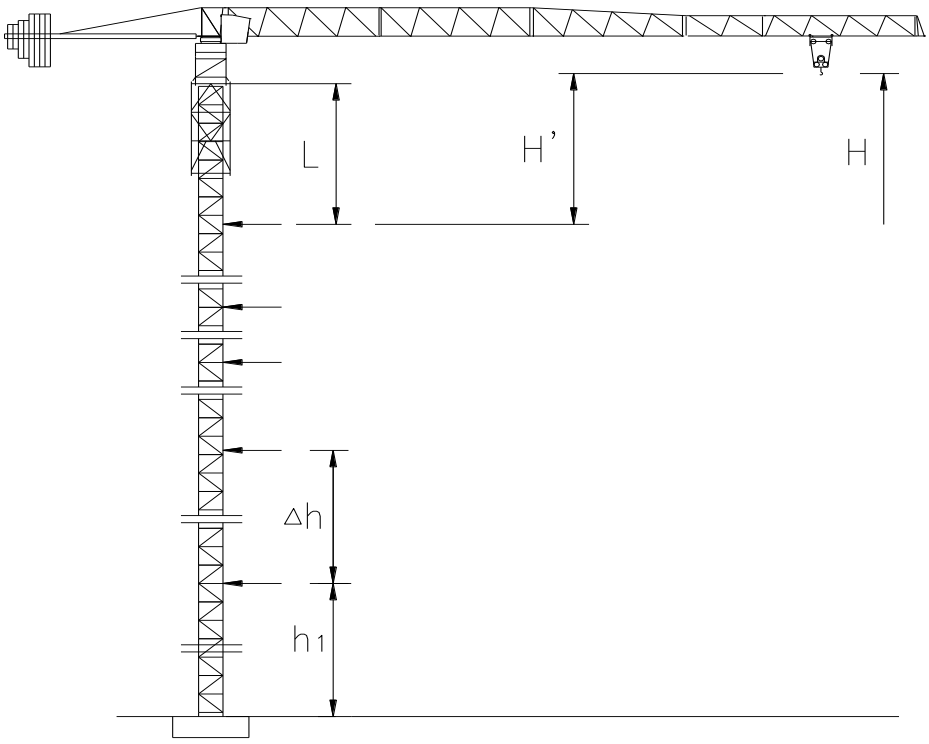


Fig. 3-21 Drawing of anchored tower crane

Table 3-35 Technical requirements of attachment

Below the first anchored frames	**Height h1 /m**		22.7≤h1 ≤49.7
	Quantity of tower sections n1		6.1≤n1 ≤ 15.1 (Including base tower section)
Each two anchored frames	**Maximum working height H≤150m**	**Height Δh /m**	21≤**Δ**h≤38.4
		Quantity of tower sections Δn	7≤**Δ**n≤12.8
	Maximum working height H>150m	**Height Δh /m**	21≤**Δ**h≤35.4
		Quantity of tower sections Δn	7≤**Δ**n≤11.8
Above maximum attachment	**Maximum working height H≤150m**	**H´/m**	H´≤ 48.8
		L /m	L ≤ 47.4
		Quantity of tower sections n	n≤ 15.8
	Maximum working height H>150m	**H´ /m**	H´≤ 45.8
		L /m	L ≤ 44.4
		Quantity of tower sections n	n≤ 14.8

In this table "H´" is refer to the distance of the highest anchored frame to the bearing face of hook, "the height of tower above the anchored-frame L" is refer to the distance of the highest anchored frame to the highest tower section of its upper end plane.

3.13.6.2 Most economic anchored-frame layout for the stationary crane with embedded anchors

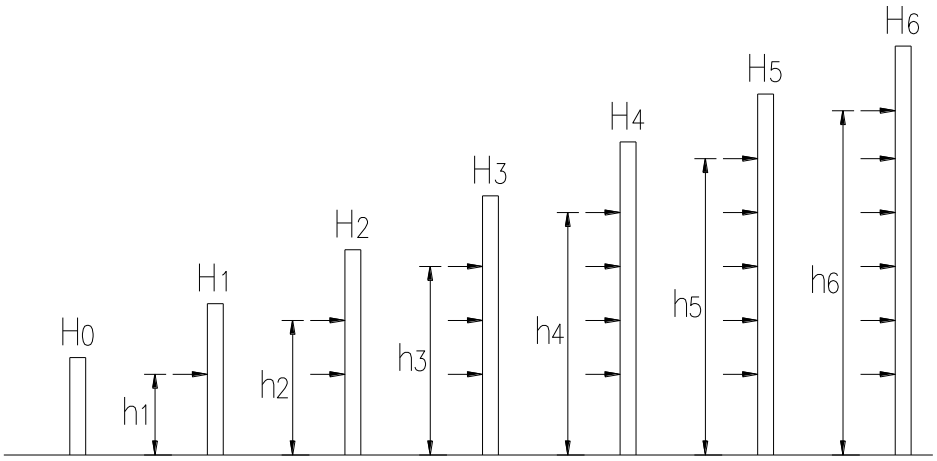


Table 3-36 Parameter of most economic anchored-frame layout

Qty of anchored-frame	Highest working height H/m	The height of top attachment H/m	Height of tower above the anchored-frame H´/m	Qty of base section	Qty of tower section
1	H1=96	h1=47.2	≤48.8	1	29
2	H2=132	h2=83.2	≤48.8		41
3	H3=165	h3=119.2	≤45.8		52
4	H4=198	h4=152.2	≤45.8		63
5	H5=231	h5=185.2	≤45.8		74
6	H6=264	h6=218.2	≤45.8		85

3.14 Power supply

3.14.1 Definition

Nominal power

This is the sum of the nominal powers (operating powers consumed simultaneously by the three movements) of:

- hoisting mechanism
- trolley mechanism
- slewing mechanism

Starting power

This is the sum of the powers consumed temporarily by these same three movements under the following conditions:

- starting power of the mechanism with the highest current consumption (in general: the hoisting mechanism)
- nominal power of the two other mechanisms

Nominal current intensity

Results from the nominal power

Starting current intensity

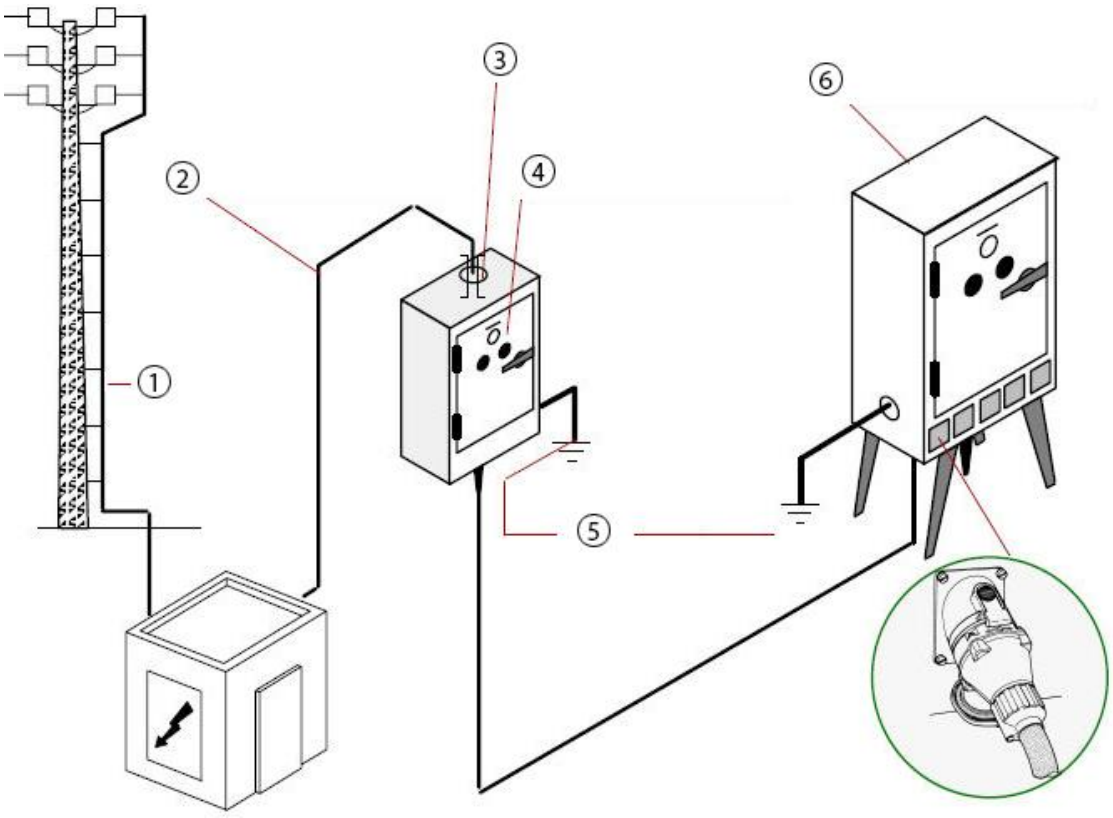
Results from the starting power.

Mechanism	Frequency	Type of mechanism	Nominal power in kW	Nominal intensity at A
Hoisting mechanism	50Hz	H37FC25-530B	37	≈68.57
Trolley mechanism	50Hz	T55FC70-b / T55FC70-b(D)	5.5	≈11.6
Slewing mechanism	50Hz	S75CA-130LB12/14A S75CN-130LB12/14A	2*7.5	≈34.6

3.14.2 Current supply

3.14.2.1 Characteristic of the site power supply

The electrical equipment of the tower crane must comply with relevant regulations to ensure normal operation of equipment and safety of personnel. The equipment must conform to the current standards of the country where it is located. There is an example of overall current supply arrangement below:



(1)	Power grid	(2)	Counted by voltmeter
(3)	Enforced isolation	(4)	Auto-break device
(5)	Local grounding plug	(6)	Distributing box

The protection of power grid should include:

A distributing box after the voltage-meter, which has built-in automatic breakers and leakage protection device, which is adjustable, to turn off the circuit.

The distributing box, included in tower crane electrical system should configure multistage switch. The switch can be locked at off-location, in order to maintenance or dealing with accident.

All the power cables must keep away from the communication cables!

3.14.2.2 Grounding

Installing grounding wire should accord with current standards, which requires:

- Metal parts' grounding;
- Track's grounding.
- All the grounding parts should be connected, the connection of the grounding circuit should be checking in period.
- The grounding wire is yellow-green, which connects the "grounding" terminal of metal parts to grounding plugs or grid. The method of grounding sees also in relative introductions of mechanism parts, the grounding resistance should not more than 4 Ohms.

- **It's forbidden to replace the grounding wires with neutral wires.**
- **The grounding wires should be conducted, and isolated from any breaker.**

3.14.2.3 Power source cable

The power source cable includes 3 phase conductors, 1 neutral conductor, and 1 grounding conductor which is yellow-green. The grounding line should be fixed on the reserved terminal.

Accident could be caused by any source line's damage, so it's recommended to dispose the source lines in appropriate way to ensure that no damage on insulation of the lines.

3.14.2.4 The requirement of tower crane's source

A. Power

The power of the source is determined by capacity of all mechanism, speed controlling manner and working condition (With load or without load start-up).

B. Characteristic of supply voltage

- According to our technical specification, the supply voltage at the crane switch must be:

50 Hz in Europe

maximum voltage without load: 400 V + 6% (i.e. between 400 V and 420 V)

minimum voltage with load: 400 V - 10% (i.e. between 360 V and 400 V)

- The minimum voltage depends on:

the voltage supplied by the supply source with load,

the voltage drops in the supply cable,

the cable cross- section (the thicker the cable is, the lower the voltage drop will be),

the type of the cable (aluminum or copper),

the cable length between the supply source and the crane switch,

the current surge when starting the crane.

Choosing a cable cross-section

As a first approach, a cable cross- section is accepted if the current density which is passing through is lower than 4 amperes per mm^2.

Example: Current intensity of the crane 50 amperes:

$$Minimum\ cable\ cross-section = \frac{50}{4} = 12.5mm^2$$

- Take the cable cross- section (in the "Cable cross- section" rod of the table below) which is equal or slightly bigger, i.e. **3 x 16 mm² + N** (neutral)**+T** (earth)

Copper Cables		
No.	**Cable cross- section**	**Voltage drop per kilometer per ampere, V/(km·A) (cos Φ= 0,8)**
1	3 x 6 mm²+ N+T	6.00
2	3 x 10 mm²+ N+T	3.50
3	3 x 16 mm²+ N+T	2.20
4	3 x 25 mm²+ N+T	1.50
5	3 x 35 mm²+ N+T	1.10
6	3 x 50 mm²+ N+T	0.77
7	3 x 70 mm²+ N+T	0.57
8	3 x 95 mm²+ N+T	0.46
9	3 x 120 mm²+ N+T	0.38
10	3 x 150 mm²+ N+T	0.32
11	3 x 185 mm²+ N+T	0.28
12	3 x 240 mm²+ N+T	0.23

C. Determining the coefficient of the voltage drop

- Take the coefficient of the voltage drop in the table above depending on the cable cross-section calculated before.

Calculation of the maximum supply cable length for a known cable cross-section

Data:

- Supply source: 50 Hz
  420 V with the crane without load
  390 V with the crane with load
- Crane: Value of the permissible minimum voltage 360 V with load.

The voltage drop must not exceed 390 V - 360 V = 30 V in the cable of length L.

The formula will be:

$$Maximum\ length = \frac{permissible\ voltage\ drop}{coeff.\times\ I_d}$$

with:

30 V: permissible voltage dropping,

Voltage dropping: depending on the cable cross- section,

Id: starting current intensity.

Example:

1. For a cable of 3 x 16 mm^2 + **N** (neutral)**+T** (earth), the coefficient is of 2,2
2. With a starting current intensity of 190A

it is obtained:

$$\frac{30}{2.2 \times 190} = \frac{30}{418} = \ 0{,}072\ km, i.e. 72\ m$$

0. In order to obtain a more considerable length, a bigger cable cross- section must be taken (with a lower coefficient).

Example:

- For a cable of 3 x 35 mm^2 + **N** (neutral)**+T** (earth), the coefficient is of 1,1
- With the same starting current intensity of 190 A

it is obtained:

$$\frac{30}{1.1 \times 190} = \frac{30}{209} = \ 0{,}144\ km, i.e. 144\ m$$

The power voltage drop can't be over 5%, for the *WA7025-10E*:

Its standard main power cable type is YC3×35+2×10. Its thickened main power cable type is YC3×50+2×16. The length of the thickened main power cable is 200~300m. When using the thickened main power cable, the tower working height is 200~300m. The current of master breaker is 150A, and the rated current of thickened main power cable is 114.2A.

3.14.2.5 Connecting the motors

Before connecting the crane, check the connection in the terminal boxes; carry out the same operation when replacing a motor.

A. Identification of the motors

On the rating plate are indicated the supply voltage, the frequency of this voltage followed by the sign for star or delta connection depending on the connection to be carried out for this voltage, or there are two voltages indicated of which the lowest one corresponds to delta connection.

Furthermore, in order to call the servicemen's attention to the motor 400 V in delta connection, a plate is riveted on the motor stator.

B. Checking the direction of rotation of the motors

Having connected the crane to the mains, operate a" Lowering" pulse on the control unit or with the jib retaining winch for GTMR and HDT cranes which are equipped with a LVF hoist winch; check that the rope slackens.

- If yes, the direction of rotation is correct
- If not, interchange two wires in the plug or in the circuit breaker of the mains supply.

4 ERECTION/ADJUSTMENT/DISMANTLING

4.1 Foreword

This part comprises the instructions allowing the fitter in charge with the crane installation on the site to:

- erect the crane,
- carry out the adjustments,
- dismantle the crane.

According to the method applicable to the configuration(s) defined on the order.

The erection and dismantling operations of the crane must be **ABSOLUTELY CARRIED OUT** in the indicated order.

This part does not comprise instructions concerning special operations.

These last operations can only be carried out by the constructor or his representative.

This part cannot be separated from the whole document: it can only be used after reading the ***Chapter 2 <SAFETY INSTRUCTION>*** and ***Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>***.

4.2 Note on safety regarding erection

The operating mode defined below allows fast and safe assembling of the crane up to its climbing or working position (complete erection by means of a mobile crane).

The erection operations need an auxiliary lifting equipment of which the characteristics must be adapted to the parts to be handled.

AUXILIARY LIFTING EQUIPMENT

The optimization of the operating time of the mobile crane needs a good preparation and a good coordination between the various erection and assembling sequences, the fitter teams, the access possibilities, and the assembling area.

This document aims to familiarize yourself with the whole erection operations of which each one is detailed in the specific files.

4.2.1 Erection instructions

- These instructions concern:
  - The erection of the crane
  - The increase in height of the crane
  - The dismantling of the crane
- All the handling operations must be carried out according to the instructions of this manual. and especially:
  - Ensure the correct supports of the loads
  - Do not work with overload
  - Use slings in perfect condition and dimensioned for the weight of the elements to be handled.
  - Observe the slinging points

The erection operations can only be carried out with the wind speed below 14 m/s.

The erection operations must be carried out in the order indicated in this manual.

During the preparing steps compulsorily fit the safety equipment such as ladders, platforms, grab rails, guard ropes, etc. in order to use them during the erection.

Any hoisting operation is absolutely forbidden if the counter ballast is not placed.

COMPOSITION OF THE COUNTER BALLAST

FITTING THE COUNTER BALLAST BLOCKS

- For cranes on chassis and cross−shaped base, the ballast placed must correspond to the hook height to be reached. In case of partial ballasting, the partial ballast must correspond to the erection height of the crane, but must never be lower than the indicated minimum value.

CHASSIS − BALLAST AND REACTIONS
CROSS−SHAPED BASE − BALLAST AND REACTIONS

- For cranes with special operating conditions, observe the given instructions.

SPECIAL CHARACTERISTICS

- For any particularly problem concerning the assembly organization or any other matter, do not hesitate to ask for the technical assistance of the constructor.

For each crane, there are variable elements according to the models, versions, options. The sketches used on the following pages represent the crane in one of its possible configurations. When these sketches explain only a function, they have a grey outline.

Before assembling the sections, carry out a visual check of the steel structure parts, welds and assembling parts. Elements which show deformations, corrosion and cracked welds must be returned to the workshop for repairing.

4.2.2 Fitting the split pins

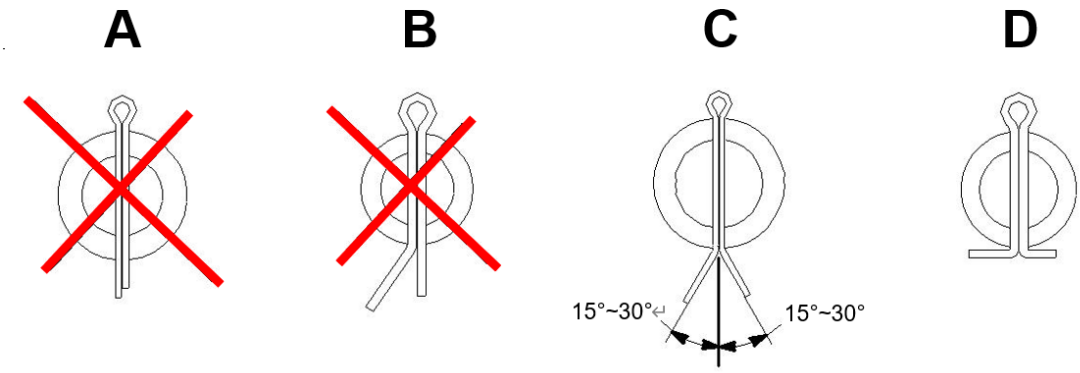
In order to ensure their pin locking function correctly, this split pin type must be fitted by opening both split pin legs and not only the longest one (Detail B).

It is not compulsory to fold down the legs against the pin; It is sufficient to fold down each leg according to an angle a, depending on the split pin diameter (detail C and table below). This limited opening makes the split pin removal easier when dismantling the crane pins.

Nevertheless, it is necessary to check that the legs are not running the risk of abutting against obstacles, what may lead to their deformation, and even their deterioration in case of shaft rotation.

In order to avoid this disadvantage, it may be necessary to fold the legs completely (Detail D).

Only use new split pins or split pins in good working order.



4.2.3 Fitting the high-strength bolt

The preload of the high-strength bolt must be aligned with the data in the following Table 4-1

Table 4-1 Preload of high-strength bolt

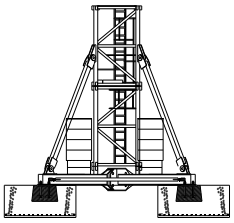
Performance race	Strength of extension Rm N/mm^2	Yield point Rel N/mm^2	Preload F_1 kN									
			M16	M18	M20	M22	M24	M27	M30	M33	M36	M39
8.8	≥800	≥640	70	86	110	135	158	205	250	310	366	437
10.9	≥1000	≥900	99	120	155	190	223	290	354	437	515	615
12.9	≥1200	≥1080	119	145	185	229	267	347	424	525	618	738
Calculate the effective area of the bolt			157	192	245	303	353	459	561	494	817	976
Note: The preload value in the table is calculated as 0.7 Rel, in which Rel take the minimum value in each gear.												

4.2.4 The diagram of erection

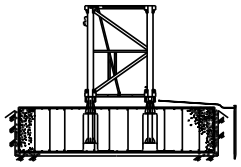
- Chassis

➢ Installing the bogies

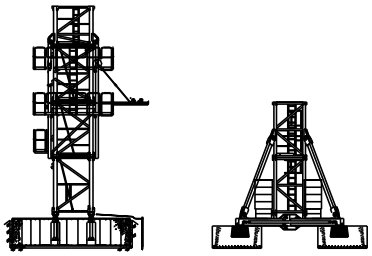
➢ Fit the chassis and place the ballast.



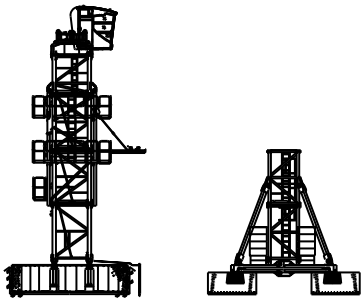
- Outrigger stationary foundation and one base mast section



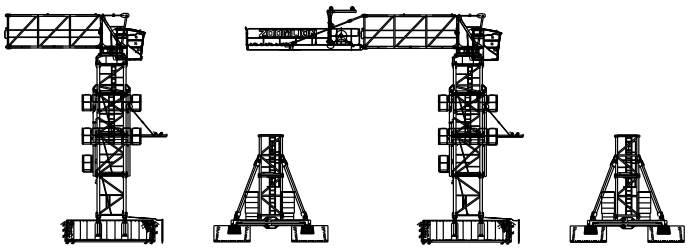
- The climbing equipment assembly (include tower section, climbing equipment, mounting device and transition section)



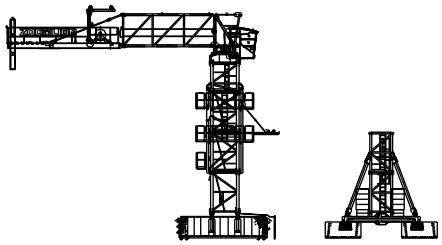
- The slewing unit (include turntable, slewing ring, slewing support, slewing mechanisms, cabin, electrical control cabinet and electric resistance cabinet)



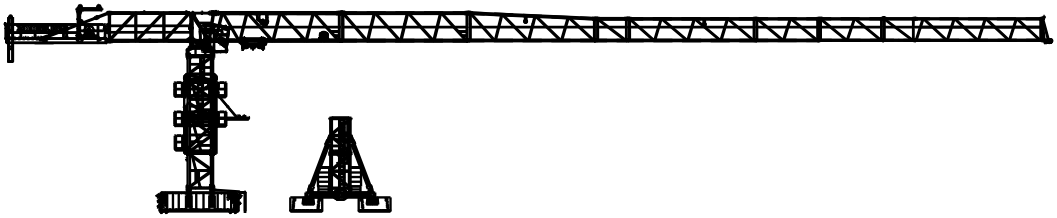
- The counter jib assembly (include hoisting mechanism and tie bar).



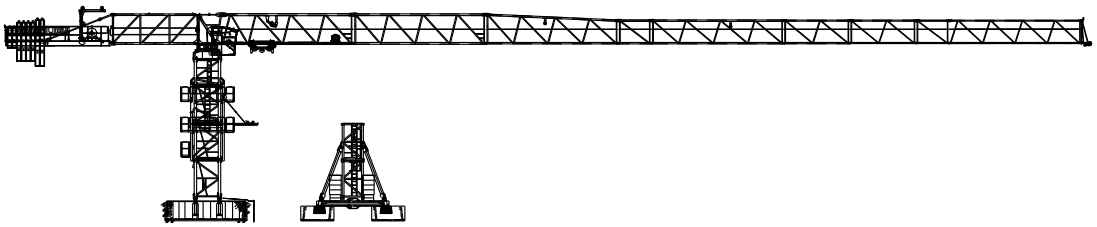
- The first 3t counter ballast



- Jib assembly (include trolley and trolley mechanism)



- The remainder counter ballast, electrical control system, the hoist rope and climbing operation



- *The installation orders based on produces standard packing and delivery status to make the optimal efficiency installation principle*
- *The installing of each unit assembly all based on the actual requirement. In accordance with reasonable order to install in turns after dismantling. If you have any questions, please consult our service staff.*

4.3 Installing the tower section and climbing equipment assembly

4.3.1 Mast section

4.3.1.1 Tower section (Rung ladder)

- Base tower section

There are four groups of vertical pin shaft connection holes at the top and below surfaces of the base tower section, the upper pin holes areΦ55, the lower pin holes are Φ65. (see Fig. 4-1)

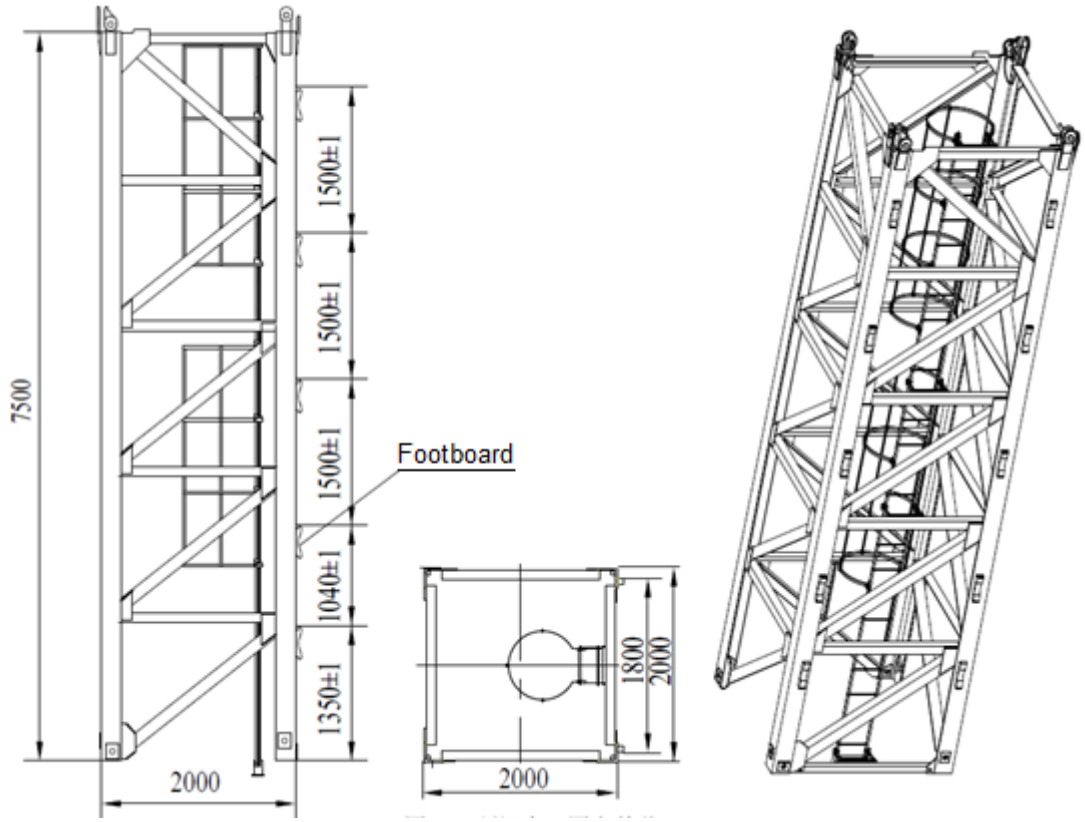


Fig. 4-1 Base tower section L68G23

■ Tower section

➢ Tower section L68A4 is Piece-type structure (see Fig. 4-2), each piece of the structure is assembled by dedicated bolts, the upper and lower pin holes are all Φ55. Tower section L68A4 can also be substituted by L68B6 /L68B6A.

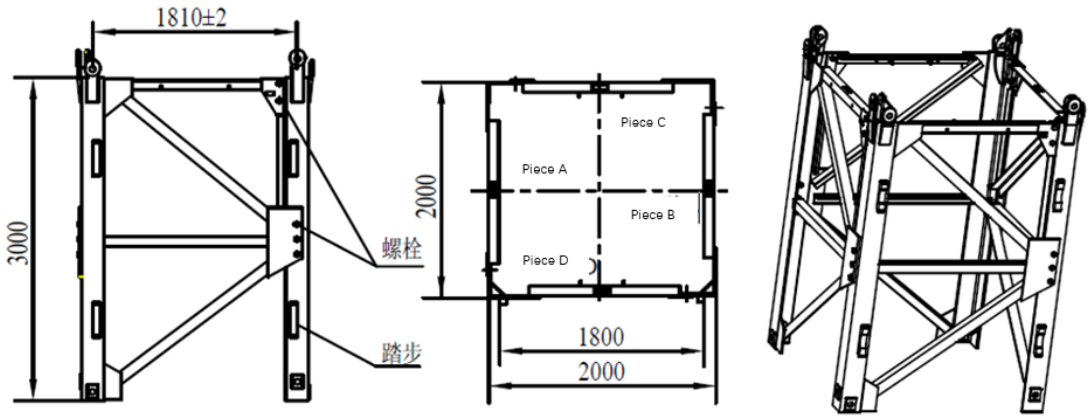


Fig. 4-2 Tower section structure L68A4

➢ Tower section L68B7 / L68B7A are Piece-type structures (see Fig. 4-2), each piece of the structure is assembled by dedicated bolts, the upper pin holes are Φ55, the lower pin holes are Φ65.

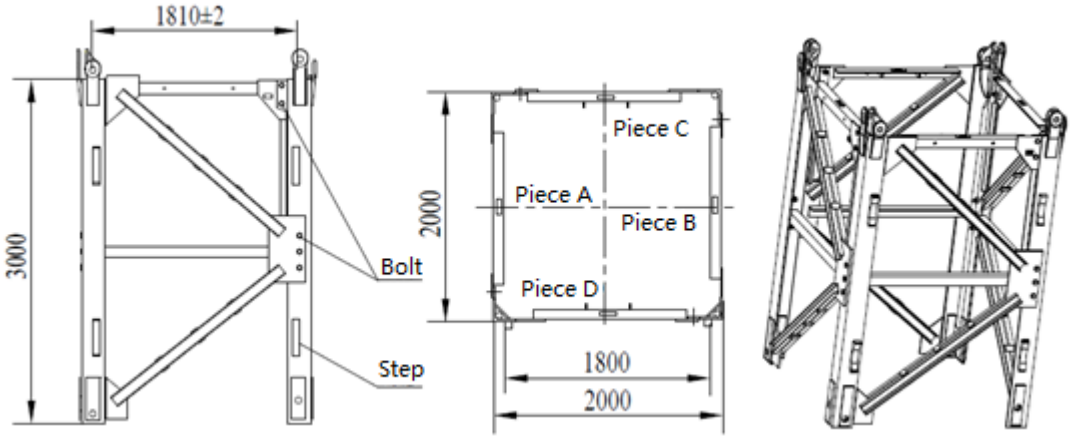


Fig. 4-3 Tower section structure L68B7

- Every Tower Section is equipped with channels, flat roof and ladders for human's resting and pass. The channels have H, J two types (see Fig. 4-4). The installation of Tower section and channel has been done on the ground and they must be used relatively. All elbow ladders should be installed on the side leaf of climbing pedestal. According to the height of tower body, the bottom tower section must install Channel H, the remaining channels H and channels J alternate installation in turn.

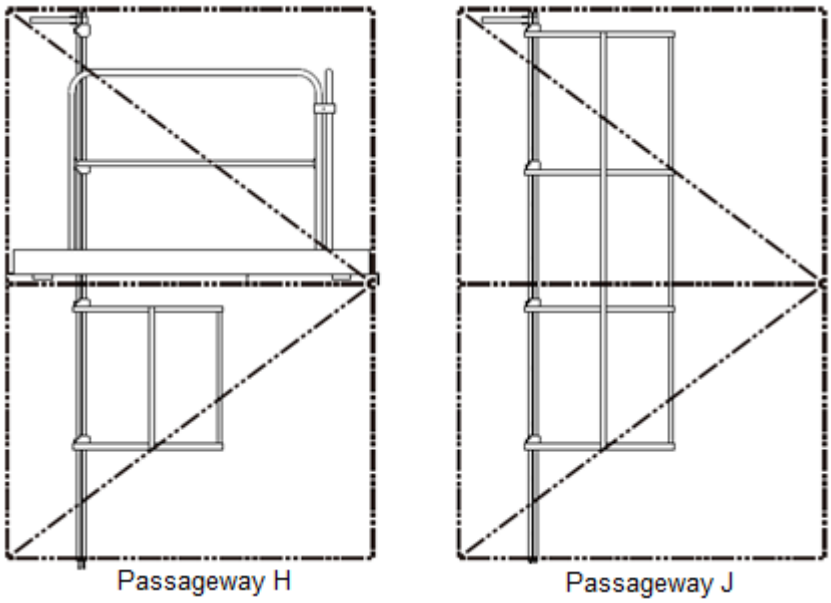


Fig. 4-4 Passageway H and Passageway J

4.3.1.2 Tower section (Incline ladder)

■ Base tower section

There are four groups of vertical pin shaft connection holes at the top and below surfaces of the base tower section L68G23-C, the upper pin holes areΦ55, the lower pin holes are Φ65. (see Fig. 4-5).

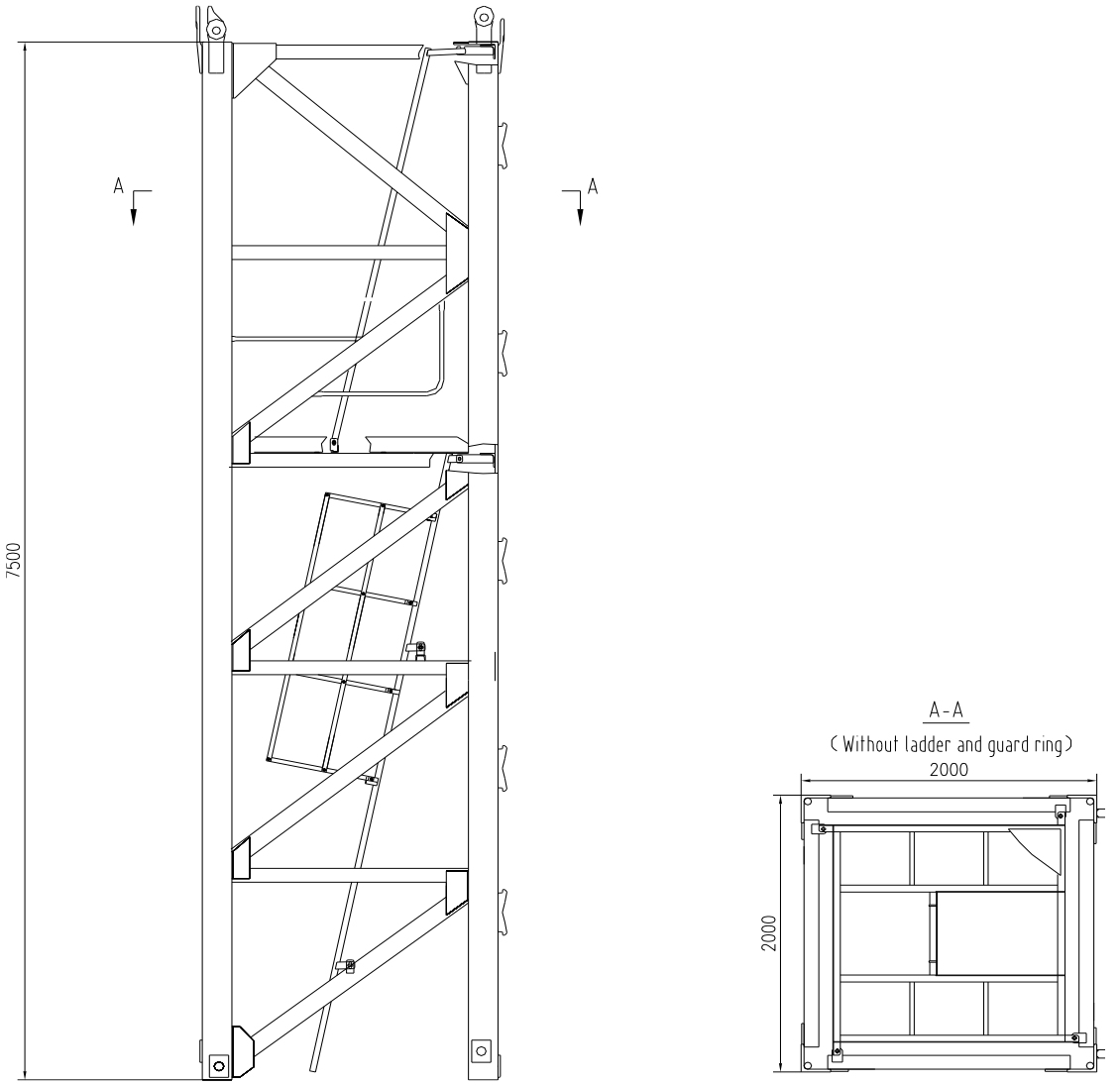


Fig. 4-5 Base tower section L68G23-C

■ Tower section

Tower section L68A1A is a piece structure, each piece is assembled by bolts, the upper and lower pin holes are Φ55 (see Fig. 4-6); Tower section L68A1A can also be substituted for L68B1A (seeFig. 4-7).

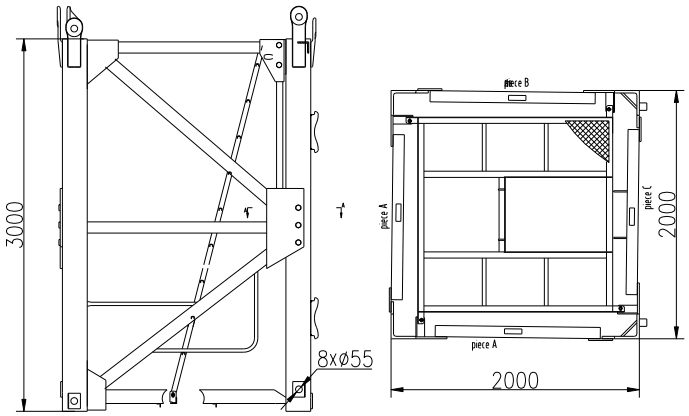


Fig. 4-6 L68A1A

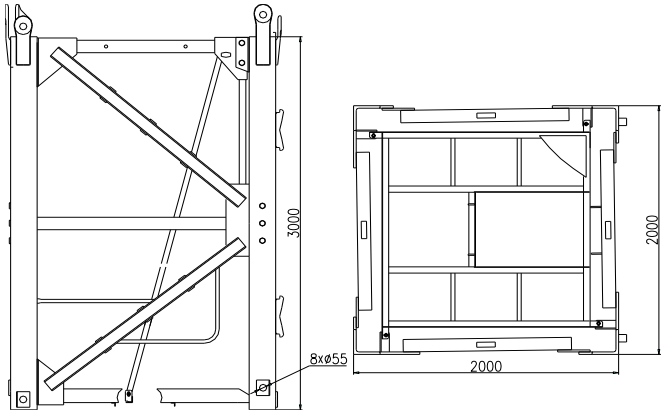


Fig. 4-7 L68B1A

Tower section L68B7A-C (use for chassis stationary) is a piece structure, each piece assembles by special bolts, the upper pin holes areΦ55, and lower pin holes are Φ65. (see Fig. 4-8)

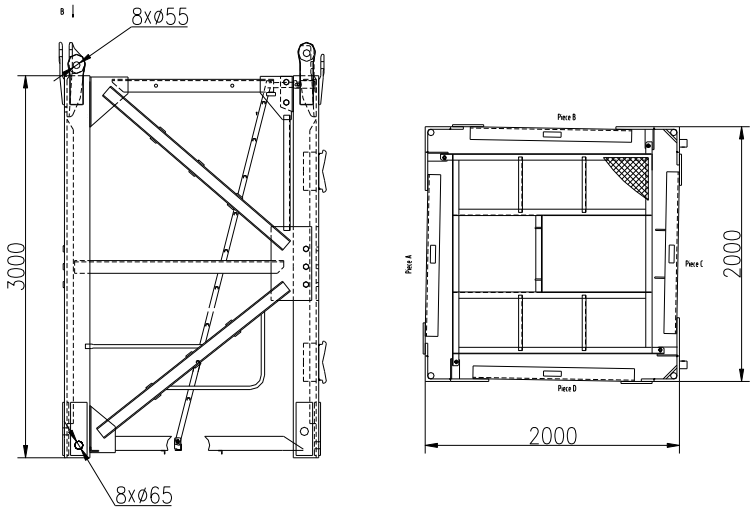


Fig. 4-8 L68B7A-C

4.3.2 Climbing unit

4.3.2.1 Climbing system

The climbing system consists of the climbing equipment structure, platforms, handrails, ladders, cylinder, climbing beam, pump station and so on, shown in Fig. 4-9. Assemble the 2 sheets of climbing equipment structure first, then install the platforms and handrails according to ***Chapter 7 < SPARE PARTS >***. Finally, install the cylinder, pump station, and climbing beam to the assembled climbing equipment.

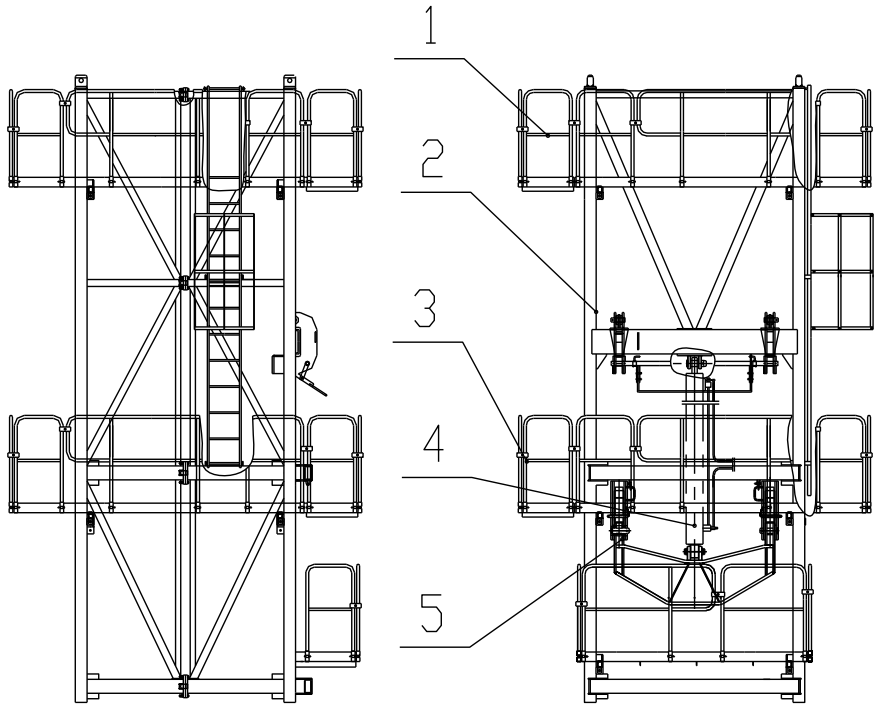


Fig. 4-9 Climbing unit

(1) Upper platform
(2) Climbing equipment structure
(3) Middle-level platform
(4) Cylinder, pump station
(5) Climbing beam

4.3.2.2 Transition section

Install the ladders and platforms to the transition section structure according to the following figure and ***Chapter 7 < SPARE PARTS >***.

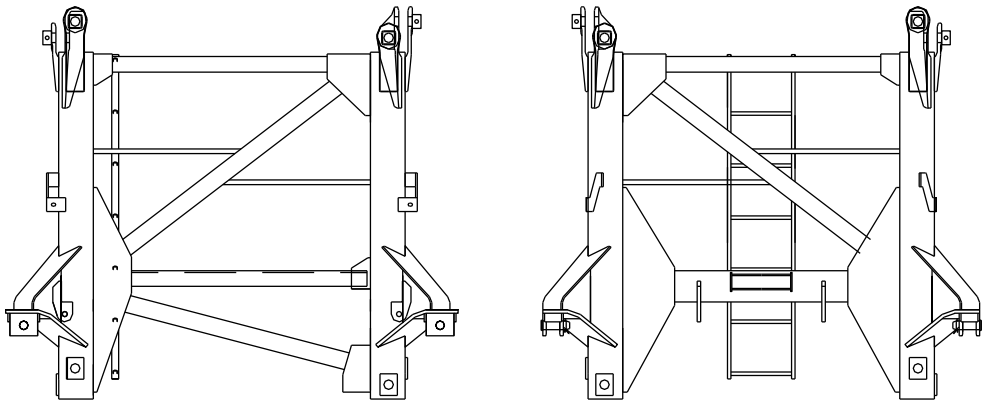


Fig. 4-10 Transition section

4.3.2.3 Mounting device

Assemble the mounting device and erection platform to the transition section.

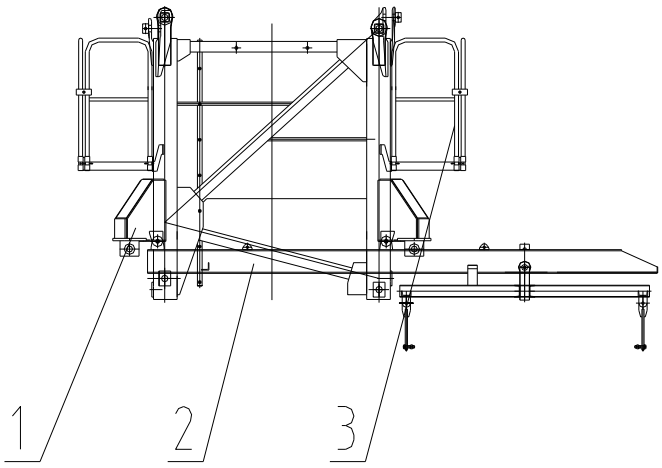


Fig. 4-11 Assemble mounting device

(1) Transition section
(2) Mounting device
(3) Erection platform

4.3.2.4 Assembling the climbing unit

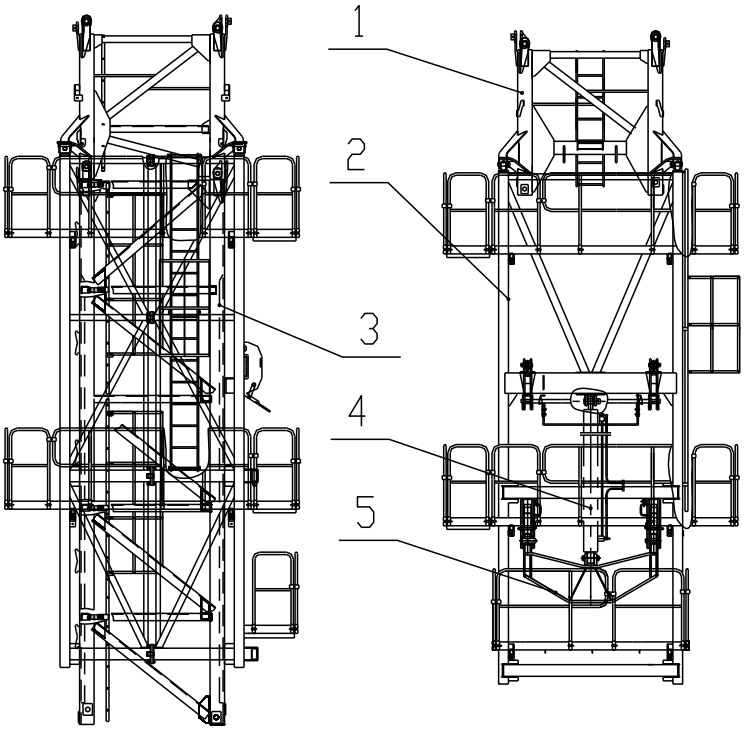


Fig. 4-12 Installation scheme 1 of Climbing unit

(1) Transition section
(2) Climbing equipment
(3) Base tower section
(4) Cylinder, pump station
(5) Climbing beam

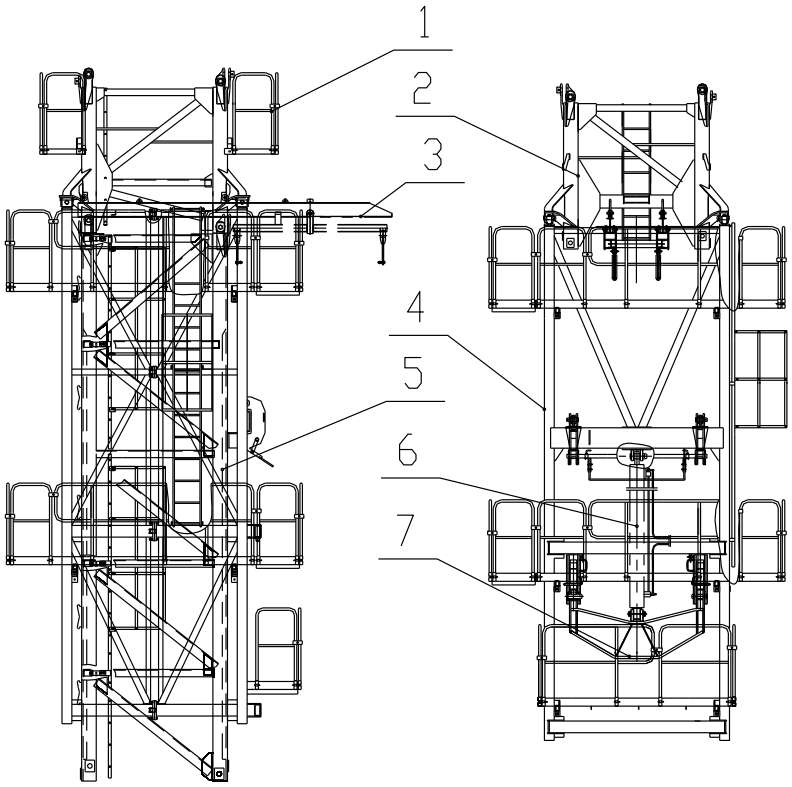


Fig. 4-13 Installation scheme 2 of Climbing unit

(1) Erection platform
(2) Transition section
(3) Mounting device
(4) Climbing equipment
(5) Base tower section
(6) Cylinder, pump station
(7) Climbing beam

4.3.3 Installing

- For the outrigger stationary tower crane, install the climbing unit to the outrigger as Fig. 4-14;
- For the **60.5m** stationary chassis tower crane, assemble the chassis according to ***Section 4.16*** first, then install the climbing unit to the chassis;
- For the **61.5m** travelling chassis tower crane, prepare the travelling system according to ***Section 4.17*** first, then assemble the chassis according to ***Section 4.16***, finally install the climbing unit to the chassis.

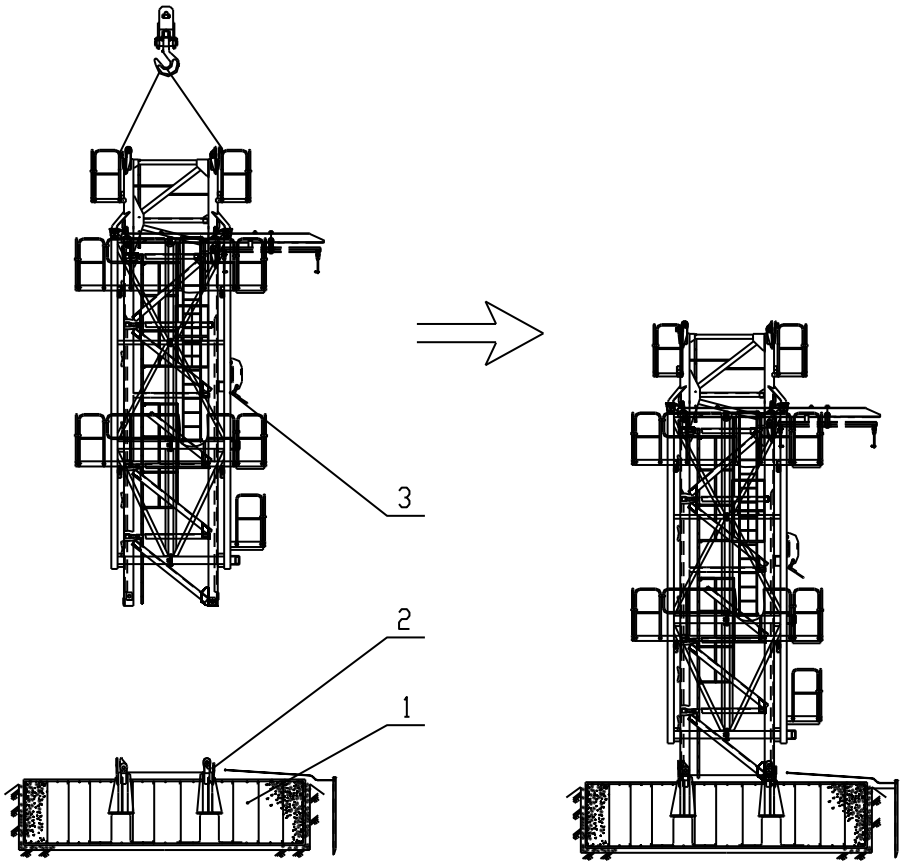
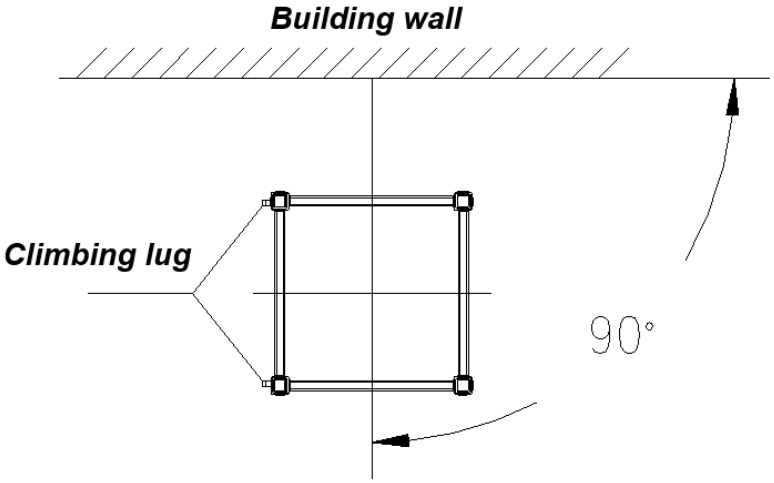


Fig. 4-14 Installing the climbing unit

(1) Outrigger stationary foundation (2) Outrigger

(3) Climbing unit

In order to ascend and descend the tower crane successfully, please ensure that the tower has a step plane perpendicular to the building.



When installing, pay attention to the direction of tower sections' climbing steps; Recommended installing the bolt from top to bottom, also install from bottom to top according actual condition, meet the stress condition.

The base tower section and the climbing lug must be aligned.

Sling the Climbing unit, fixed it on the outrigger with 8 sets Φ65-203 pins see Fig. 4-15.

Check the mast verticality through theodolite or lifting line method. The verticality error of four side of main chord rod shall be not more than 1.5/1000.

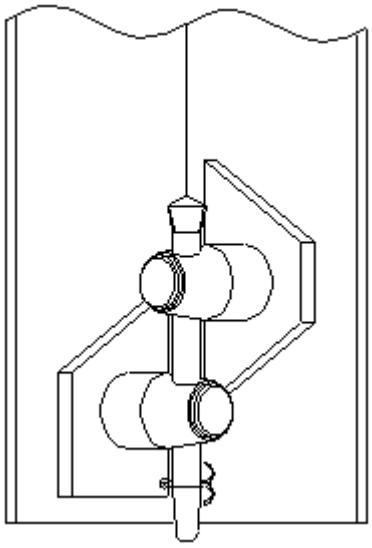


Fig. 4-15 Pin connection

- *The roller is adjustable. When the crane is working, adjust the gap between the climbing equipment guide wheel and the main chord of the tower section to the widest state; when the crane is heightening, adjust the gap to 1~2mm.*
- *Installing the climbing hydraulic cylinder, the pump station is hoisted on the lower platform. The oil pipe is installed. To avoid cylinder burning-out, please check in the pump station. Make sure that the motor fan is aligned with the direction of the label. If there is any error, you should reconnect the motor cable;*
- *Make sure that the cylinder and the mast latch should be on the same side. The mounting platform is opposite to the mast latch of the tower.*
- *Put the climbing claws on the lugs of tower section*
- *The large free-standing height of M tower mast shall be lowered the climbing equipment to the ground or reduce the use of off-working.*

4.4 Installing the slewing unit

4.4.1 Description

The main parts of slewing unit had assembled following our company require, users only install the Platform and rail, etc.

The slewing unit consists of turntable, slewing ring, slewing support, slewing mechanisms, cabin, and resistor cabinet, see Fig. 4-16.

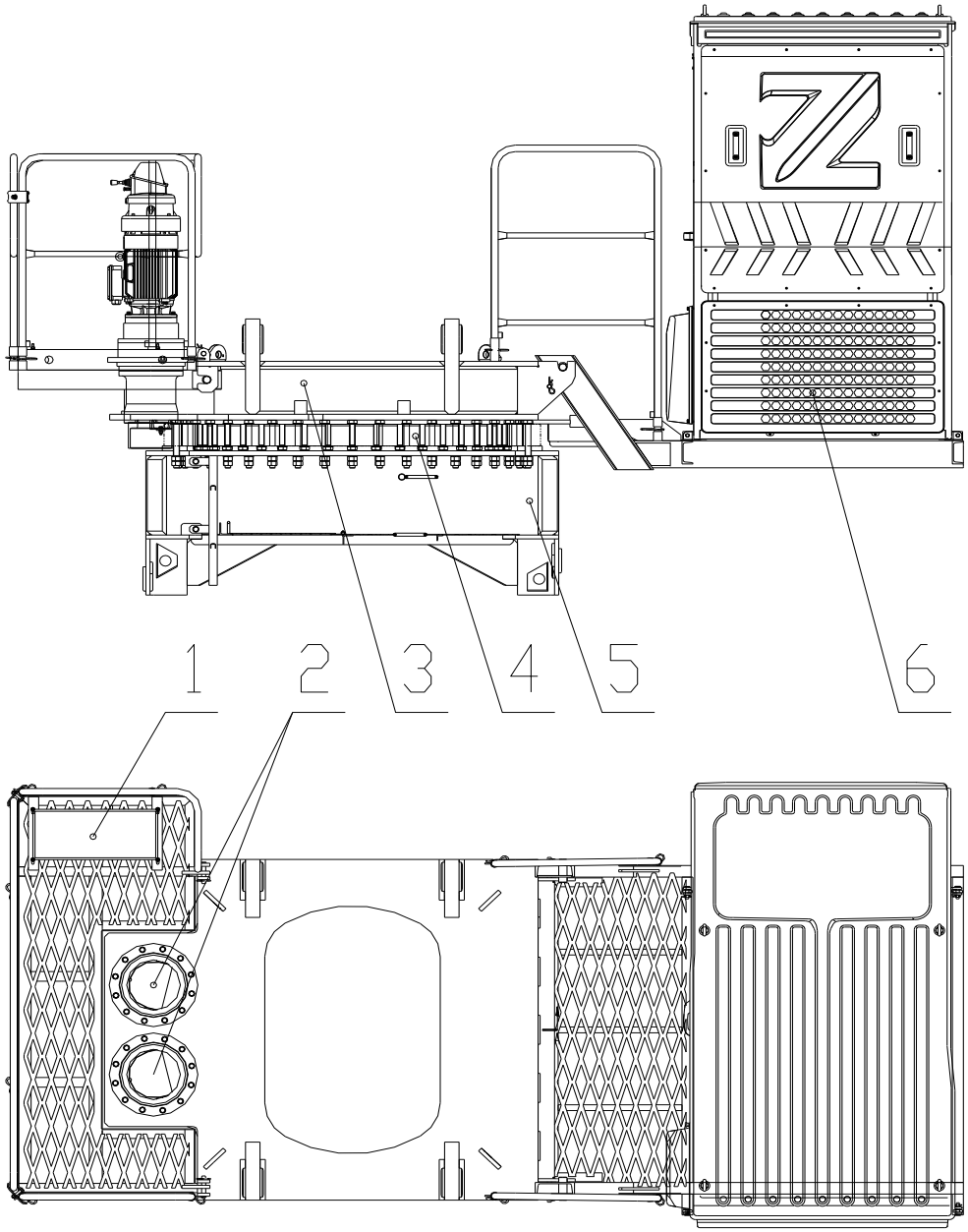


Fig. 4-16 Slewing unit

(1) Resistance cabinet
(2) Slewing mechanisms
(3) Turntable
(4) Slewing ring
(5) Slewing support
(6) Cabin

CAUTIONS:

- Bolt pair for slewing ring
  - The high-strength bolts are **M27×240 (level 10.9)** and the preload moment shall be **950~970 N·m** (with grease oil).
  - Use flat washers which need hardening and tempering. Spring washers could not be used.
- Installation of bolt pair for slewing ring
  - Before installing, clean the erecting datum plane of slewing ring and the erecting plane of yoke, and wipe off wet fouling, burr, paint, and other foreign impurity.
  - During installing, the sign “S” and the hole with steel ball blocking should be placed less under load area or no-load area (That is, the slewing ring near the installation place).

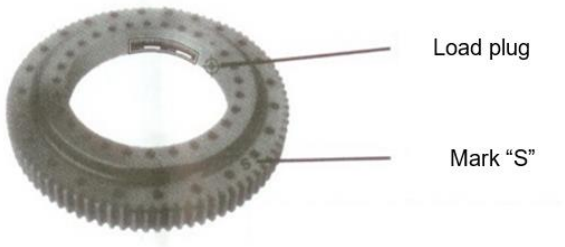


Fig. 4-17 Soft belt of the slewing ring

Screw down the high-strength bolts in the direction of 180° symmetrically and continuously. Make sure the preload moments are equal in screw bolts at the last time.

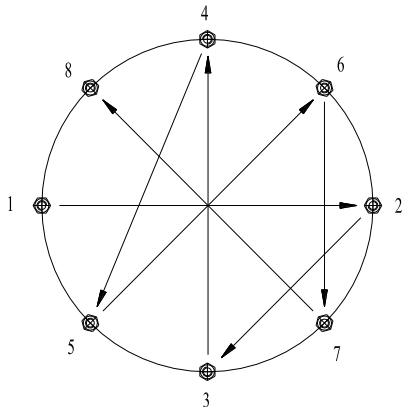


Fig. 4-18 The sequence of screwing down bolts

- Lubrication and maintenance
  - Add grease into slewing ring regularly. Shorten the period of greasing in special working condition such as in tropic, big humidity, too much dust and big range of temperature changing. Add enough new grease before and after tower crane out of working over a long period.
  - Check the preload moment of bolts when slewing ring is in service for 100 hours. Then check it once more after every 500 hours working time, ensuring there is enough preload.
  - Do not sluice slewing ring by water for fear that water get in.

4.4.2 Installing

Align 4 main chords of the slewing ring support to 4 main chords connecting sleeve of transition section. Let them down slowly to keep slewing support contact with the transition section, see figure below. Connect it to the transition section by 8 sets Φ55 pins.

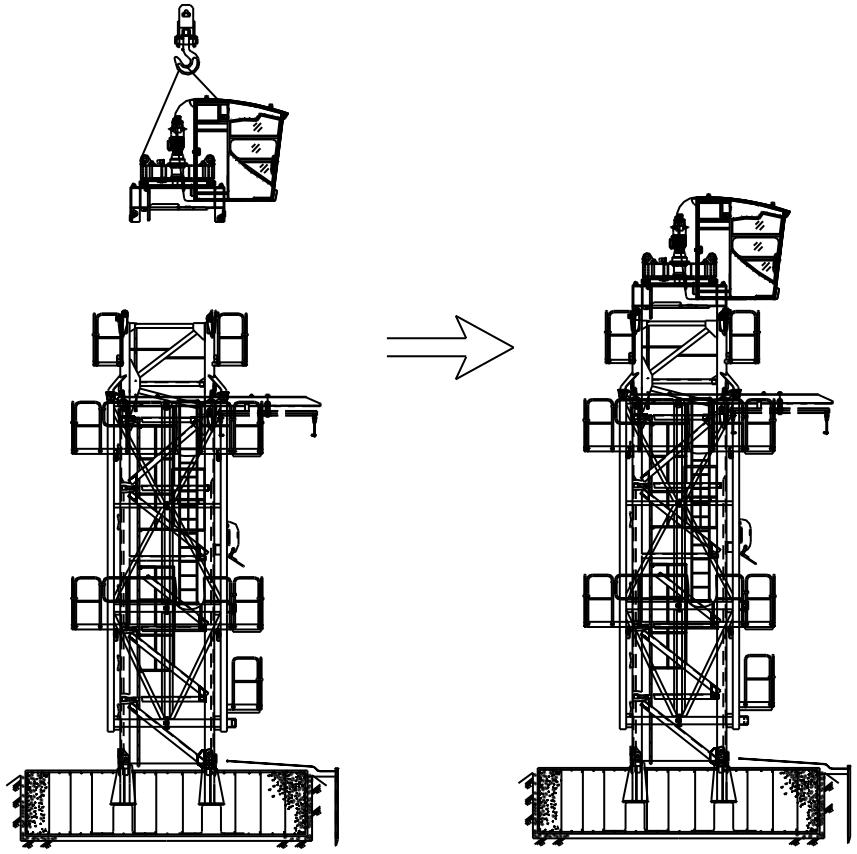


Fig. 4-19 Installing slewing unit

4.5 Installing the counter jib

4.5.1 Description

Counter jib consists of front counter jib, rear counter jib, hoisting mechanism, derrick (optional) and counter jib tie bars, see Fig. 4-20. Before them assemble well, the short tie bars are fixed on the front counter jib, and the long tie bars are fixed on the rear counter jib.

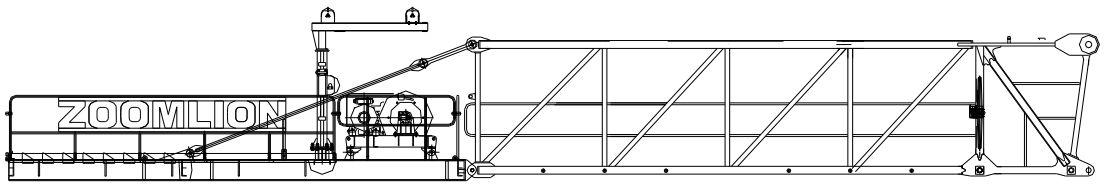


Fig. 4-20 Counter jib assembly

4.5.2 Assemble the front counter jib

Before sling front counter jib, each short strut connects to the front counter jib by 1 sets of Φ50 pin, the installation as following picture.

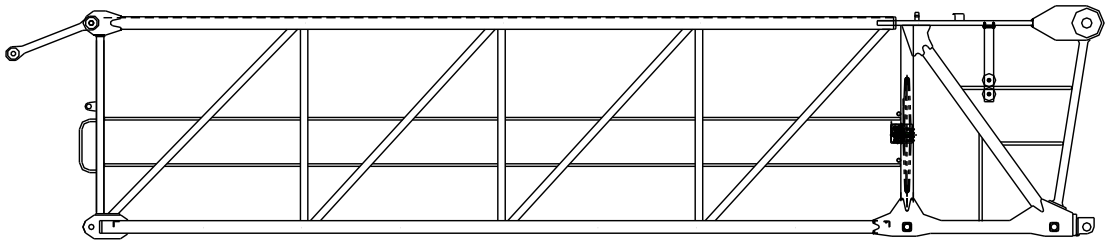


Fig. 4-21 The Front counter jib

4.5.3 Assemble the counter jib

The front counter jib connects to turntable by 4 sets of Φ70 pins, pay attention to washer between the bottom chord rod of counter jib and split pin to avoid the pin scrape bottom chord rod while the tower crane in service.

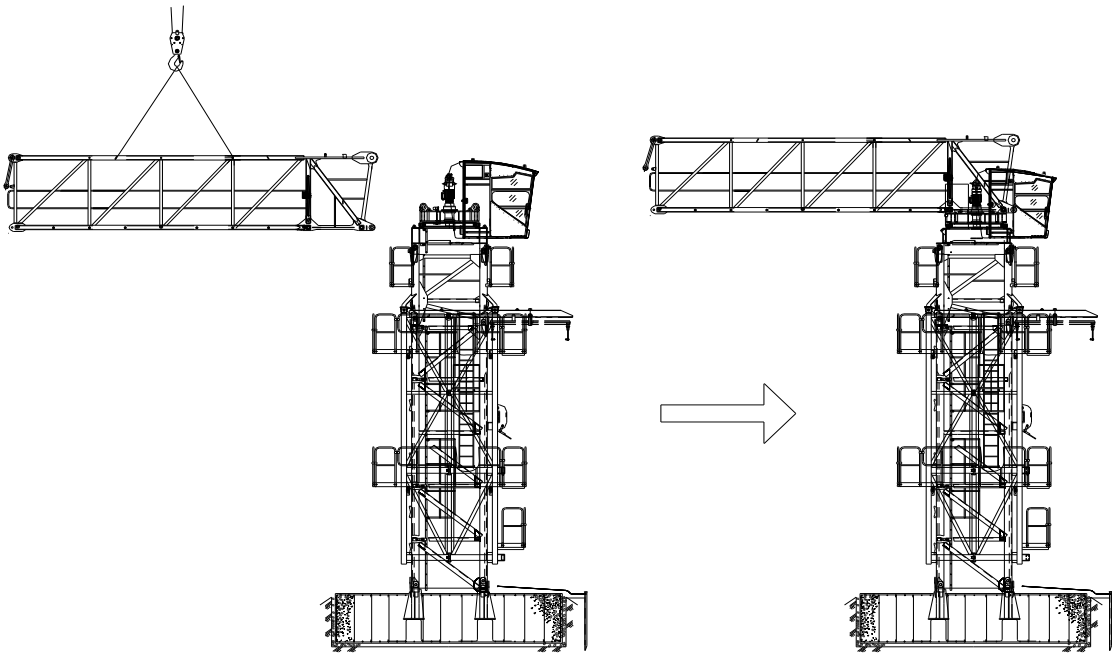


Fig. 4-22 Assemble the counter jib

4.5.4 Assemble the rear counter jib

Before sling the rear counter jib, in addition to install the platform, rail, derrick and hoisting mechanism, and also necessary to install the counter jib strut, as the following picture. The mechanism can be sling together or separately.

The main parts of counter jib (including the strut and hoisting mechanism) assembly had assembled following our company require, users only install the platform and rail, etc.

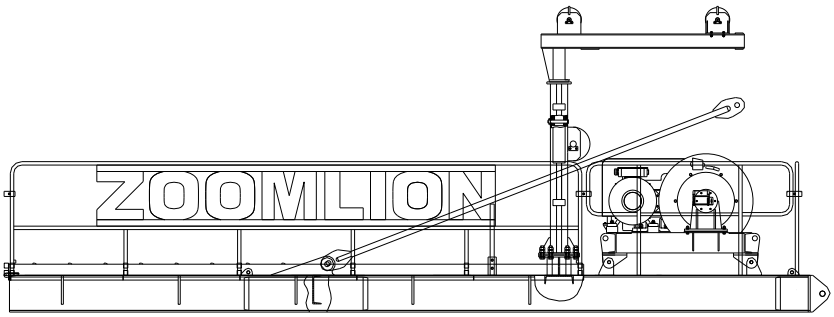


Fig. 4-23 Assemble the Rear counter jib

4.5.5 Sling the rear counter jib

Before sling, slew the slewing parts to a proper position, then sling rear counter jib by the 4 lifting lugs on it, as show in the following picture.

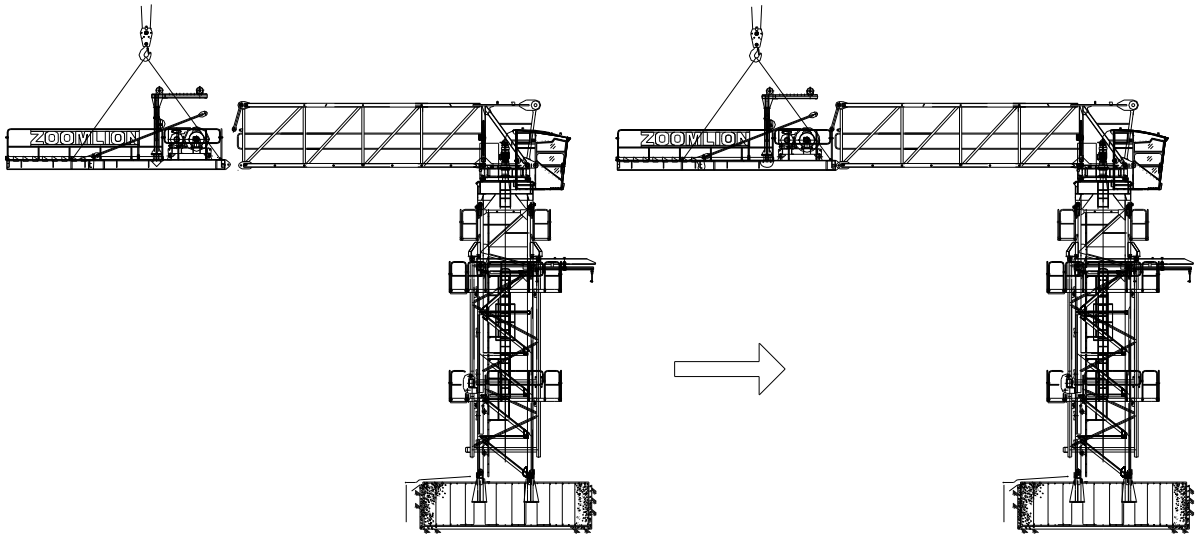


Fig. 4-24 Sling the rear counter jib

Use 2 sets of Φ55 pins to connect bottom chords of the rear and front counter jibs, then sling the rear counter jib slowly to make it turn around the connecting pins, fixed the long and short tie bars by 4 sets of Φ50 pins, as show in the following picture.

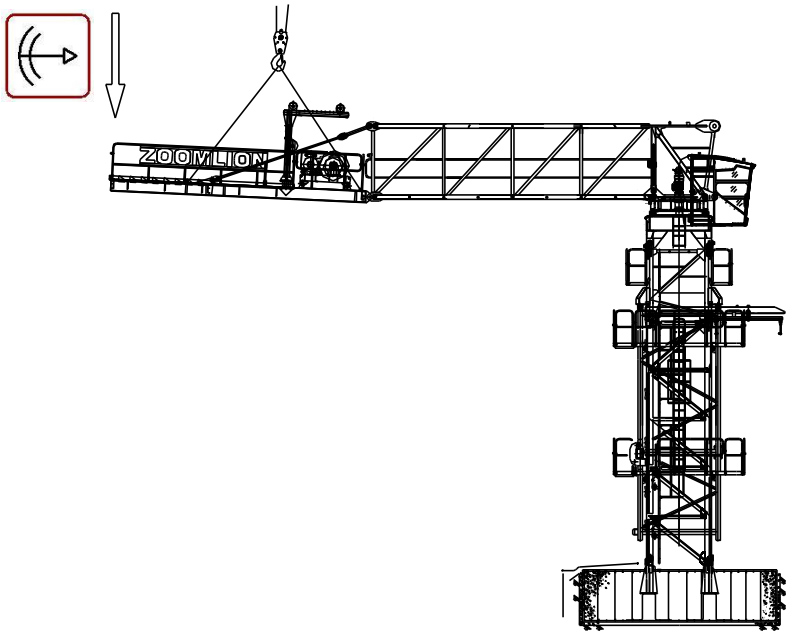


Fig. 4-25 Sling the rear counter jib

Finally, put the rear counter jib down slowly, and then finish the installation.

4.5.6 Installing the first 3.0 t counter ballast

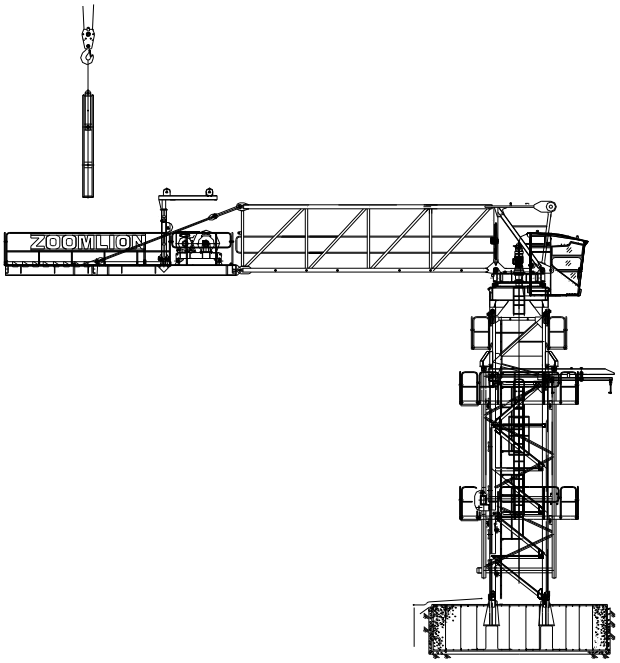


Fig. 4-26 Installing the first 3.0t counter ballast

- *The counter ballast is placed by hoisting mechanism, positioned at the middle of left and right, the distance between the two sides of counter jib and the side chords is uniform.*
- *The pins of counter ballast must beyond the support plate of the counter ballast.*

4.6 Installing the jib assembly

4.6.1 Assembling the jib

The jib assembly consists of the jib structure, trolley mechanism and trolley.

Assemble the jib according to the sequence mark on each section strictly, it's forbidden to install them mistakenly or randomly. The jib can be assembled to be length of 70m, 65m, 60m, 55m, 50 m, 45m, 40m, 35m, and 30m, refer to the ***Section 4.6.1.1***.

CAUTION:

- To avoid of the hoisting and trolley pulleys touching the ground when being transported and stored, the state of the pulleys should be like the Fig. 4-27.

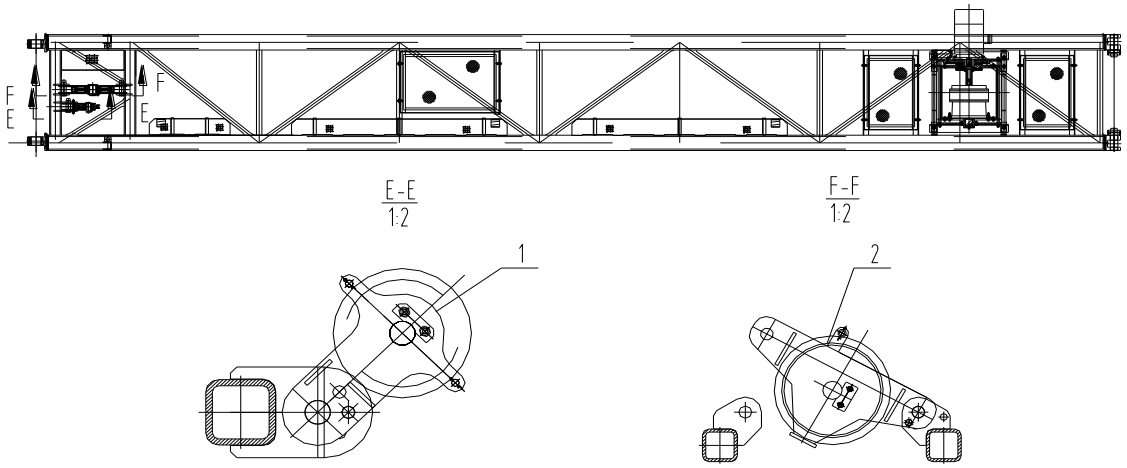


Fig. 4-27 State of the hoisting and trolley pulleys in transportation

- When installing the hoisting and trolley pulleys of the Jib Ⅰ, adjust them to the after-installed state. Otherwise, the hoisting and trolley ropes will wear the incline diagonal or the rope-block rod as the Fig. 4-28.

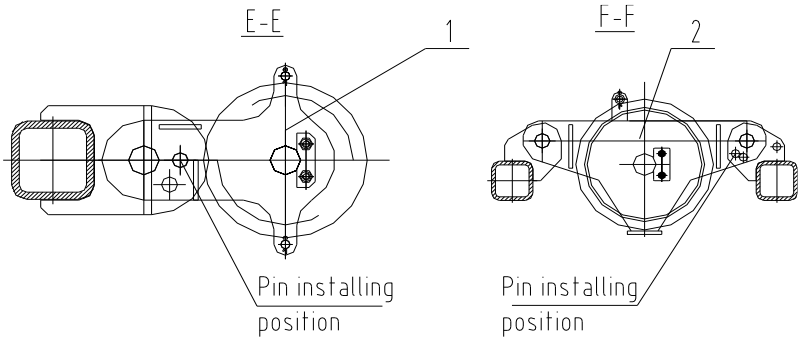


Fig. 4-28 State of the hoisting and trolley pulleys after installed

4.6.1.1 Jib combinations of different jib lengths

Table 4 28 Jib combinations of different jib lengths

Jib part / Jib length	Jib Ⅰ	Jib Ⅱ	JibⅢ	JibⅢ'	JibⅣ	Jib Ⅴ	JibⅥ	JibⅦ	Jib end
70m	●	●	●	●	●	●	●	●	●
65m	●	●	●	●	●	●	×	●	●
60m	●	●	●	●	●	●	●	×	●
55m	●	●	●	●	●	●	×	×	●
50m	●	●	●	●	×	●	×	×	●
45m	●	●	●	●	●	×	×	×	●
40m	●	●	●	●	×	×	×	×	●
35m	●	●	×	●	●	×	×	×	●
30m	●	●	×	●	×	×	×	×	●

Table 4 28 Jib part codes

Jib part	Code	Jib part	Code
Jib Ⅰ	000219705CT001000	JibⅥ	000219705CT006000
Jib Ⅱ	000219705CT002000	JibⅦ	000219705CT007000
JibⅢ	000281705JT003000	JibⅧ	000219705CT008000
JibⅣ	000281705JT004000	Jib end	000270505FT008000
Jib Ⅴ	000219705CT005000	/	/

4.6.1.2 The dimensions of jib connecting pins

■ The jib pin dimensions

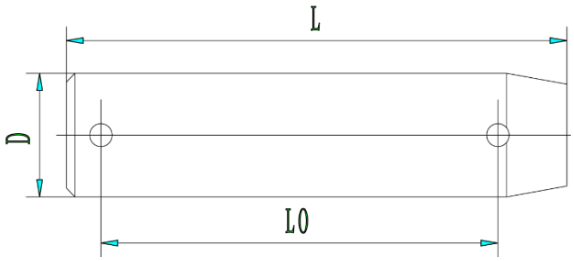


Table 4-2 Pins used to connect the upper and bottom chords of each adjacent jib

Position	Upper chord pin			Bottom chord pin		
	D [mm]	L0 [mm]	L [mm]	D [mm]	L0 [mm]	L [mm]
Jib Ⅰ & Jib Ⅱ	Φ90	250	320	Φ80	180	230
Jib Ⅱ & JibⅢ	Φ80	220	285	Φ70	160	203
JibⅢ & JibⅣ	Φ80	210	275	Φ70	160	203
JibⅣ & Jib Ⅴ	Φ60	180	240	Φ60	143	190
Jib Ⅴ & JibⅥ	Φ60	160	220	Φ60	133	182
JibⅥ & JibⅦ	Φ60	150	210	Φ60	133	182
JibⅦ & JibⅧ	Φ60	120	180	Φ60	121	170
JibⅧ & Jib end	Φ60	120	180	Φ60	121	170

4.6.1.3 Assembling steps

1) Prepare several brackets which's length are about 1.2m near the tower crane, for the jib above 50m shall not be less than 4, and for the jib not more than 50m shall not be less than 3. Each jib is connected by a pin at the upper chord by and two pins at the bottom chords. Assemble jibs except jib Ⅰ first, refer to Fig. 4-29.

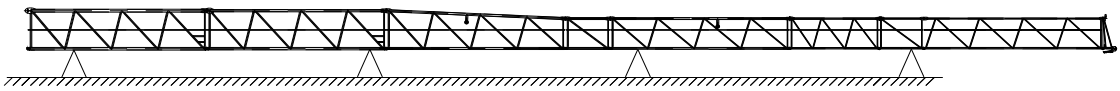


Fig. 4-29 Assembling jib

The assembling sequence must be strictly according to the sign on each jib, assembling in wrong sequence or assembling optionally are not allowed.

The trolley mechanism motor is on the opposite side of the driver's cabin.

2) Trolley mechanism from the side before loading jib Ⅱ, see Fig. 4-30.

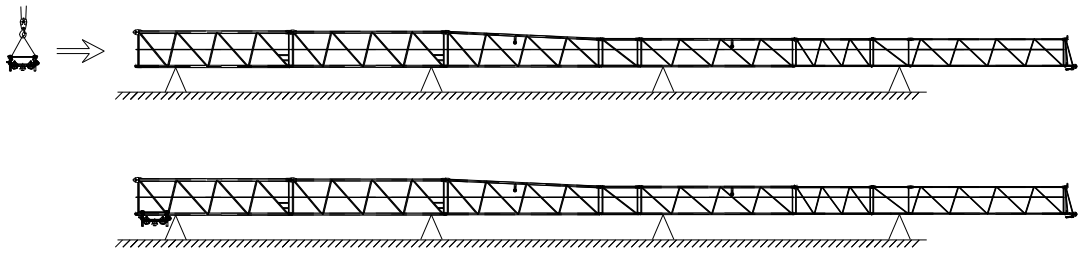


Fig. 4-30 Installing trolley

3) Jib Ⅰ installation connected to jib assembly section, and then remove the trolley to the jib Ⅰ roots and fixed, see Fig. 4-31.

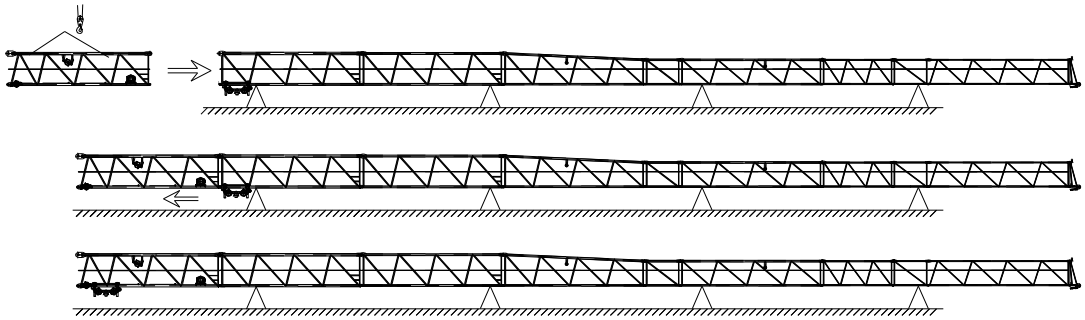


Fig. 4-31 Installing jib Ⅰ

No matter how long the jib is assembled, the trolley should be fixed on the guide rail of the bottom chord of the jib to prevent sliding.
The two trolley ropes (the short and long ropes) are connecting with trolley through the root pulley and tip pulley respectively, and then the length of the rope is tensioned respectively.

4.6.2 Reeling the trolley rope

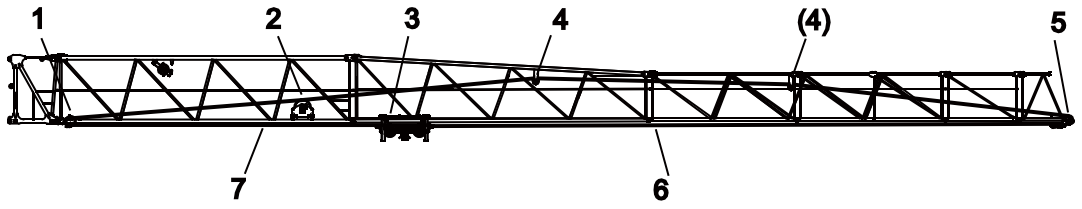


Fig. 4-32 Trolley wire rope layout plan

(1) Pulley on jib root
(2) Drum of trolley mechanism
(3) Trolley
(4) Rope rollers of jib
(5) Pulley on jib end
(6) Long rope
(7) Short rope

- *When change the double trolleys to single trolley at 2-fall, take out the trolley rope in the safe room of the auxiliary trolley.*
- *The short and long ropes of trolley mechanism must have three circles of safety rope on the drum under any circumstances, and a circle of isolation rope should be left on the drum.*
- *When changing the length of jib, the excess rope is tied and fixed to the trolley.*

4.6.3 Installing the jib assembly

1) Operating the slewing mechanism and make it running or use the crank of slewing mechanism to rotate the upper structure of tower crane to the position where the jib can be conveniently installed.
2) According to the center of gravity of the jib assembly of each jib length to hang the rope, see Fig. 4-33 and Table 4-3.Try to test the sling point whether balanced, otherwise the position of the hanging rope can be moved appropriately. The distance between the two sling points is 8m≤d≤20m.

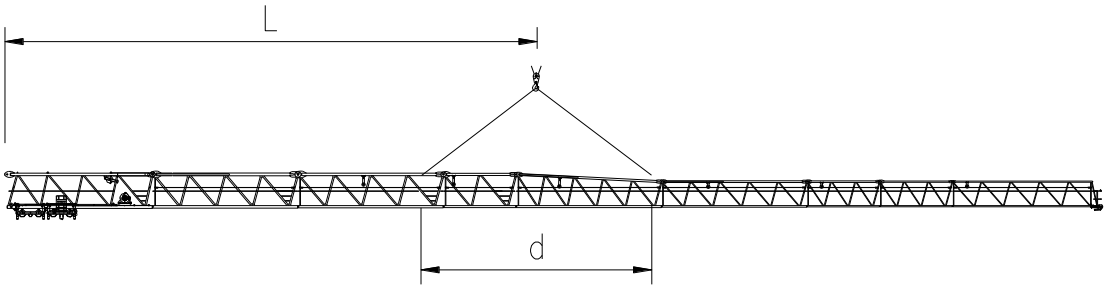


Fig. 4-33 Reference center of gravity of jib

Table 4-3 Reference center of gravity of jib with different lengths

Jib length/m	70	65	60	55	50	45	40	35	30
L/m	20.63	20.04	19.52	18.63	17.18	16.40	14.95	12.64	11.18
G/t	9.16	8.84	8.64	8.32	7.80	7.52	6.99	6.15	5.62

- *The above data are for reference and can be adjusted according to the actual situation on site.*
- *Record the place of hoisting point for the dismantling use.*
- *Hoisting jib by rope, see Fig. 4-34, the methods of A, B, D are right, while the methods of C is wrong.*
- *Forbid pulling aslant when hoisting jib assembly, see Fig. 4-34.*
- *In order to reduce the volume and weight of the jib assembly, or reduce degree of difficulty in the installation of air jib assembly and can be installed the counter jib after the completion of any link first installed jib* I *section , but this may need to be done in the air luffing rope an tension.*

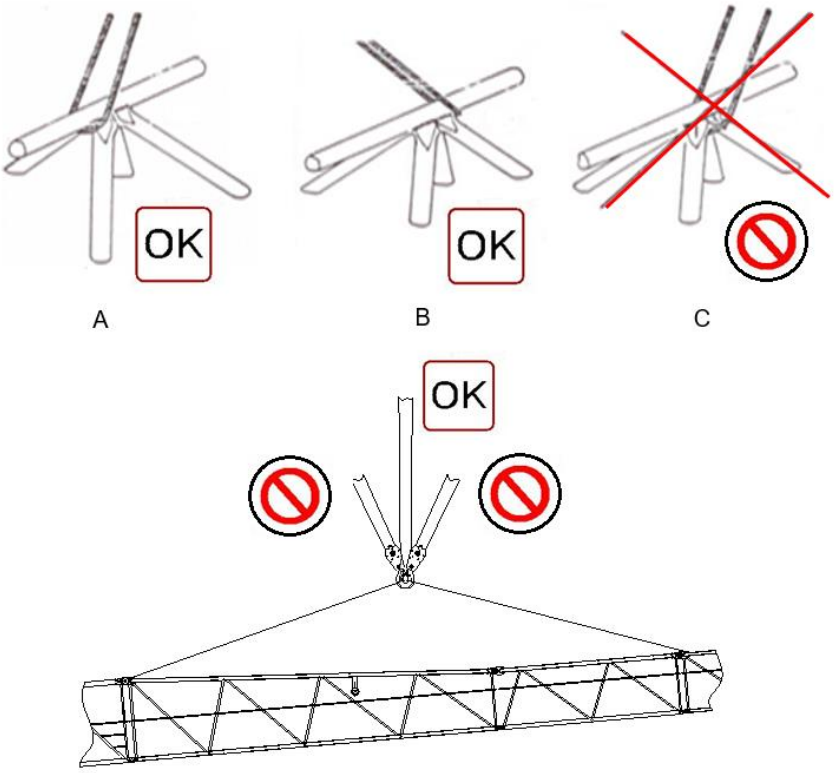


Fig. 4-34 Notice about hoisting jib

3) Hoist the jib assembly to mounting height, see Fig. 4-35. Connect it to the counter jib by one Φ100 pin and two Φ80 pins.

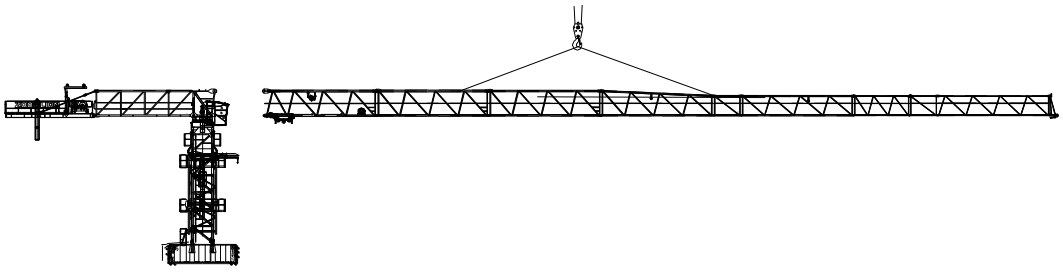


Fig. 4-35 Installing the jib assembly

4.7 Installing the remaining counter ballast

Install the remaining counter ballast blocks according to the ***Section 3.7.2***.

Users have to choose a proper plate to cover the remaining empty after installing all the counter ballast.
After install all the counter ballast, please check carefully and make sure that all the counter ballast are fixed stable.

4.8 Electronic control system installation

- Please follow the attached circuit diagram to connect the circuit.

The wiring diagrams are posted on prominent positions of mechanism and electronic component (as Fig. 4-36), the two ends of cable also attached model name, connection potion, parameters indicate (as Fig. 4-37). Please follow the instructions to connect wire.

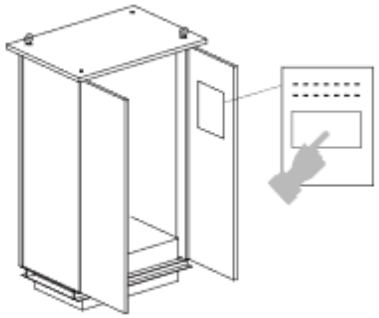


Fig. 4-36

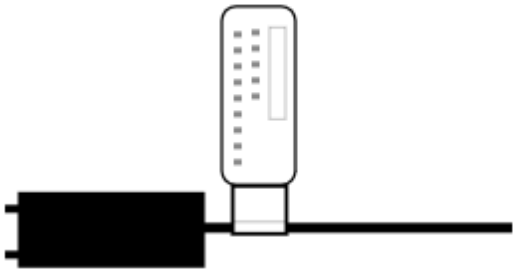


Fig. 4-37

- The installation of electronic control system needs choose good weather condition (cannot raining/snowing/fogging). Otherwise, may damage electronic control system or personal injury.
- Before the installation of the electrical control system, a preliminary inspection shall be carried out on all components of the electrical control system to observe whether there is damage or loss of part in the control cabinet, and whether there is damage, carbonization and loosening of wires and cables. And please release the damaged equipment.
- Before the electrical control system is not connected, separate insulation tests can be carried out on the motor, resistor, cable and other parts to judge whether there is a fault, but insulation test cannot be carried out after the connection of the electrical control system.
- The wire connection and the body installation of all components in the control cabinet should be firm and reliable, and no loosening phenomenon should occur,
- The display screen of the auxiliary safety monitoring system should be fixed firmly and the communication cable connection should be reliable.
- Please connect the cables between the control cabinets as well as between the control cabinets and other external wiring diagram. please note that the connection of each cable should avoid interference with moving part, and also leave a margin for the moving part to move. If the cable slot, please put the cable in the slot.
- After wire connection, make sure circuit is correct, connection firm and reliable, no short circuit.

- *The cable hanging on the mast should using cable net, and set cable net every 20m.*
- *The power cable can only extension with intermediate junction box, directly junction is prohibited.*
- *The power cable and control cable should distribute separately, do not close parallel installation.*

4.9 Power line connection of mechanism

- Please refer to the attached circuit diagram for wire connection.
- The wiring diagrams are posted on prominent positions of mechanism, please refer to the diagrams for wire connection.

4.10 Frequency converter self-learning

The tower crane is driven by full frequency conversion. When the crane is started for the first time, after trial operation and calibration setting, and before normal operation, the frequency converter of hoisting, slewing and trolley shall be studied and operated, so that the frequency converter can obtain the internal mechanism and make the operation more stable and efficient.

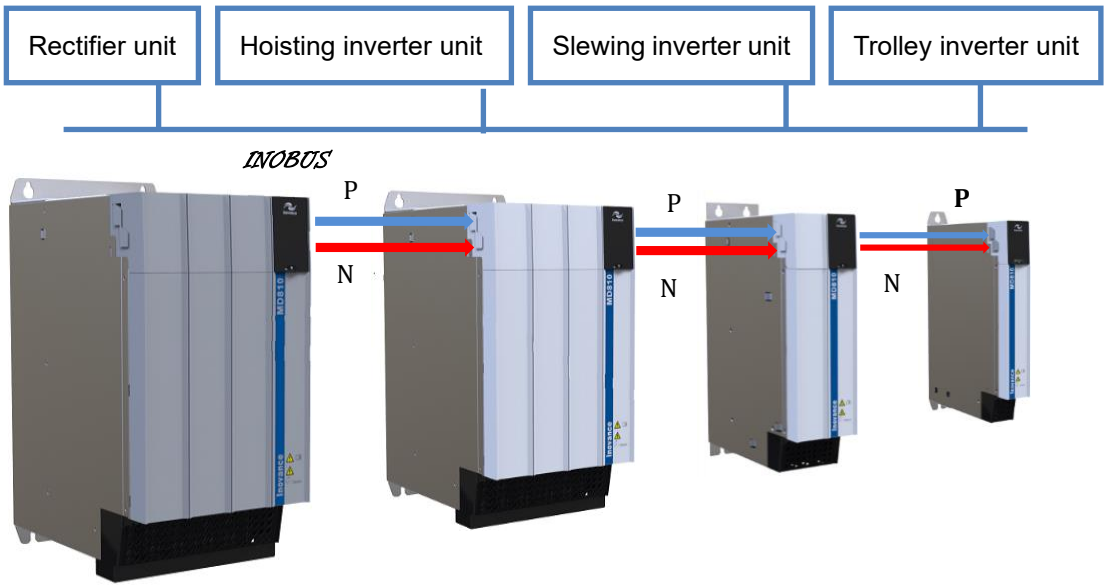


Fig. 4-38 Frequency converter structure

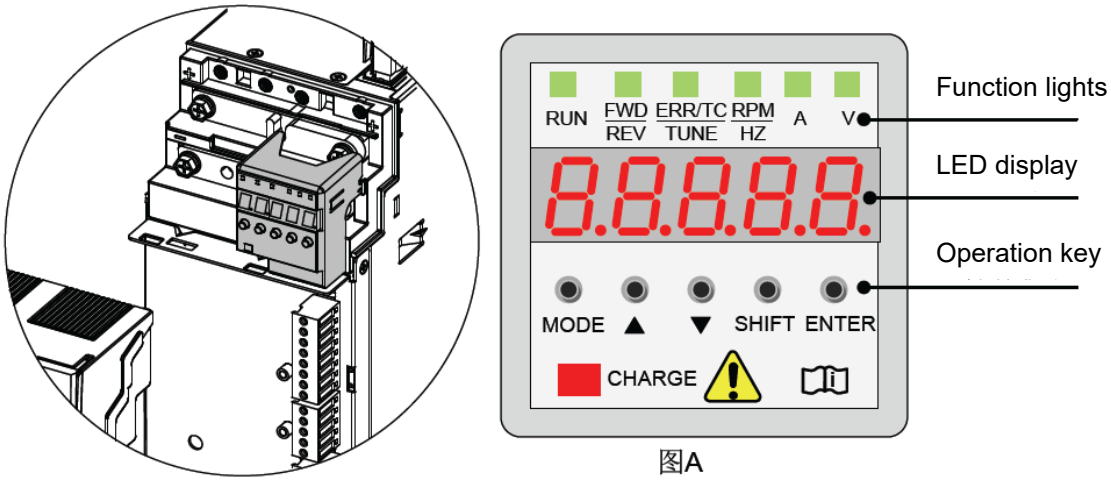


Fig. 4-39 Frequency converter operation panel

Key	Key's name	Key's function
MODE	Mode key	Enter or quit the menu, switch the modes of inquiring parameters.
▲	Add key	Add the data or parameters.
▼	Reduce key	Reduce the data or parameters.
SHIFT	Shift key	Choose the displaying parameters circularly, choose the spell of parameter to modify.
ENTER	Enter key	Enter submenu, confirm set parameters.

■ Self-learning methods of frequency converter:

1) After the motor connected and powered on normally, first set the command source F0-02 of the frequency converter to 0 (command and control of the operation panel);
2) Input motor type plate parameters (A0.01-A0.05), when slewing self-learning change F4-00 to 0.
3) Set function code F1-37 to 3 (static tuning) and press "Enter" to confirm. At this time, the panel will display RUNE. Then press "Enter" on the panel and keep 3s, the frequency converter will drive the motor to start running. Waiting for 2 mins, the screen back to normal parameter display status, tuning done.
4) Set the frequency converter command source F0-02 to 2 (terminal control). when slewing self-learning change F4-00 to 8.

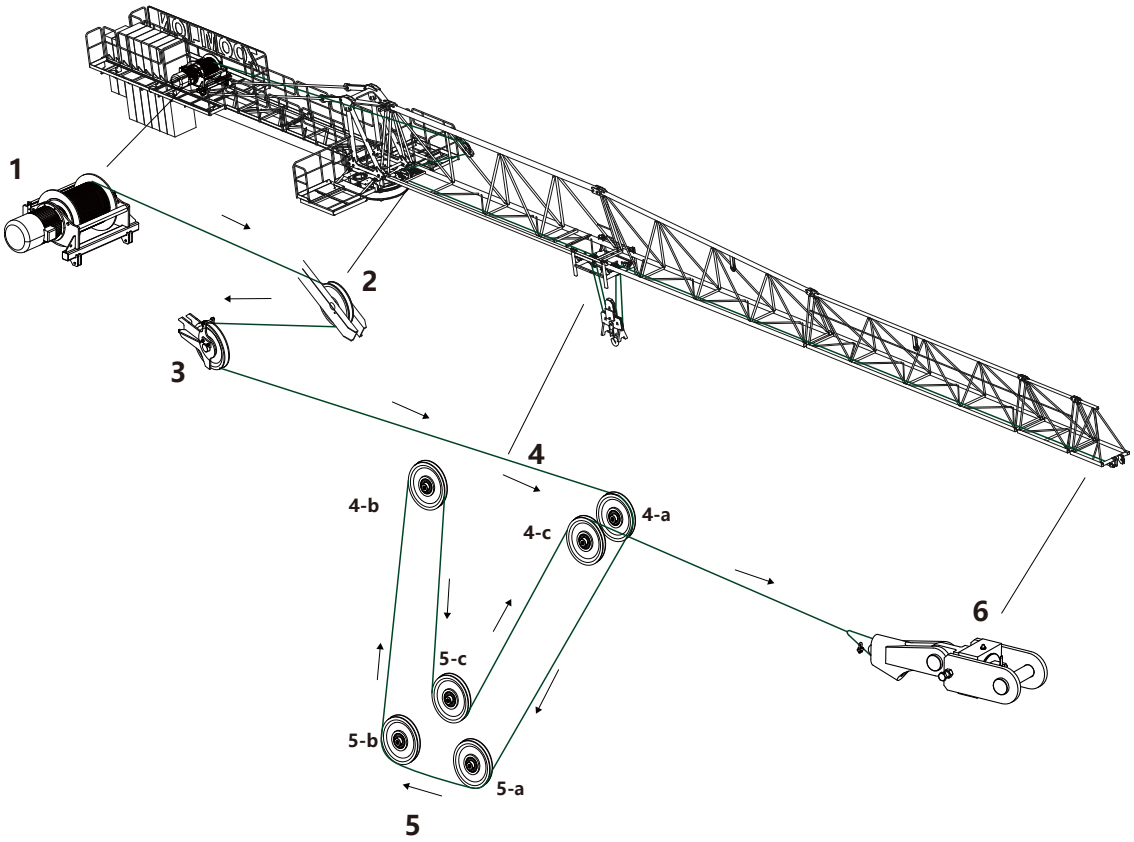
   To further improve the performance of slewing mechanism, it is recommended to continue online tuning of the slewing frequency converter after the completion of static tuning. The steps are as follows:
5) Set the source B8-03 to 1 (online tuning), screen display "uLoc";
6) After confirming that there is enough room and safe operation, operate the slewing handle to the 4th gear. At this time, the tower crane jib will rotate the 4th gear speed. The frequency converter will successively display: UloC→LoC→Good, which indicates that the spectrum tuning is over and normal use can be started.

Note: UloC: Start tuning online
LoC: Enter online tuning
Good: Online tuning ends

If online self-learning fault, the frequency converter will display 'E77.00'code. need clear the fault and restart the self-learning process. Firstly, static tuning and make sure parameters are correct, then start online tuning. Before online tuning, drive the boom to the place which have enough moving distance, then start it. Change driving mode to level 3 or 4 and keep it. The screen display 'LOCK' means frequency locked, keep around 6 seconds, display 'GOOD', means tuning finished, we can shut down tower crane.

4.11 Winding the hoisting rope

1) Moving the trolley to the jib root. It is placed below the trolley that the support is made by customer self. The hook is fixed vertically.
2) Pull the hoisting rope out from the rope drum of hoisting mechanism, start the fall down gear of mechanism. Drive the rope to pass through the rope roller on the counter jib, pulley with load limiter which on the jib Ⅰ, direction-changing pulley on the jib root, and the pulley assemblies of the trolley and hook (**on the ground**), see Fig. 4-40.



(1) Drum (2) Load limiter

(3) Trolley (4) Anti-twist device

Fig. 4-40 The drawing of winding the hoisting rope

(Winding order: 1 → 2 → 3 → 4-a → 5-a → 5-b → 4-b → 5-c → 4.c → 6)

3) Use two clips to fix the hoisting rope to the proper position on the trolley, leaving a margin of not less than 1.2m.
4) As Fig. 4-41, the hoisting rope get into the anti-twist device which on the jib end after getting out from the trolley. Use the wedge (3) lock the rope (1) to the wedge sleeve (2), and install a rope clip to the end of the rope. Install the wedge sleeve (2) to the roe anti-twist device by the pin (6) and split pin (7). Pay attention to match way of the wedge, wedge sleeve and clip.

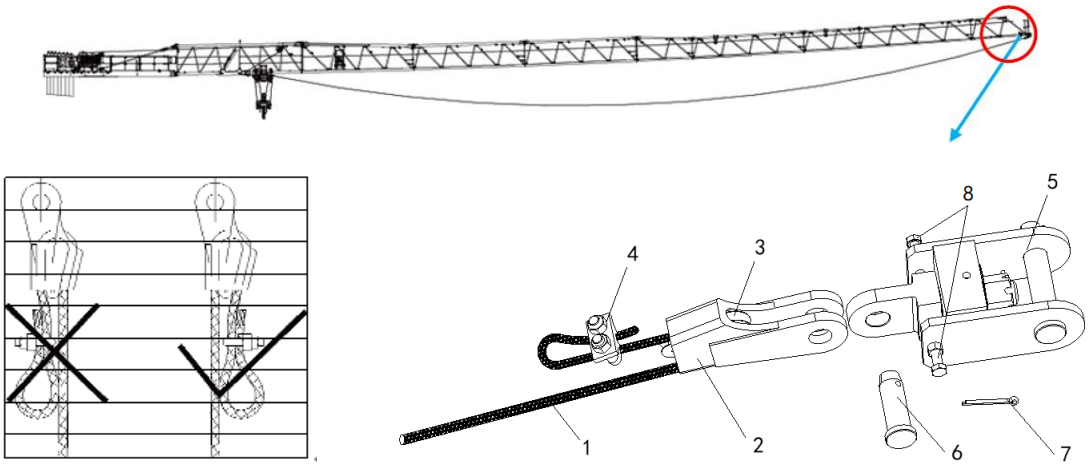


Fig. 4-41 Fixing the hoisting rope to the anti-twist device

(1)	Hoisting rope	(2)	Wedge sleeve
(3)	Wedge	(4)	Rope clip
(5)	Anti-twist device	(6)	Pin
(7)	Split pin	(8)	Adjusting bolts & locking nuts

1) Slowly start the hoisting mechanism. Hoist the hook to a height of **1m** above the ground, and make sure that the hoisting rope has been fixed firmly.
2) Start the trolley mechanism to open the trolley and hook to the hoisting tip jib.
3) Fix the wedge at the tip jib anti-twisting device. Slowly lower the trolley to the support below the tip jib. And dismantle the rope clamp that fixed the hoisting the trolley, and loosen the hoisting rope.

- **When hoisting ropes are non-rotating ones, the anti-twist device shall lock tightly the locking screws (8) (see Fig. 4-42) while the tower crane is in service.**
- **When hoisting ropes are anti-rotation ones, the anti-twist device shall unlock the locking screws (8) when the crane is in service.**
- **When using new ropes, the hook will rotate at no-load operation. At this time, unlock the anti-twist device.**
- **After long time using of tower crane, the wire ropes will be extended and slightly twisted, in this case, unlock the anti-twist device temporarily, and lock the device again when ropes have been tensioned.**
- **Once rope has their strands loosened, the anti-twist device will accelerate rope deterioration, so should change the deteriorated ropes timely.**

4.11.1 Adjusting method of Anti-twist device

- After screw the bolts of both sides out from the square plane of the rotating shaft, lock the locking nuts of both sides, so that the anti-twist device can rotate freely.

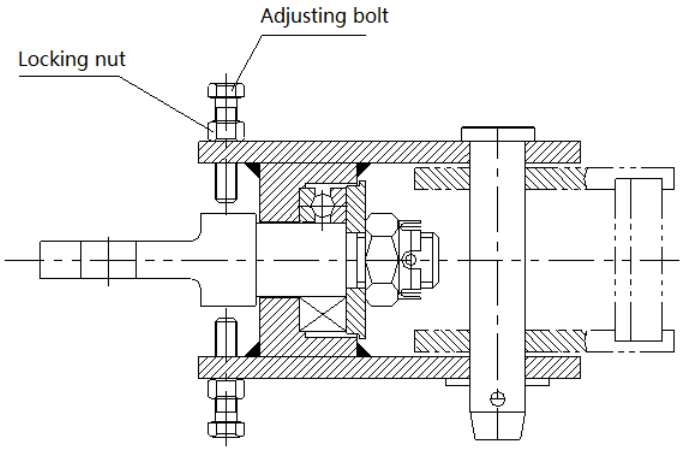


Fig. 4-42 Releasing the anti-twist device

- Screw down the adjusting bolts of both sides until them touch the square plane of the rotating shaft tightly, then use the locking nuts of both sides to fasten the bolts, so that the anti-twist device is locked.

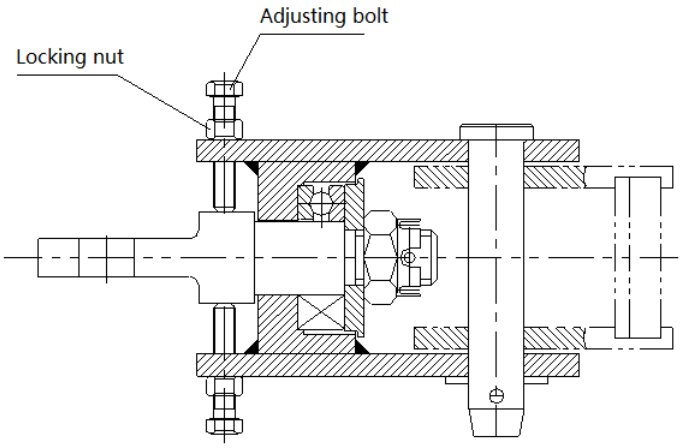


Fig. 4-43 Locking the anti-twist device

It's forbidden to place the hook on the working platform or mounting-in platform for winding the hoisting the hoisting rope; if the tower crane is too high, you can slew the tower crane and hoist the hook to a floor which has enough bearing capacity, then to proceed the rope-winding operation.

4.11.2 Adapting of the new hoisting rope

- Before using the new hoisting rope, ensure that the safety devices are working normally.
- There is rotating inner stress in the new hoisting rope, the stress must be released by the anti-twist device before the tower crane working formally.
- The releasing way is making the tower crane execute 20 **working circulations** at low-speed and low-load state.
- The whole rope-pulley system can be adjusted to normal working state in the way, too.

4.11.2.1 Definition of the working circulation

A working circulation including a reciprocating motion of hoisting and a reciprocating motion of trolleying with **80% rated load of jib end**.

Reciprocating motion of hoisting: hook hoisting from the lowest position to the highest position and then move back to the lowest position;

Reciprocating motion of trolleying: hook trolleying from the jib root to the jib end and then move back to the jib root.

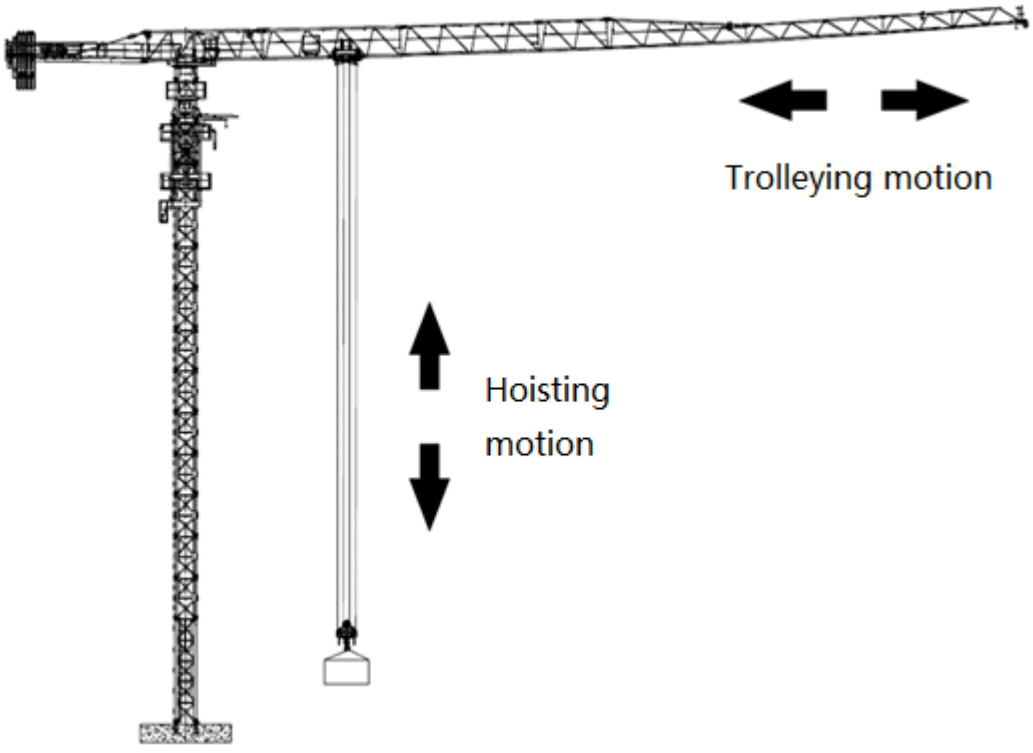


Fig. 4-44 Reciprocating motions of working circulation

Do not use the new hoisting rope in the state of high-speed and heavy-load directly. Use it in a low speed and load state for certain times of working circulation, then increase the speed and load step by step.
So that the rope lifetime can increase and rope fault can decrease.

4.11.3 Solutions of rope twist and daily inspection

In the winding and adapting process of the new hoisting rope, it's vital to pay attention to rope twisting and hook deflecting. Besides, it's vital to inspect the same problems regularly in normal using. The specific solutions and daily inspection items are:

1) The anti-twist device must keep at locking state when solving the rope twist problem;
2) Observe if the hook is deflecting when it moving down, if dose, it means there is inner stress in the rope, record the deflecting direction in this situation;
3) When the hook deflecting just happened, stop moving down immediately, then open the anti-twist device, rotate it by hand to release the inner stress until the hook doesn't deflect, then lock the anti-twist device;
4) Drive the trolley from jib root to jib end and then drive back to the jib root for 3 times, observe if the hook is deflecting again, if dose, repeat the process 3) until the hook doesn't deflect.
5) Observe if the hook is deflecting when it moving down further, if dose, repeat the process 3) and process 4) until the hook doesn't deflect.
6) If the hoisting rope is rotating rope (type of 6x29Fi or K4x39S or other types of the same kind), check if there is any deflecting on the hook for every 10 days, if there is, adjust as the processes above;
7) If the hoisting rope is anti-rotating rope (type of 35Wx7 or other types of the same kind), check if there is any deflecting on the hook for every 10 days, if there is, adjust as the processes above. Check for 3 times continuously, if there is no any deflecting on the hook, release the anti-twist device, let it rotating freely.

- **If the hoisting rope is rotating rope (type of 6x29Fi or K4x39S or other types of the same kind), the anti-twist device must be locked when the tower crane is working.**
- **If the hoisting rope is anti-rotating rope (type of 35Wx7 or other types of the same kind), the anti-twist device must be released when the tower crane is working.**

4.11.4 Suggestion about the rope length

The rope length in use should be decided by the hoisting height and physical truth. Especially for that there is quite a long time from 0 to the maximum height for the constructing height of the building, if the rope length reaches the length of maximum free-standing height tower height at the beginning, in quite a long time, most of the rope will stock on the drum, it not only increases the winding diameter, but also cause the rope stocking. Besides, the rope's lifetime is limited, if any misuse or accident happened (such as taking out of rope groove, overload, stress-releasing device fault, greasing not in time, etc.), the rope breaks in the early time, it will cause the whole rope scrapping.

So, it is suggested to use a rope of 1/4~1/3 maximum length in the early time, replace to the maximum length then. It's really benefits for the rope drum, hoisting mechanism, and whole safety!

4.12 Power connection and test run

Switch on power to all electrical circuits according to the electric circuit diagram and start all mechanisms for test run. Check mechanism for proper operations. At the same time, check wire ropes at different locations for normal working and for any interference with structure member. Remove all abnormal cases.

4.13 Calibration of electronic limit

4.13.1 One-key calibration of electronic limit

4.13.1.1 Purpose

Before the tower crane performs the normal hoisting task, this method can be used to perform the initial calibration settings of the tower crane's hoisting, slewing and luffing three-axis positions and the initial weight calibration setting, which is lay the foundation for the real-time display of position of the subsequent tower crane's hoisting, slewing and luffing three axes and hoisting weight.

4.13.1.2 Application description

"One-key calibration function" can realize the initial calibration setting of the three-axis position and weight of the tower crane through the single-point position and weight sampling value. First, let's explain the interface that needs attention in the process.

The calibration setting interface is used to guide the user to complete all steps of tower crane calibration. Click the tower crane model display box to enter the model setting interface, click "✔" and save to enter the next interface (the working condition setting interface). The interface is shown in Fig. 4-45.

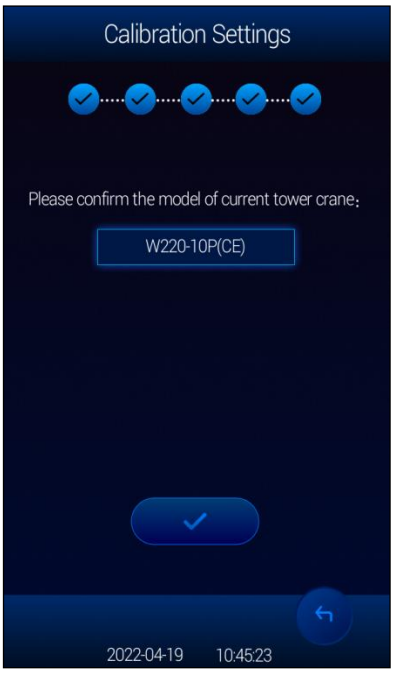


Fig. 4-45 Calibration setting interface 1

If the five steps have not been full completed, click the return button in the lower right corner or the button in the lower left corner to return to the main interface, the following interface prompt will pop up, please confirm whether to exit the calibration setting interface, as shown in Fig. 4-46:

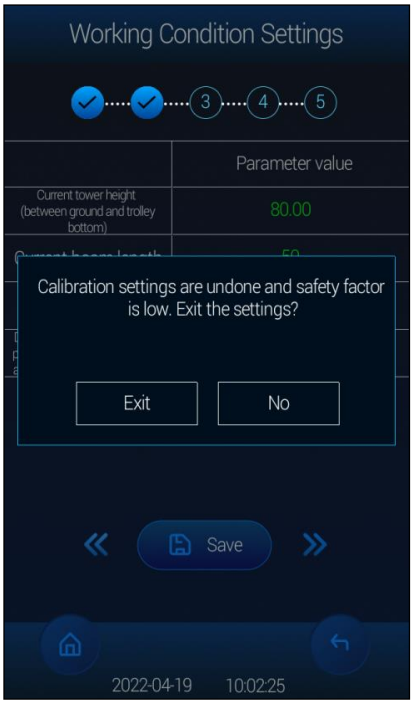


Fig. 4-46 Calibration setting interface 2

You must complete the first and second steps of calibration before you can click Continue to set up the next steps. If you have not completed the first or second step, click Continue to set up, the following interface will pop up, please return to the settings Unfinished interface Complete the settings of the first and second steps. The interface is shown in Fig. 4-47:

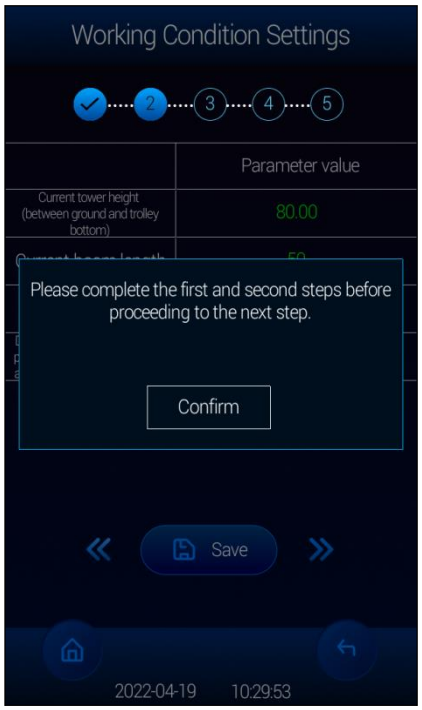


Fig. 4-47 Calibration setting interface 3

If you return to the previous step or enter the next step without completing the settings in the working condition setting interface, encoder setting interface, one-key calibration interface or calibration review interface, the following interface prompt will pop up, please confirm whether to continue, the interface is as shown in Fig. 4-48:

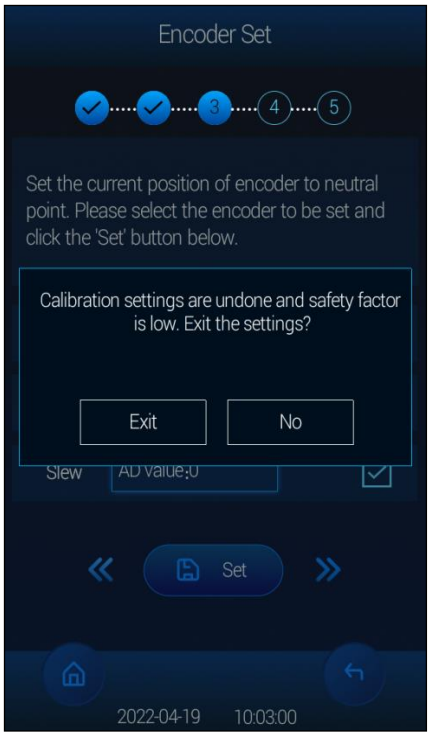


Fig. 4-48 Calibration setting interface 4

After completing the first and second steps, click Continue to enter the setting interface of the next step. If the subsequent steps are all completed, the following interface prompt will pop up, click Exit to return to the previous menu, the interface is as shown in Fig. 4-49:

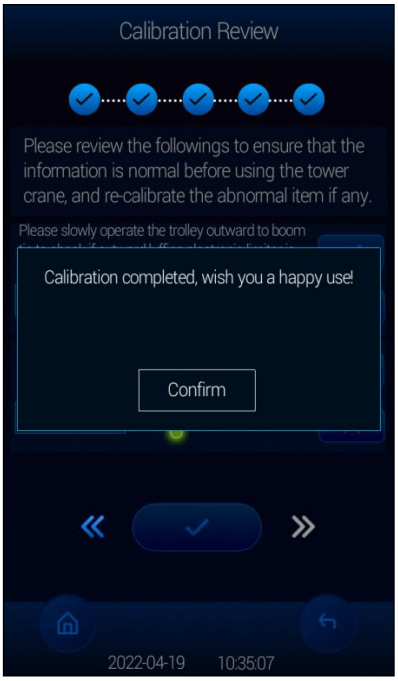


Fig. 4-49 Calibration setting interface 5

If the settings of the first and second steps have been completed in the previous stage, when you enter the calibration interface again, you can directly enter the calibration interface of the subsequent steps and select the interface to be set.

Next, several main interfaces of the complete process of the one-key calibration function are explained. details as follows:

- Model setting interface

The model setting interface is used to set the tower crane model. The interface is shown in Fig. 4-50:

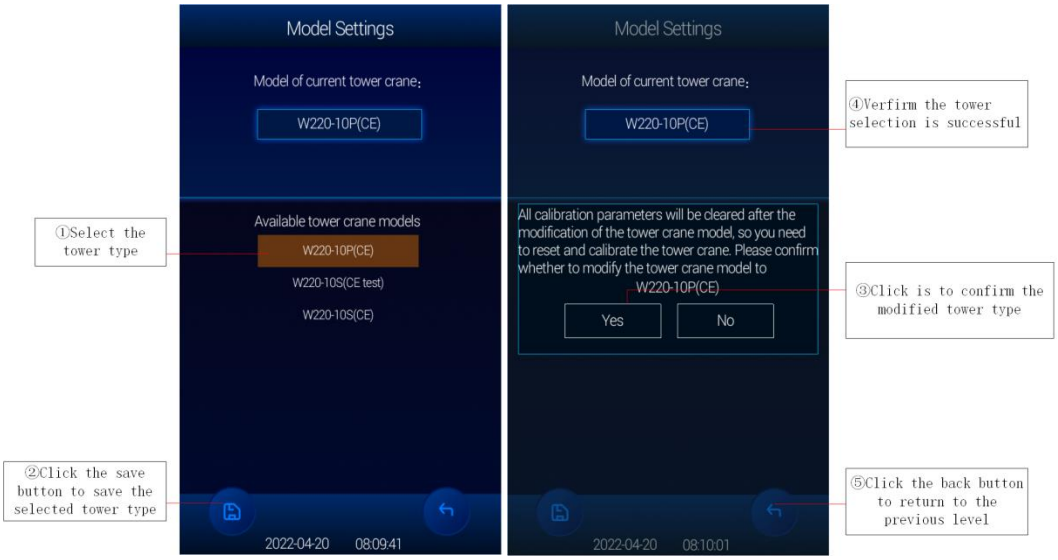


Fig. 4-50 Model setting interface

As shown in the figure, you can slide the model list up and down to select the model, and then press the save button to complete the tower crane model setting. After the setting is completed, enter the configuration of the "Condition Setting Interface".

■ The working condition setting interface

The working condition setting interface is used to set working condition parameters, including the current tower height, current arm length, fall, and hook lower stop distance. The interface is shown in Fig. 4-51:

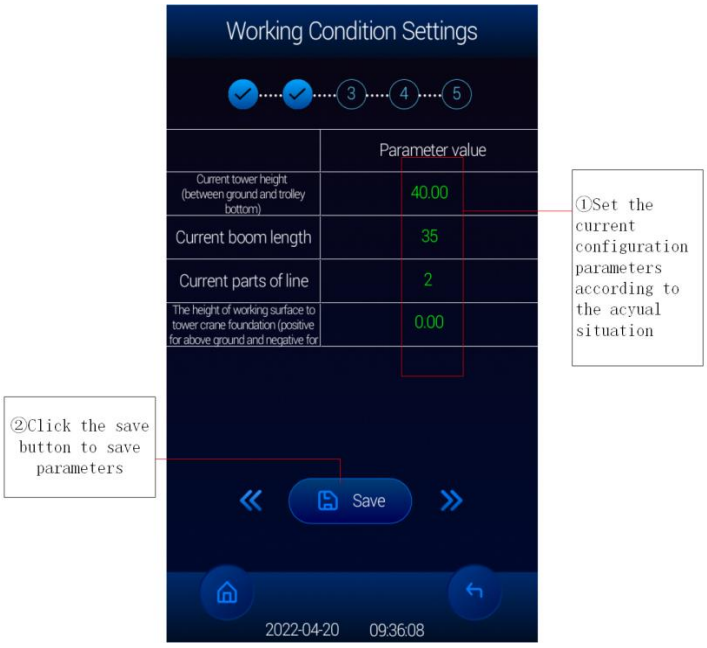


Fig. 4-51 Working condition setting interface

As shown in Fig. 4-49, select the project parameters to be set, and manually input the parameter values. The physical meanings of the specific parameters are as follows:

Current tower height: the working height of the current tower crane;

Current boom length: the working range of the current tower crane;

Fall: the working fall of the current tower crane;

The distance of the lower stop points of the hook: the value of the lower stop points of the tower crane height limit;

After the setting is completed, click the save button to save the current setting, and prepare to enter the setting of the "encoder setting interface".

■ Encoder setting interface

Encoder setting can set the current position of the encoder as the midpoint, select the height, amplitude (when the tower type is a boom crane, there is no such item), and rotate the encoder that needs to be set among the three encoders, and click the save button. The setting can be completed, and the interface is shown in Fig. 4-52:

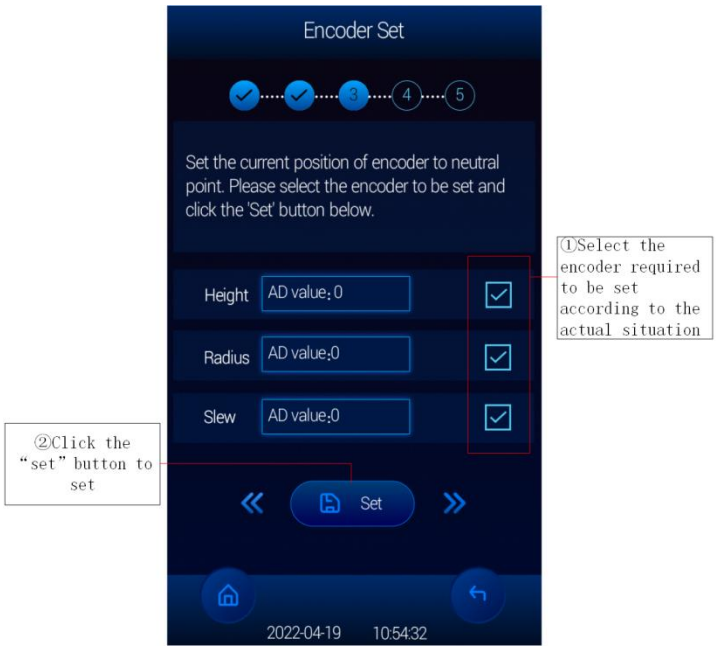


Fig. 4-52 Encoder setting interface

When setting the height encoder, please operate the hoisting mechanism to move the hook to the bottom of the trolley, and the amplitude encoder and rotary encoder can be set arbitrarily.

■ The one-key calibration interface

The one-key calibration interface is used for one-key reset height, amplitude (when the tower type is a boom crane, there is no such item), swing and lifting weight zero position, please operate the selected mechanism to the required position in the interface to complete the corresponding. The tower crane can be used normally only after one-key calibration of the mechanism. The interface is shown in Fig. 4-53:

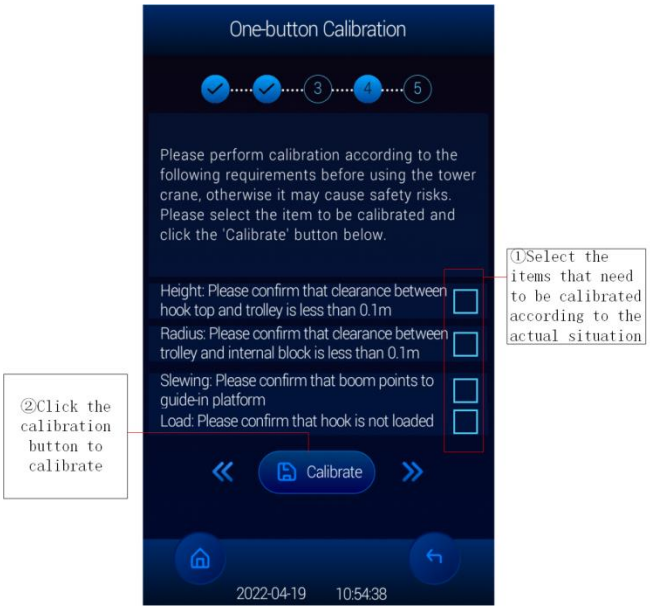


Fig. 4-53 The one-key calibration interface

■ The calibration review interface

The calibration review interface is used for amplitude and height review (if the height and amplitude are not calibrated, there is no review item, and no review is required; when the tower type is a boom crane, there is no calibration review step). The interface is shown in Fig. 4-54.

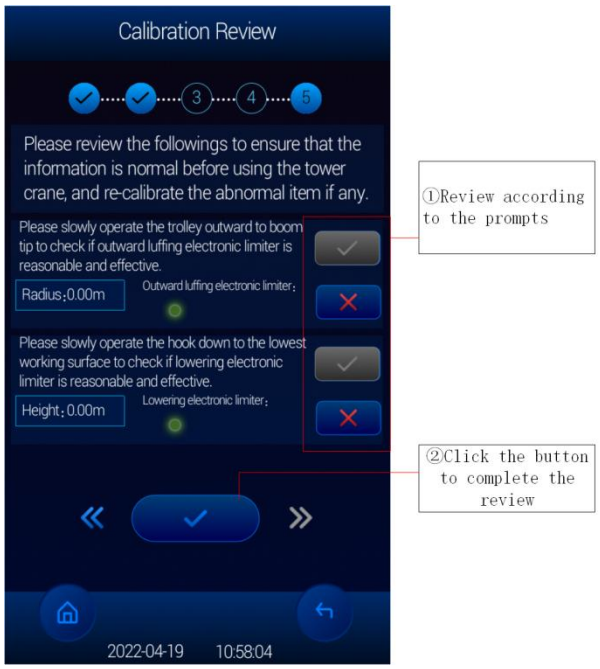


Fig. 4-54 The calibration review interface

Please follow the prompts to operate the tower crane for review. When the electronic limit is triggered, the light is green and the "√" button on the right can be clicked. When the electronic limit is not triggered, the light is gray and the checkmark cannot be clicked. The "×" can always be clicked. The calibration status is set to uncalibrated. When the range or height has been reviewed, the color of the content in the corresponding red box will turn green, "Unreviewed" will change to "Reviewed" and the font color will turn green.

If the working condition is 2 falls and the double trolley is used at the same time, please use the trolley according to the specification (only the outer trolley can be used, otherwise the calibration cannot be completed).

In summary, the complete one-key calibration steps can be completed according to the above interface flow.

4.13.2 Electronic limit dynamic deceleration

■ Purpose

After completing the "one-key calibration function" setting of the tower crane, when the tower crane is in the "electromechanical dual control" mode, when the positions of the three axes of hoisting, slewing and luffing are close to their respective stopping points and continue to move in the direction of the stopping point, you can Realize the steady deceleration of the three-axis motion, and finally stop at the relevant stopping point, thereby ensuring the safety of the boundary of the three-axis of the tower crane.

■ Application specification

The dynamic deceleration function is a safe speed limit function when each axis of the tower crane is at the boundary, ensuring that each axis can smoothly decelerate when it moves to the boundary. The deceleration algorithm is a dynamic uniform deceleration speed control algorithm proposed by fully considering the current position value of the tower crane's three axes, the setting value of the stop point, the acceleration and deceleration time controlled by the inverter, and the mechanism's real-time state and control parameters such as the mechanism transmission ratio. The current safe speed parameters that can be run are obtained by calculating the distance between the current three-axis motion position and the stop point position, so as to realize the safe speed limit of the three-axis of the tower crane.

The dynamic deceleration can only work after completing the "one-key calibration function" setting of the tower crane, when the tower crane is in the "electromechanical dual control" mode.

4.13.3 Electronic limit auto-calibration

■ Purpose

During the normal operation of the tower crane, the two parts of the displacement sensor are judged by comparing the movement displacement of the mechanism converted from the sampling values at both ends of the inverter and the limiter of each axis of the tower crane (hoisting, slewing and luffing) in real time. Whether the components are faulty, so as to ensure the safety of the three-axis control of the tower crane's hoisting, slewing and trolleying.

■ Application specification

When the hoisting, slewing and trolleying mechanism of the tower crane has a fault of the inverter or the encoder at the limiter end (including the fault of the coupling, etc.), it will cause a large difference in the movement displacement of the mechanism converted from the sampling values at both ends, so that there will be a fault related to the mutual calibration of the shaft and electricity. Finally, "height (or slewing, trolleying) sensor speed feedback fault (fall off)" will be displayed on the fault diagnosis page of the screen.

4.13.4 Mechanical limiter review

■ Purpose

When mechanical limits such as load moment, weight, hoisting, slewing, and trolleying are triggered, determine whether the relevant physical parameters (such as load moment percentage, weight percentage, and position and other tower crane real-time parameters) are safely set. Within the threshold range, it is consistent with the setting of the electronic limit value.

■ Application specification

When the relevant mechanical limit of the tower crane is triggered, if the difference between the real-time parameters of the tower crane related to the mechanical limit and the set value of the electronic limit exceeds a certain range, the fault diagnosis page of the tower crane display will report the relevant limit parameters. "The state of the electrical inspection machine is abnormal".

4.14 Fall-changing system

The fall-changing system is a pendulum system that consists a pulley assembly, when the device is connected to the hook, the whole system is 4 falls, when the device is off from the hook and stay at the below surface of trolley, the whole system is 2 falls. See Fig. 4-55.

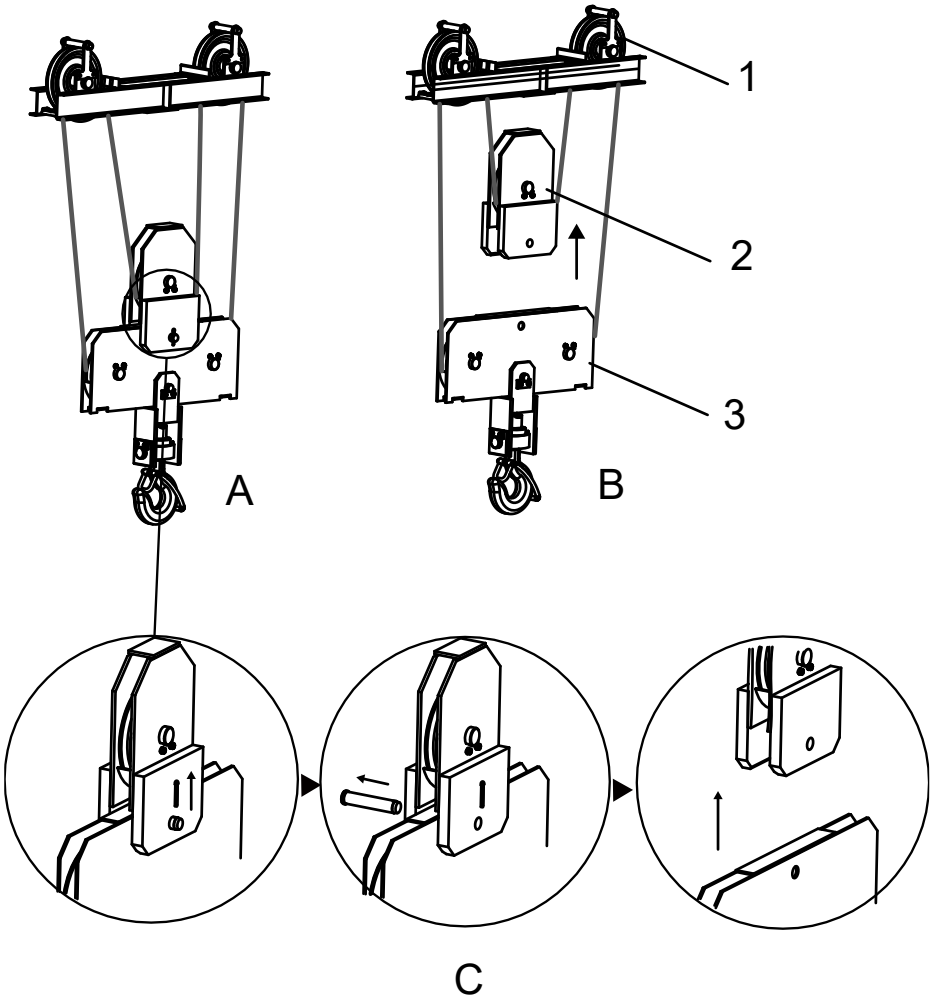


Fig. 4-55 The schema of the fall-changing system

(1) Trolley

(2) Upper pulley assembly

(3) Below pulley assembly

The fall-change is converted at the jib root section under the conditions of no-load, slow speed and no swing. No matter how it is required to convert 2 falls to 4-fall or to convert 4-fall to 2-fall, the by-pass switch must at first be turned to the by-pass status to disable the height limiter. After conversion completion, the by-pass switch must be restored to its original status.

When needing the 2 falls, manipulate the climbing unit, the hook moves towards the ground, pull out the pivot, start the climbing unit again, let the pendulum system arise for it contacts the trolley. When needing the 4 falls, let the hook move towards the ground, put the pivot back.

If the hoisting rope is converted to 4-fall, the hoisting rope mechanism is manipulated again, the hook is lowered to ground, and the hanging body falls back the groove of the hook. Insert the pin and split pin, and the split pin fully open. For debugging, refer to the ***Chapter 5 <OPERATION AND CONTROL>***.

Advise for Fall- changing about the height of tower crane over free-standing height: to avoid 4-fall change to 2-fall occur collide the top and the top hung body of hook do not fall on the ground, we advise consumer change fall on the floor or platform of climbing equipment.

Please adjust the safety device before starting to use the tower crane.

4.15 Climbing operation

4.15.1 Pre-climbing preparation

- Fill the oil tank with hydraulic oil according to the requirements of hydraulic pump station. Make sure of the electric motor circuit correctly connected and the fan rotates clockwise and the operating lever of hand control valve working smoothly without any clogging.
- Set up each tower section with correct order and grease its connection pinholes. Place in row the tower sections to be jacked just under the jib before climbing. This will enable no slewing mechanism in the whole process of climbing operation for adding sections, thus minimize the climbing time.
- Release the power cable slightly in excess of the total climbing height, and then fix the cable.
- Before jack-up, please random distribution of 4 core cable (one side is four phase plugs, other is four loose thread (include 1 ground PE)) to the climbing pumping station terminal blocks, and then insert the plug into the master four phase of tank wall socket. At the time, switch the climbing operation switch of drive box cup cabinet door to ON status. Right now, slewing the trolley limiter to first gear. At the time, you can through the operation of the hydraulic pump station to handle the climbing operation.
- Slew the jib to the front of the climbing equipment and the counter jib at the rear of climbing equipment (climbing cylinder is just under the counter jib).
- On the platform of the climbing equipment, prepare the pins tower mast pins.

4.15.2 General notices of climbing operation

- Keep the crane rotation part in balance.
- It is prohibited to operate the climbing unit when the wind speed at the highest spot exceeding 14m/s.
- Make sure that the climbing unit works normally before climbing.
- It is prohibited to hoist load (up or down) while the climbing unit is in operation or after climbing.
- Adjust the roller gab at 1~2mm before climbing operation, then adjust the gap at maximum after climbing finish
- It is prohibited to move the trolley while the climbing unit is in operation or after climbing.
- Keep the jib in the same direction as the in-let tower section during climbing operation. Stop the jib with the slewing mechanism brake and be sure of the trolley stopping at the jack-balanced position.
- If several tower sections are to be added in succession, the main chord rods and slewing ring support of the lower body must be connected by 8 Φ55 pins without shoulder after adding one section and before hoisting the next section. Only in this case can 8 Φ55 shoulder-free pins be permitted for use.
- Keep the climbing lugs on the newly added tower section in alignment with those on the existed section.
- It is prohibited to slew, change work-radius and hoist load without connection of the slewing ring support to the tower body by 8 Φ55 shoulder-free pins.
- When the height has reached the demanded work height (not exceeded the independent height), slewing the jib at different angles, check all the connections of the tower crane, including the embedded bolts (if one main chord is below the counter jib, then fasten all the nuts, the above-mentioned connection is all double nut to prevent loosening).

Please strictly operate the tower crane according to the operation instructions for the climbing process is most likely to have grave accidents.

4.15.3 Keep the tower crane in balance before climbing

Before keeping the tower crane in balance, hoisting device of the tower section and mounting device must connect through 4 sets shackle, and then hoist the hoisting device and mounting device of special hook, and put on the mounting beam of transition section (Show in Fig. 4-56). Move the trolley to the reference balance position, show in Table 4-4. Hoist one tower section or other weights (The trolley position in table is an approximate value, which must be adjusted according to the actual situation in climbing), and then dismantling the pins between the transition section and tower section.

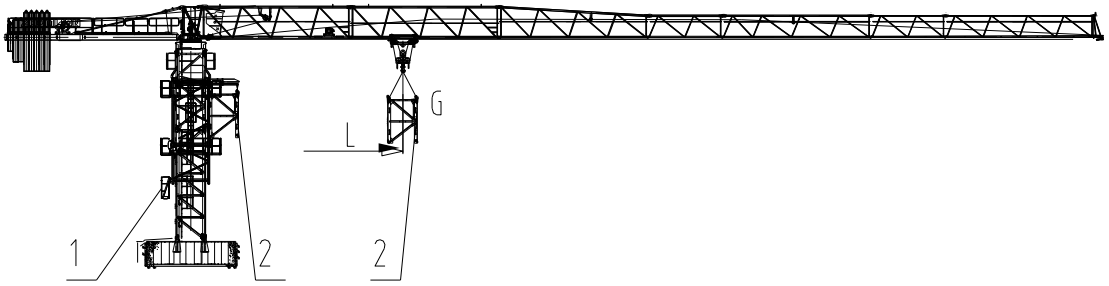


Fig. 4-56 Keep the crane in balance

(1) Platform (2) Tower section

Table 4-5 Reference balance position of different lengths of jib

Jib length (m)	Weight G (t)	Radius L (m)	Jib length (m)	Weight G (t)	Radius L (m)
70	1.61	26.6	45	1.61×2	27.7
65	1.61	27.0	40	1.61×2	26.0
60	1.61	31.6	35	1.61×2	26.7
55	1.61	38.8	30	1.61×2	26.9
50	1.61	42.2	/	/	/

CAUTIONS:

- These values are based on approximate figures only, which must be adjusted according to the actual situation in climbing.

  The balance weight above is according to the weight of tower section L68A4/L68A1 without passageways, when the tower sections are L68A1A/ L68B1A/ L68B1, the balance position must change accordingly.
- Make the top structure of the tower crane at the slewing-braking state by active the brake of the slewing mechanism. Slewing movement is not allowed.
- Pushing the operation handle of the hydraulic climbing unit to “Climbing direction”, extract the oil cylinder to jack the hang plate into groove near the tower section’ climbing lug, insert the safety pin, continue to extract the oil cylinder to jack the climbing equipment to a position where the transition section is just disengaged from the main chord rod of the tower body.
- Check the support leg and tower body main chord rod connect the transition section and tower sections to make sure that they are in the same vertical line. Check 8 guide rollers and tower body main chord rod to make sure that they have the same clearance. This serves to determine whether the tower crane is in balance. If not, adjust the balance position of the trolley until balance is achieved to drop the center of gravity of the upper tower crane onto the position of climbing cylinder beams.
- Record the balance position of trolley. Note: This value varies with the jib length.
- Operate the operation handle of the hydraulic system to fall the climbing equipment. Connect the pivots between the transition section and tower section.

4.15.4 Climbing operation

1) First, hoist the climbing device, and install it to the mounting beam. Then hoist a tower section, move the trolley to balance position according to the Table 4-5.
2) Use the brake on the slewing mechanism to hold the tower superstructure at a slewing braking status, thus ensuring no slewing movements. Dismantle 4 group pins connecting the mast top to the transition section.
3) Start up the hydraulic system to extrude the oil cylinder, lift the hanging plate into the slots of the group of lugs of one tower section at the shortest distance (Check the climbing beam whether in the round groove). Insert safety pins, ensuring without error, jack the climbing equipment and the parts above it for 10~50 mm and then stop. Check the hanging beam and climbing equipment and similar power transmission parts for abnormal noise and deformation. Check the oil cylinder for automatic retraction and similar abnormal incidents. In case of OK confirmed, continue to jack (see Fig. 4-57).

A special person is required to be at the lower platform and observe whether the hanging plate is hung in the lug slots and inserting-pulling safety pins.

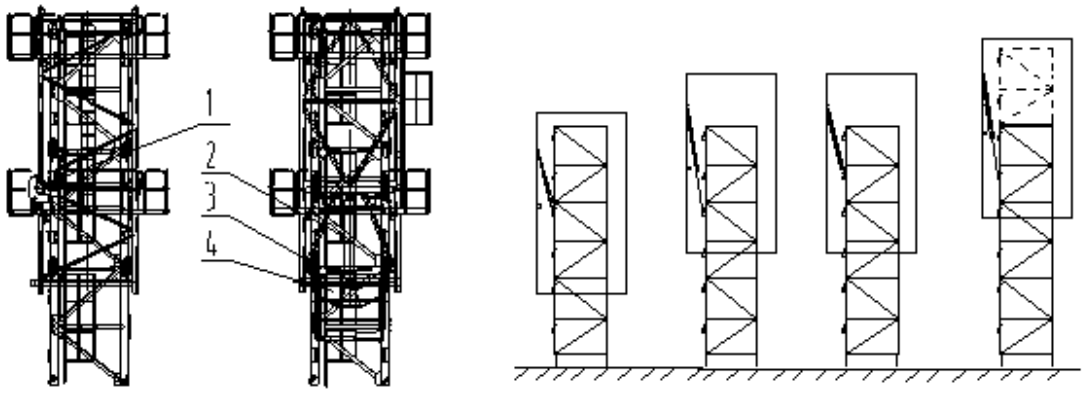


Fig. 4-57 Climbing process

(1) Climbing rod
(2) Climbing cylinder
(3) Climbing hang plate
(4) Climbing beam

4) Jack the climbing equipment for about the height of a little more than 1/2 tower section and position the climbing equipment until climbing rod is above the climbing lug, automatic reset. Stop climbing and retract the oil cylinder to let the rod down onto the lug of climbing beam.
5) Confirm that the two climbing rods lay on the top of climbing lugs and bear the weights of climbing equipment and the upper part without any strange sound and deformation, retract the oil cylinder completely, hoist climbing beam, put the hang plate into climbing beam circle groove again, insert safe pins.
6) Extrude the oil cylinder again to jack the upper structure of the tower crane for about the height of a little more than 1/2 tower section, thus there is a space for a tower mast, retract the oil cylinder slightly, align the new introduced tower section on the mast top, use 4 pins to connect each long fish-plate pin holes, and then each short fish-plate pin holes connect

ed by 4 pins, install the locking pin to connect firmly the upper and below tower sections.

7) Remove the safe pins of climbing plate, retract the oil cylinder again to put the transition section fall on the new tower mast, line up. Use 8 pins to connect firmly the transition section and the tower mast. At this time, one tower section has been added. If several sections are to be added in succession, repeat the steps above. To ensure the transition section fall on the tower mast successfully, before retracting, you can insert two guide rods (each opposite angle have one rod) into pin holes of transition angles, and then retract oil cylinder, the transition section falling.
8) At this time, one tower section has been added. If several sections are to be added in succession, repeat the steps above.
9) The last tower section must be fixed between the tower body and the transition section.

4.16 Erecting chassis stationary tower crane

Installing the chassis assembly, assemble it according to Fig. 4-58.

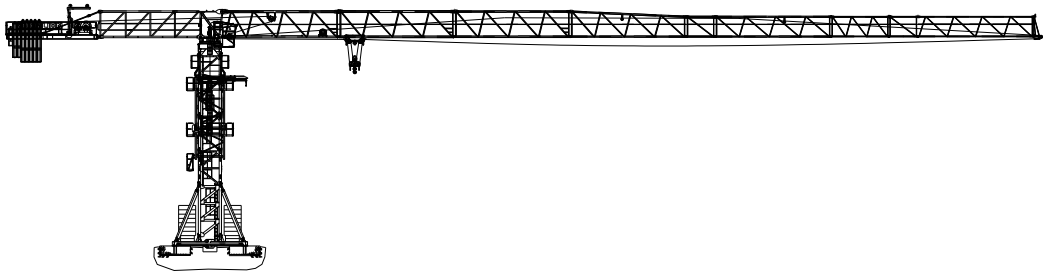


Fig. 4-58 Chassis stationary tower crane

4.16.1 Installing the crossed-beamed of chassis stationary

- Put the long cross beam on the foundation and fixed with bolts, see Fig. 4-59.

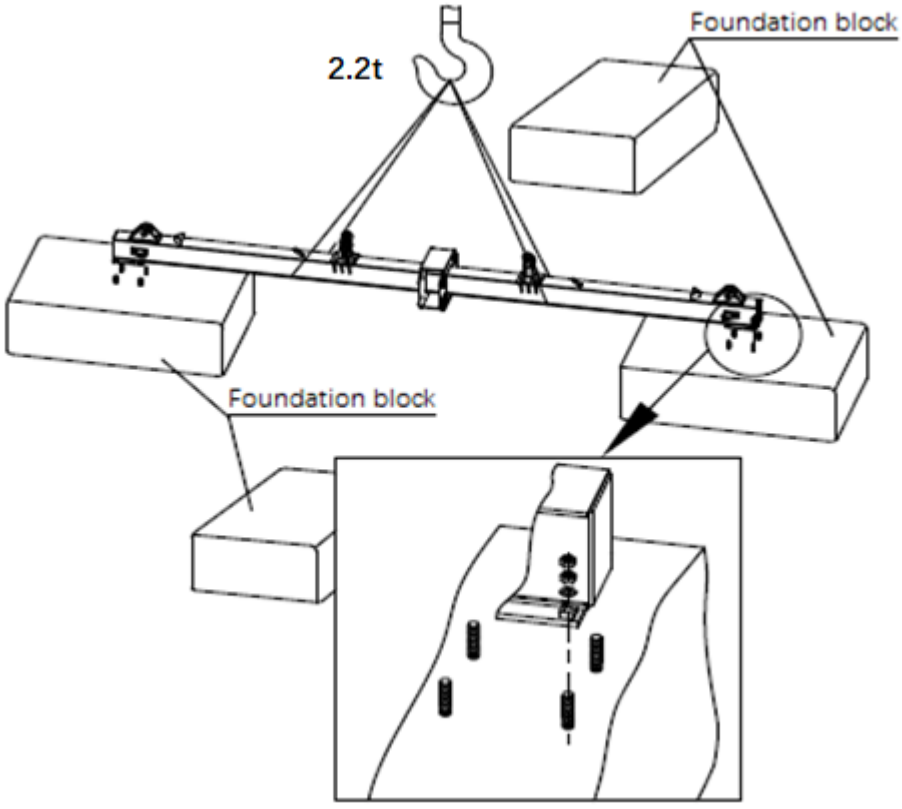


Fig. 4-59 Installing the long cross beam

- See Fig. 4-60, place one end of the short cross beam on the foundation and fixed with embedded bolts, which connect the other end with the long cross beam with 2 pins Φ60×430. Install another short cross beam in the same way.

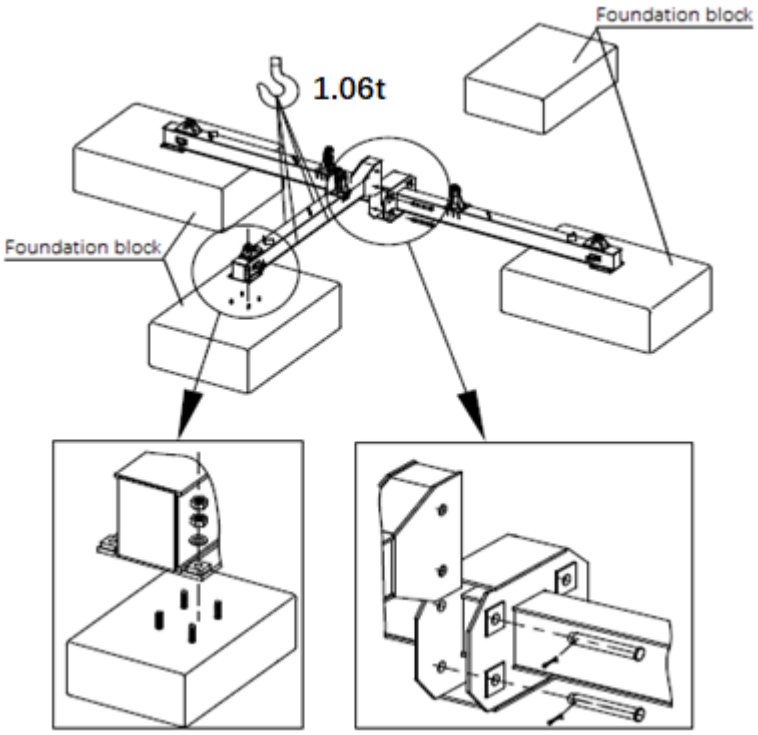


Fig. 4-60 Installing the short cross beam

- See Fig. 4-61, the tie rod connected to long and short cross beam respectively by 2 Φ30×105 pins. Install another 3 tie rods as the same way.

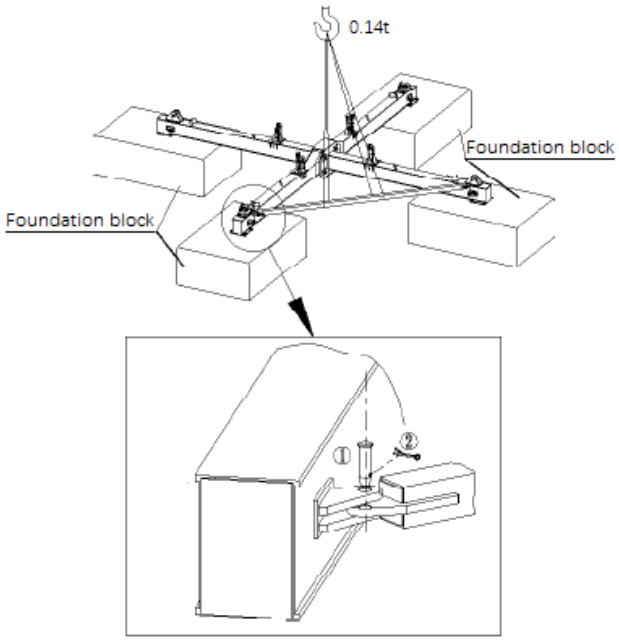


Fig. 4-61 Installing the tie rod

4.16.2 Installing the base tower section and incline tie rod

See Fig. 4-62, put the base tower section on the crosse beam and connect them by Φ65 pins. Use 2 Φ70×200 pins to connect the incline tie rod to the base tower section and the crosse beam. Install another 3 incline tie rods as the same way.

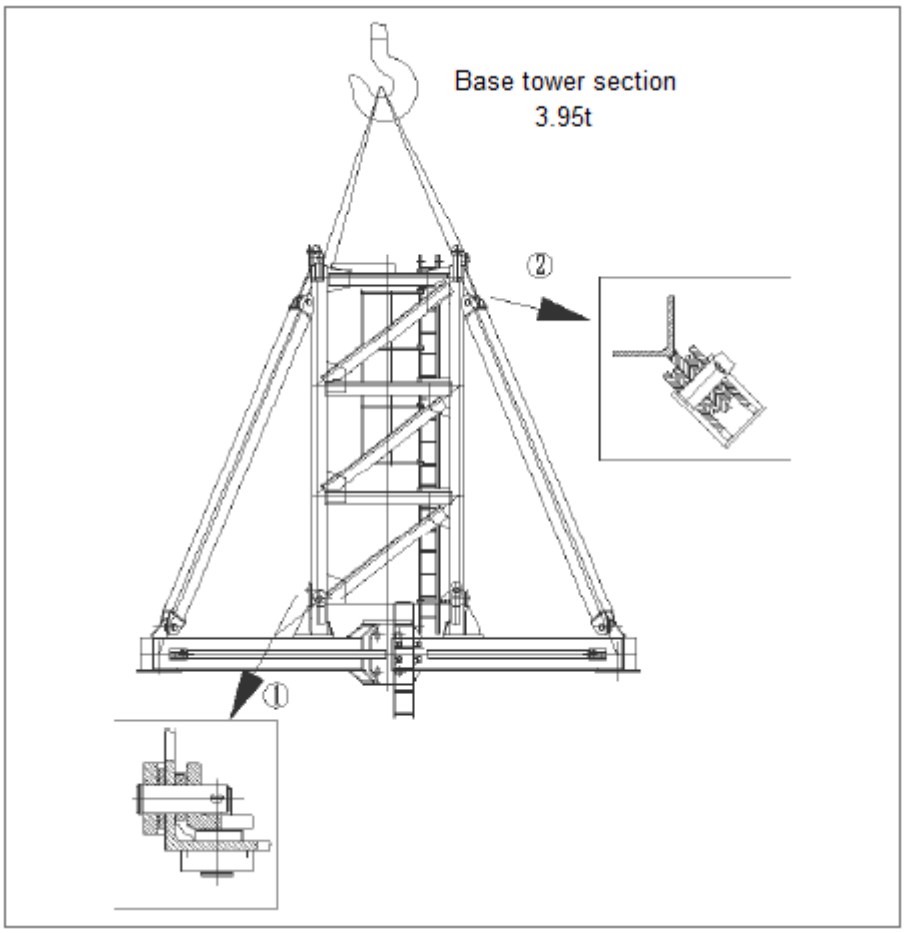
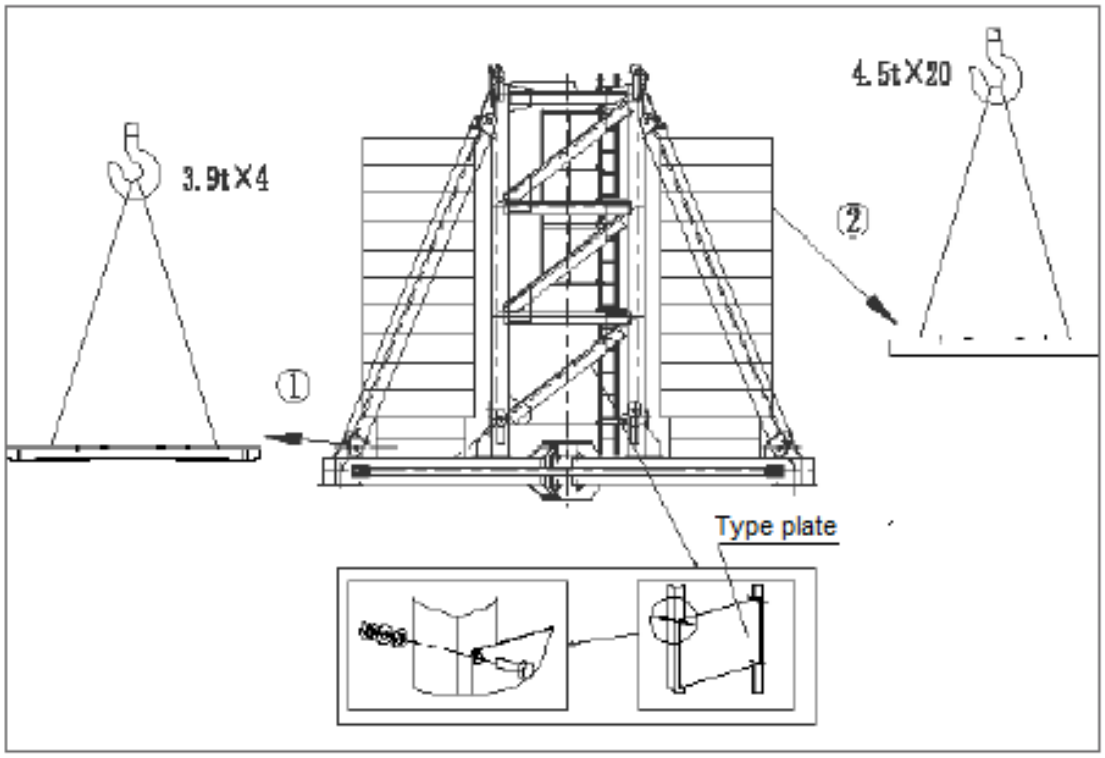


Fig. 4-62 Installing the base tower section

- *The left and right numbers of central ballast keep accordance, placed symmetrically (refer to Table 3-5 to configure the central ballast).*
- *The central ballast of 3.9t concrete protruding part to be press on the crossed beam, about uniform.*
- *Used raise platform, positioning, and center of the platform and hole shall be centered.*

- *Ensure that the perpendicularity of the base section is not more than 1.5/1000 after completing pouring foundation.*
- *During the assembly, each pin with cooperate face shall scribble lubricating grease*
- *Split pin must extend fully, bolts tighten*
- *Install the central ballast as the figure below, install the nameplate to the base tower section by 4 M6×16 bolts.*



4.17 Travelling tower crane

4.17.1 Traveling mechanism structure introduction

The traveling mechanism consists of 2 sets of driving dollies 1, 2 sets of driven dollies and cable drum.

1) The two driving dollies 1 must be arranged on the diagonal line (rail clamp outward), two driven dollies also must be arranged on the diagonal line (rail clamp outward), see Fig. 4-63;

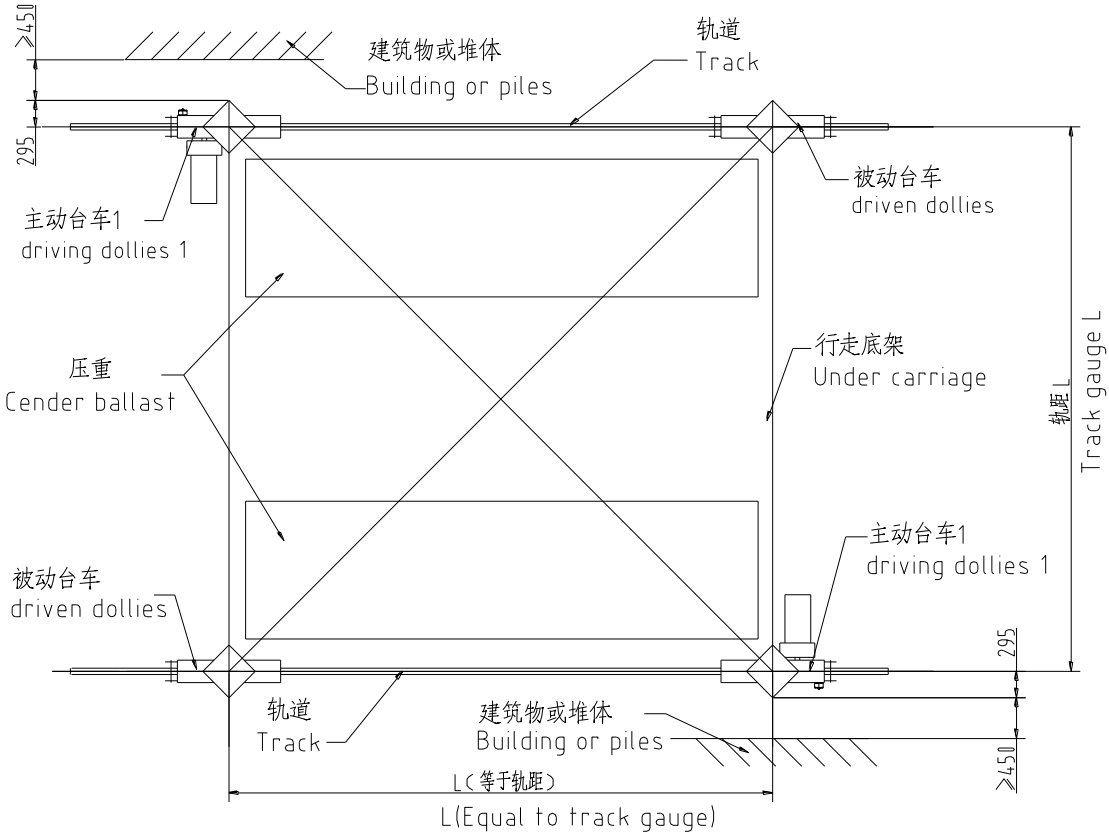


Fig. 4-63 Arrangement of the dollies

2) The motor should be fixed in the inner side of track;

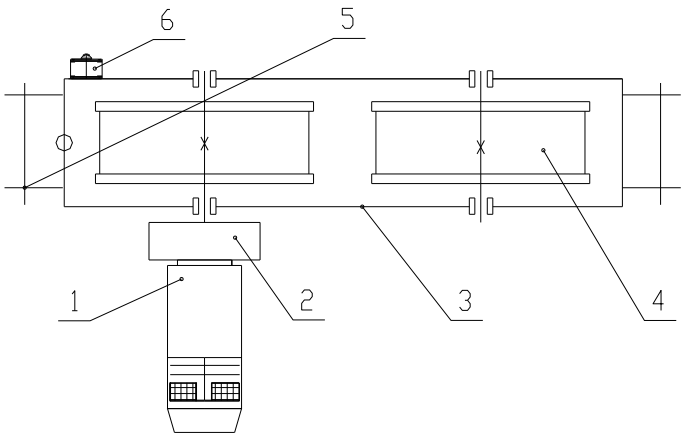
3) Counterweight should be assembled along track direction;

4) The safety distance between traveling dollies and outside buildings of track should not be less than 450mm;

5) M type power drum as cable.

4.17.1.1 Powered wheel bogie

The Powered wheel bogie have two wheels as figure below.



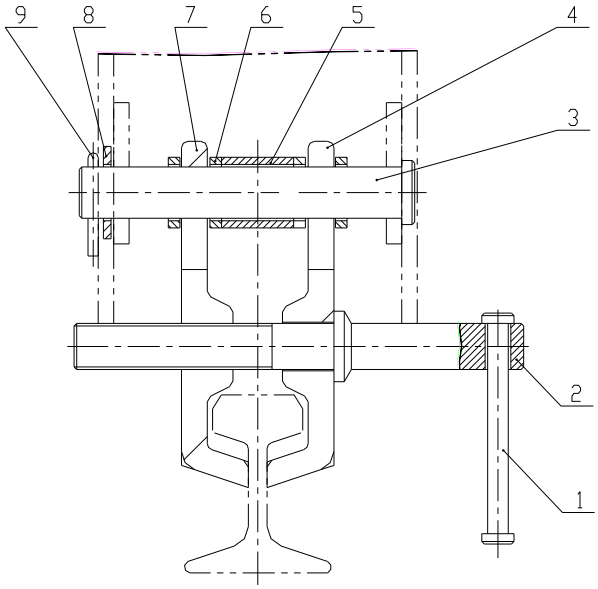
1.制动电动机 Brake motor；
2.行星减速机 Planetary reducer；
3.行走台车架 Dolly frame；
4.行走轮 Traveling wheel；
5.夹轨钳 Rail clamp；
6.行程开关 Traveling limit switch。

Fig. 4-64 Powered wheel bogie

The Powered wheel bogie consists 1 of brake motor, planetary reducer, traveling wheels (two wheels or three wheels), bogie frame, rail clamp, and traveling limit switch, etc. The motor is special frequency conversion motor with double magnet brakes. The frequency conversion is in 0 ~ 50Hz scope ensures starting smoothly without impact. When stopping, the speed reduces automatically following the frequency reduces automatically, and at the same time, delaying the brake works to ensure stopping smoothly without impact. The traveling limit switch can prevent overturning of the crane caused by the impaction between dollies and end buffers by wrong operation. When the operator is off his duty and leaves the tower crane, he must tighten the crane by rail clamps to prevent overturning of the tower crane. Release the rail clamp during operation, and turn the clamp upward to let pivot fall into the other end of ellipse hole. Thus, the clamp may not turn over downward.

4.17.1.2 Rail clamp

The construction of the rail clamp is see figure below:



1. Handle; 2. Screw rod; 3. Shaft;
4. Right semi clipper; 5. Shaft sleeve;
6. Adjusting pad; 7. Left semi clipper;
8. Washer; 9. Cotter pin.

Fig. 4-65 Tightening rail clamp

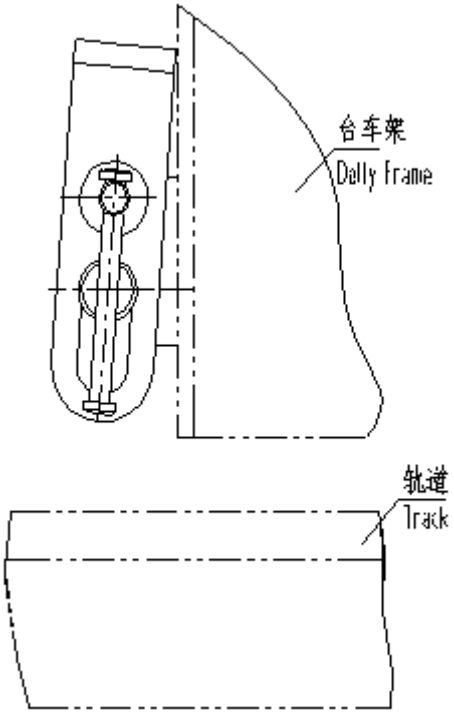


Fig. 4-66 Tightening rail clamp

Adjust the quantity of the adjusting pad between left and right semi-clamp to tighten the track according to different track width.

Note: After adjusting, assemble the clamp as Fig. 4-65 and open part 9 (cotter pin) sufficiently.

Two conditions of the rail clamp:

1. Tightening condition (the driver is off duty and leave the tower crane), front view is see Fig. 4-65;
2. Release condition during operation, side view is see Fig.4-55

4.17.2 Installation and test

This chapter introduces the installation of traveling mechanism and cable drum.

4.17.2.1 Powered wheel bogie and driven bogie

1. Lift the bogie on the track, and fix it by scantling timbers or wood wedges;
2. Disassemble 4 sets of M24×90 bolts and two B16×60 pins on the bogie connection plate for connecting with undercarriage;
3. Lift the assembled cross undercarriage, let the bogie connection plates aim at connection plate of the cross undercarriage, install the B16×60 pins and tighten M24×90 bolts. The strength grade of these bolts is 8.8 grade, and pre-tightening torque is 640N.m;
4. Disassemble the four supports on each bogie, which is easy for assembling and transportation, and then tighten the clamp track clipper and the track. Ensure the safety of after soon tower crane installation.

4.17.2.2 Cable Drum

Our company offers Normal allocation is M type cable drum with power.

- **Cable drum introduction**

M type cable drum is a drum with power, which consists of a torque motor, a reducer, a collector box, a drum, a wire box, installation supports, etc. See

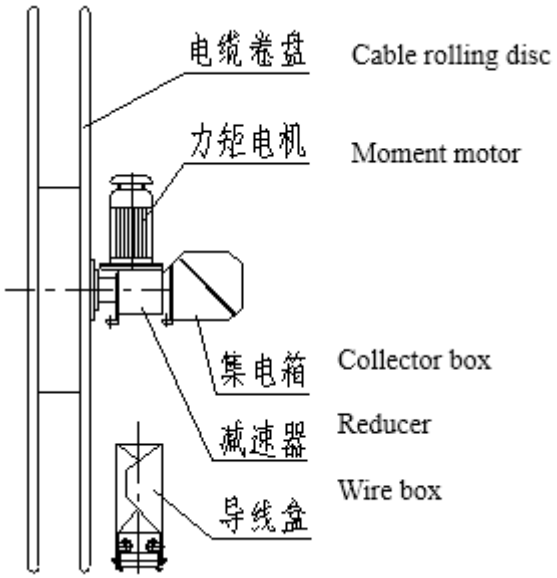


Fig. 4-67 Cable drum

When the tower crane moves towards the power, the torque motor powers on, and transmits the torque by reducer to drum through turntable and flange on the output shaft of the reducer, and then the drum turns slowly, thus the cable is wrapped onto the drum. When the tower crane moves far from the power, the cable is released automatically by dragging the cable to turn the drum which can overcomes the frictional torque in reducer.

- **Requirements of cable fixed points for the cable drum**

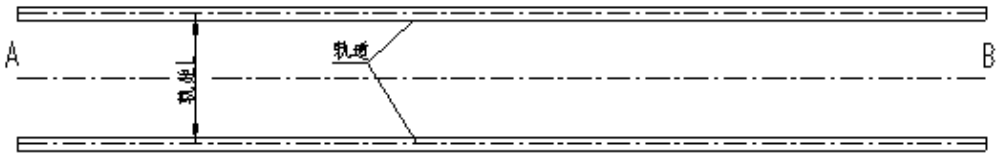


Fig. 4-68 Chassis rail

There is carriage drive beside the orbit across the real, install traveling limit switch at the ends of the orbit, cable fixed point simultaneously, when adopt M type cable drum, the fixed point can be any point on AB line — track gauge center line (See Fig. 4-68). When the cable fixed point is on any point of AB line (except A, B point) should set steering impact pad, cable will be 15 meters more.

Note: There is no description on the track foundation drawing supplied to the customer because the cable drum type and cable fixed point cannot be determined.

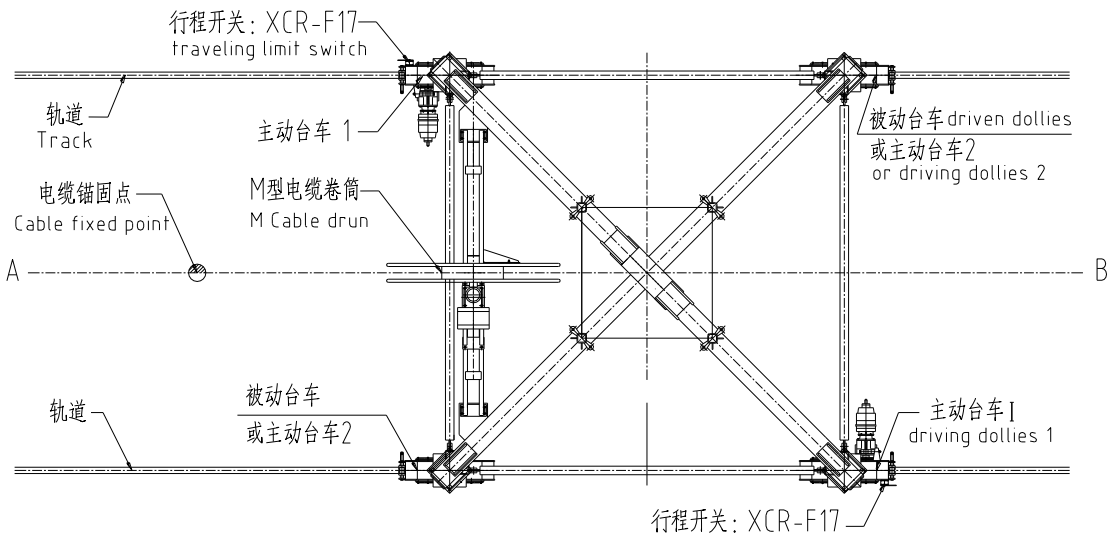


Fig. 4-69 Arrangement of the travelling parts

■ **Installation of the cable drum**

The installation of M type cable drum includes: cable drum installation, cable drum support installation.

1. Cable drum installation

① Coil disc installation shows as Fig. 4-70. Use 12 sets of M10×260 (1 bolt, 1nut, 1 washer, 1 spring washer) bolt rod to connect the frame and two round disc. Use 12 sets of M10×55 (1 bolt, 1 nut, 1 washer, 1 spring washer) bolt to connect flange disc and round disc.

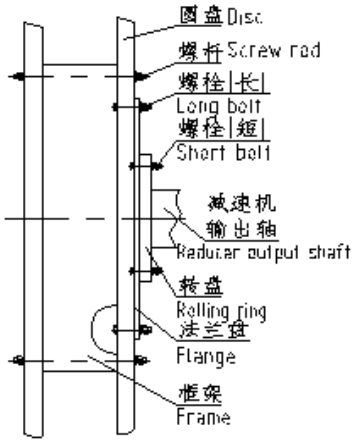


Fig. 4-70 Coil disc

② Let the installation hole on turning disc of reducer output shaft align with flange disc and tighten it with bolts;

③ Connect the torque motor output shaft with the worm key channel in reducer. Connect the torque motor end face and the upper face of the reducer with bolts;

④ The installation hole on collector box outer cover should match with reducer output shaft and connect with reducer basic seat end face with bolts;

⑤ Check reducer oil level, add HL 30 lubrication oil if it is below the center of the sight hole.

2. Installation of the cable drum support

① Install fixing support;

② Install cable drum support;

③ Install wire box support

④ Install cable drum

⑤ Adjust the position of cable drum support and wire box support to let coil disc align with wire box and cable fixed point simultaneously.

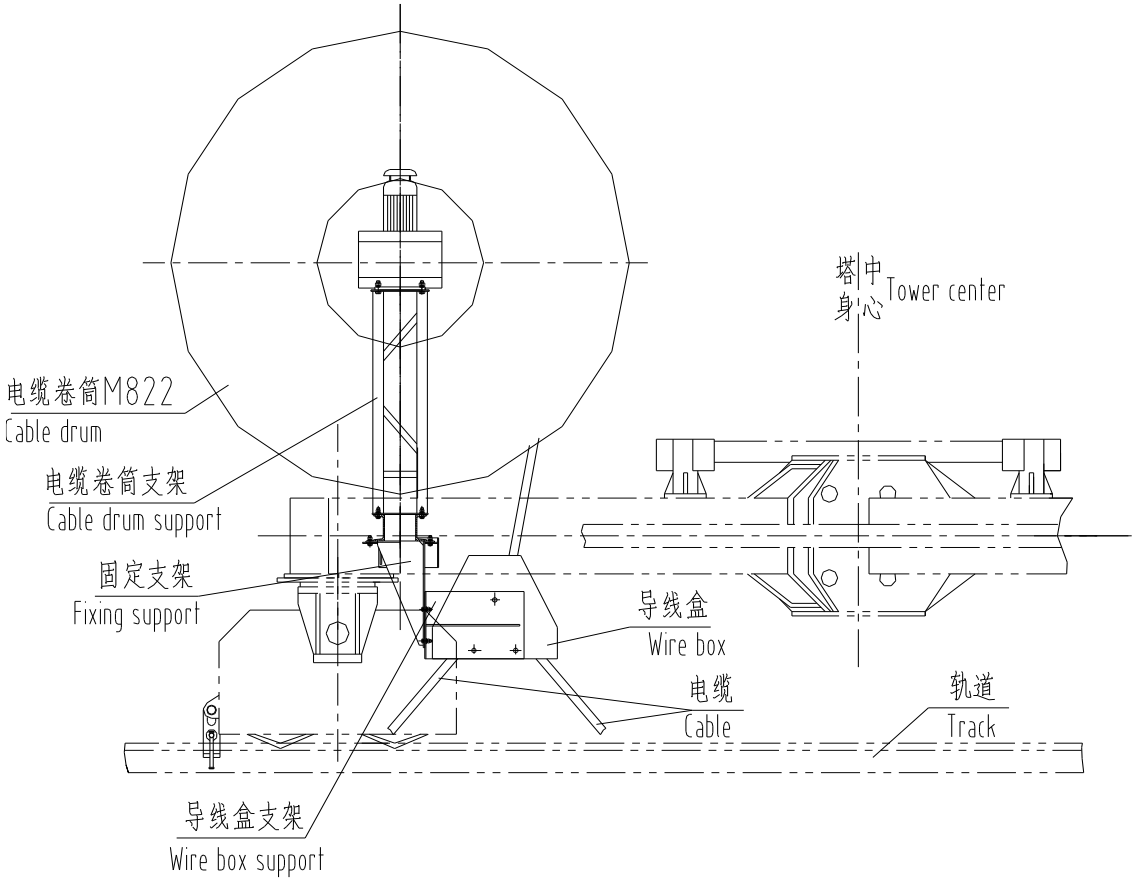


Fig. 4-71 Drum support

3. Wire connection of the cable drum

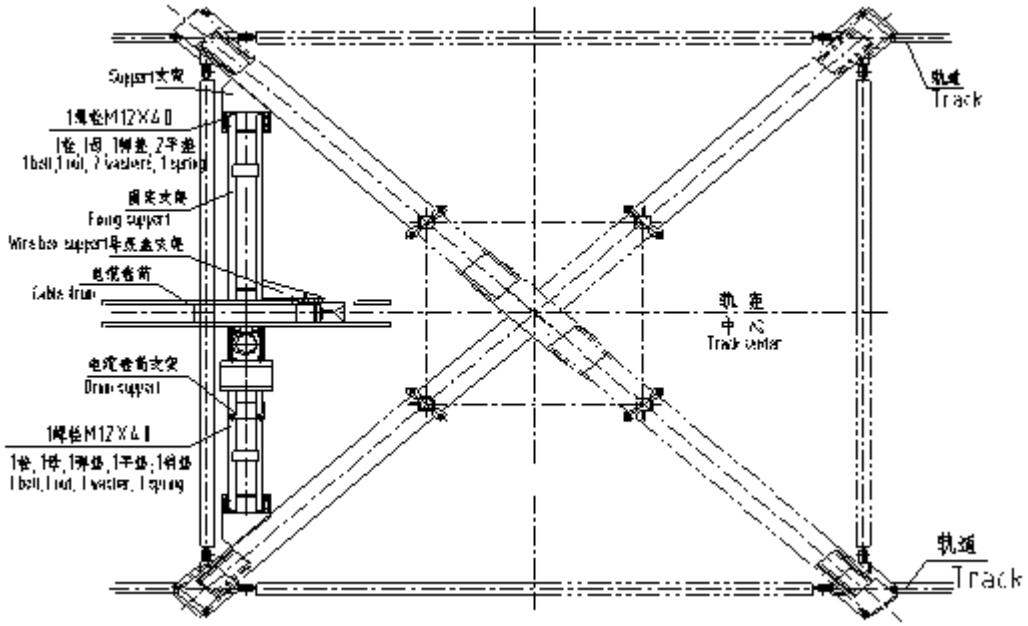


Fig. 4-72 Arrangement of the travelling chassis parts

① Straighten the cable and release it completely, the cable should not be twisted up. The cable should have 3 ~ 4 rounds on the drum when the undercarriage run to the limit position of the track;

② Open the cover of collector box and lead cable to the drum coil disc via wire box by shown direction in Fig.4-5a. Then introduce reducer output inner hole into collector box from frame and connect cable wire with inner fastener of collector ring tightly;

③ Lead out main cable of tower crane from the out fastener of collector ring to switch box via collector box cable. At last, close the collector box cover.

Note: Neutral line should be connected with the same sliding ring.

4. Test running of the cable drum

Test run the cable drum after the tower crane is installed completely. The test running main content is to adjust cable tension and torque motor change switch when the cable is received / released.

First, run carefully on the right / left side of fixed point, observe the running direction of torque motor and the receiving / releasing of cable. It is correct if in the following condition: and then the drum turns slowly, thus the cable is wrapped onto the drum. When it moves far from the direction of power, the cable is released automatically by dragging the cable to turn the drum which can overcomes the frictional torque in reducer.

Let the tower crane run along the track to and fro to observe receiving / releasing cable tension. Cable tension is suitable when receive / release the cable smoothly and motor is not overheated; otherwise, adjust output torque of motor to change cable tension.

Adjust procedures are as following, (see Fig. 4-73)

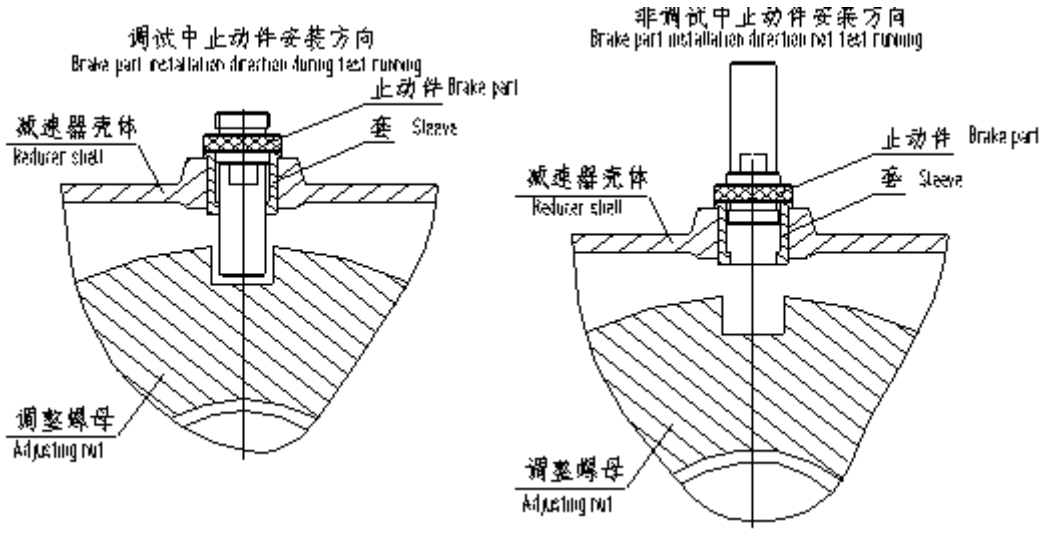


Fig. 4-73 Adjusting the cables

Screw out the brake part (which is near reducer and motor connection surface) on the reducer shell, observe if reducer adjusting nut indentation is aligned with the installation hole of the brake part (see Fig.4-13a), then insert the brake parts into the hole, and turn the turning disc by hand. Stand at the outside of drum and turn the disc clockwise, the motor output torque and cable tension, vice versa. Adjust output torque repeated to change cable tension till the cable is received / released smoothly and the motor is not overheated. Then, drag out the brake parts and turn one end of stop part with thread into hole on installation position on reducer.

4.18 Safety devices

4.18.1 Foreword

The safety devices of tower crane include: moment cutouts, load limiters, traveling limiter (include hoisting limiter, trolley limiter, slewing limiter) and weathervane.

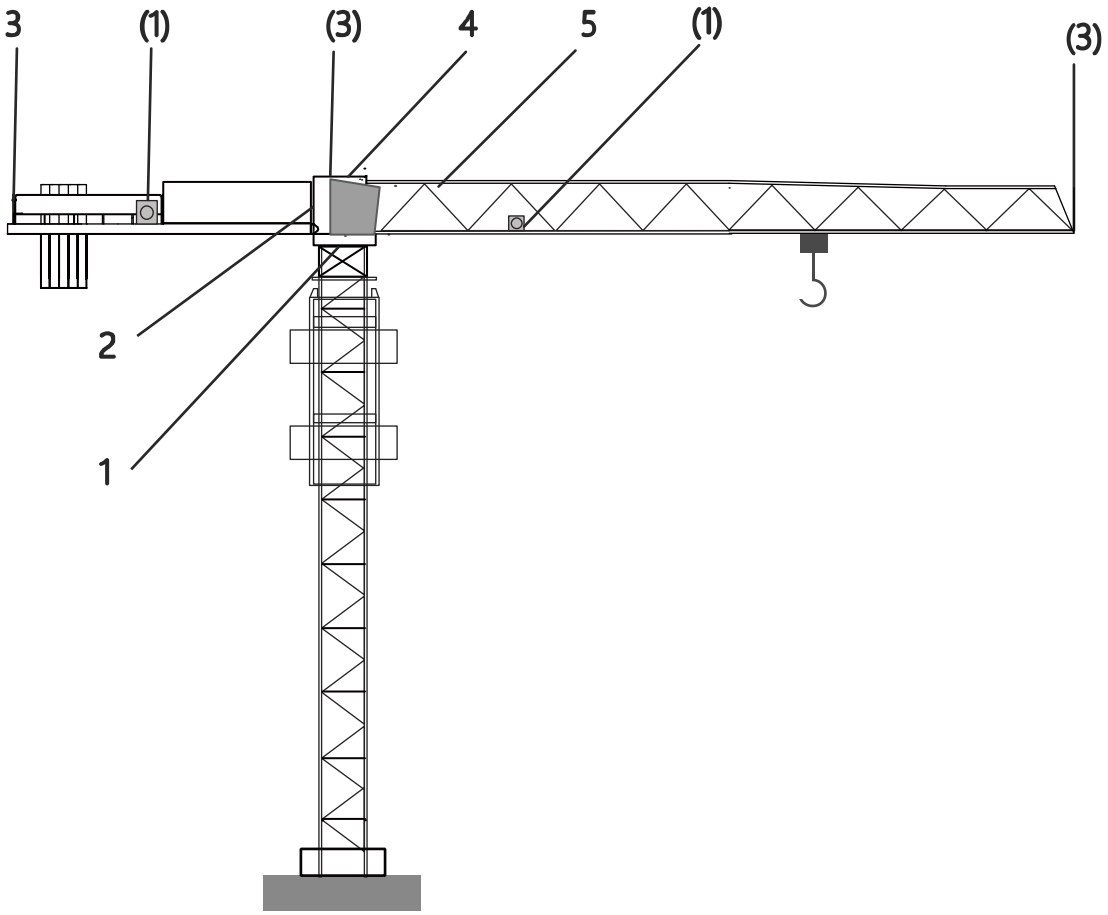
The safety device of this tower crane, besides the above mechanical limiter, also has electronic safety device in the auxiliary safety monitor system. The installation position of the safety devices shows in Fig 7-69 and table 7-26.

The crane over 30m and higher than surroundings, need installed red obstruction light on tower crane' top and front/rear jib end, this light power not affected by crane shutdown. İf crane higher than 50m, need install weathervane.

The safety devices introduce in this chapter are mechanical limiter. Before calibration, turn mode choice switch (SPM) to 'mechanical', then begin calibration. After calibration, turn SPM to 'electronic.

- **Safety devices should be the important inspection device of driver and maintenance personal.**
- **Safety device of tower crane are designed for protecting human and equipment safety, after calibration, shouldn't change it.**

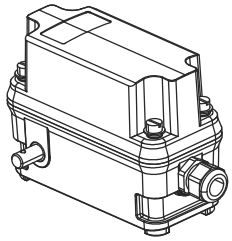
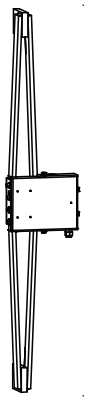
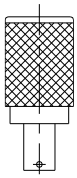
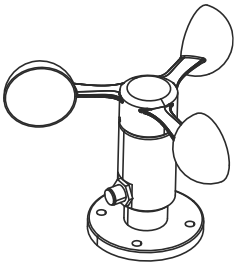
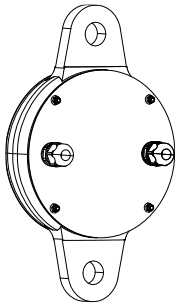
- *Using the equipment before safety device installation or calibration is prohibited, otherwise will lead to equipment damage and personnel injury even death.*
- *Only use electronic limiter without mechanical limiter calibration is prohibited.*



(1) Limiter device
(2) Moment limiter
(3) Red obstruction light
(4) Weathervane
(5) Load limiter

Fig. 4-74 Safety device location

Table 4-6 Safety device combination

No	Shape	Name	Location	Qty
1		Hoisting limiter	Hoisting mechanism	1
		Trolley limiter	Trolley mechanism	1
		Slewing limiter	Turntable	1
2		Moment limiter	Counter jib	1
3		Red obstruction light	Counter jib, tower crane's top, jib end	2
4		Weathervane	Tower crane's top	1
5		Load limiter	Jib Ⅰ	1

4.18.2 Limiters

The limiters of tower crane include: hoisting limiter, Trolley limiter, slewing limiter, they are important safety devices to accomplish the traveling control and position limit of each mechanism. Hoisting mechanism, trolley mechanism, slewing mechanism equipped electronic sensors, these sensors will monitor mechanism position and control system will convert the position signal to electronic limiter.

This crane can implement electronic limiter and mechanical limiter control, the solely mechanical limiter only used for emergency and need adjust to meet the regulation.

- **After change the rope or falls, the extreme position of hook will change, need readjust the hoisting limiter. Otherwise, may cause hook impact jib, rope break, and lead to fatal accident.**
- **When hook at the lowest position, need keep at least 3 circle rope on the drum.**

- *When crane climbing to the expectation height, adjust must without load and make sure micromove switch is correct.*
- *When change tower crane height and falls, adjusting hoisting limiter.*
- *Screw in M5 nut after adjust travelling limiter, otherwise cause memory mess.*
- *Recovery the shell after adjusts the travelling limiter, otherwise the limiter may damage by water.*

4.18.2.1 Functions of limiter

Hoisting limiter make hook decelerate and stop hoisting when come to the safety distance from trolley to the hook, when downward, prevent the wire rope from loosening completely and wrapping around the drum in the opposite direction.

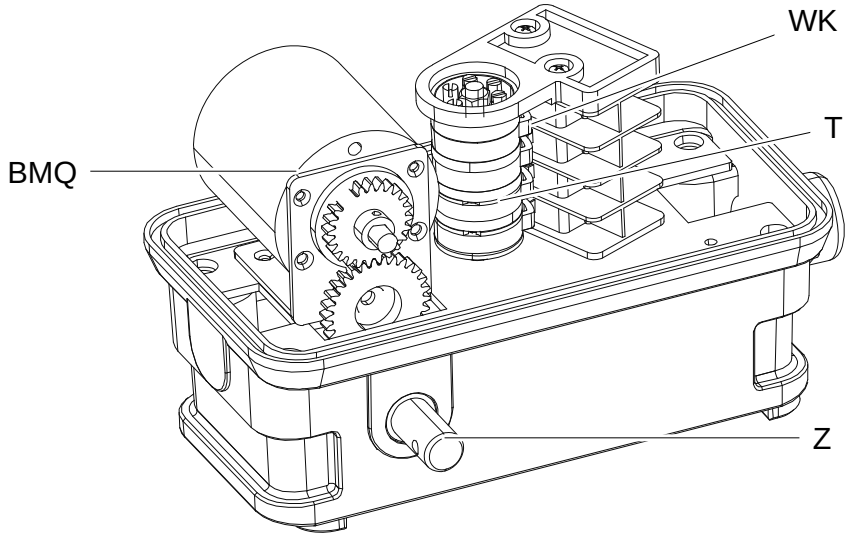
The Trolley limiter enables the trolley to automatically decelerate and stop before reaching the stop block at the root or head of the boom.

The slewing limiter is used for tower cranes without slip ring to prevent the cables from being entangled and damaged, allowing a maximum rotation of 3 turns.

- The working principle of the limiter

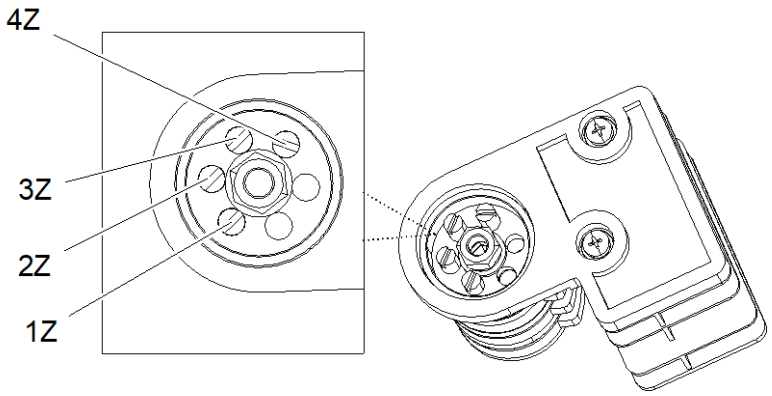
The limit device fixed on the bracket can be directly driven by the wind shaft, or driven by the pinion gear meshing on the toothed ring. There is a deceleration mechanism in the device, which drives several bumps to rotate (T), and these bumps control several circuit breakers (WK micro switch) action, thereby cutting off the corresponding mechanism movement.

In addition to the mechanical limit switch, the limiter is also equipped with an encoder (non-ETI version has no encoder). As shown below.



BMQ:	Encoder	WK:	Micro switch
T:	Memory cam	SRZ:	Input shaft

Fig. 4-75 Limiter



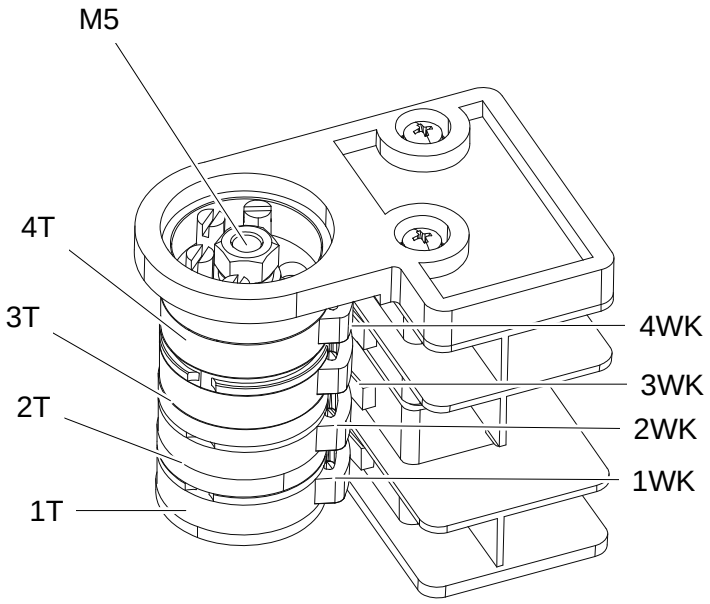


Fig. 4-76 Inside of the limiter

Adjust the shaft (1-4 Z), cam (1-4 T) and micro switch (1-4 WK), the corresponding relationship is as follows:

1Z → 1T → 1WK

2Z → 2T → 2WK

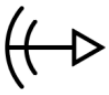
3Z → 3T → 3WK

4Z → 4T → 4WK

■ Traveling limiter adjustment steps:

1) Remove the upper cover and loosen the M5 nut.
2) According to the need, open the controlled mechanism to the designated position (no-load), at this time, the corresponding micro switch is switched instantaneously when controlling the action of the mechanism. That is, adjust the corresponding adjustment axis (Z) so that the memory cam (T) presses the contact of the micro switch (WK).
3) Tighten the M5 nut (the nut must be tightened to prevent loosen).
4) The mechanism repeatedly runs with no load for several times to verify whether the memory position is accurate (repeat the above adjustment if there is an error).
5) Confirm that the position meets the requirements and install the cover.
6) After the mechanism is working normally, it should always be checked whether the memory control position has changed so as to be corrected in time.

Table 4-7 The meaning of the indication signs

Symbol	Meaning
	Low speed operation
	Middle speed operation
	High speed operation
	Deceleration/ speed limited
	Load

Symbol	Meaning
	Slewing
	Hoisting hook
	Observation
	Sound alarming
	Light alarming
	Trolleying

4.18.2.2 Hoisting limiter

■ Hoisting up deceleration

When the distance between the hook pulley and the trolley is H1, mobilize the (3Z) axis to make the long cam (3T) press the micro switch (3WK), so that the hook rises at a low speed.

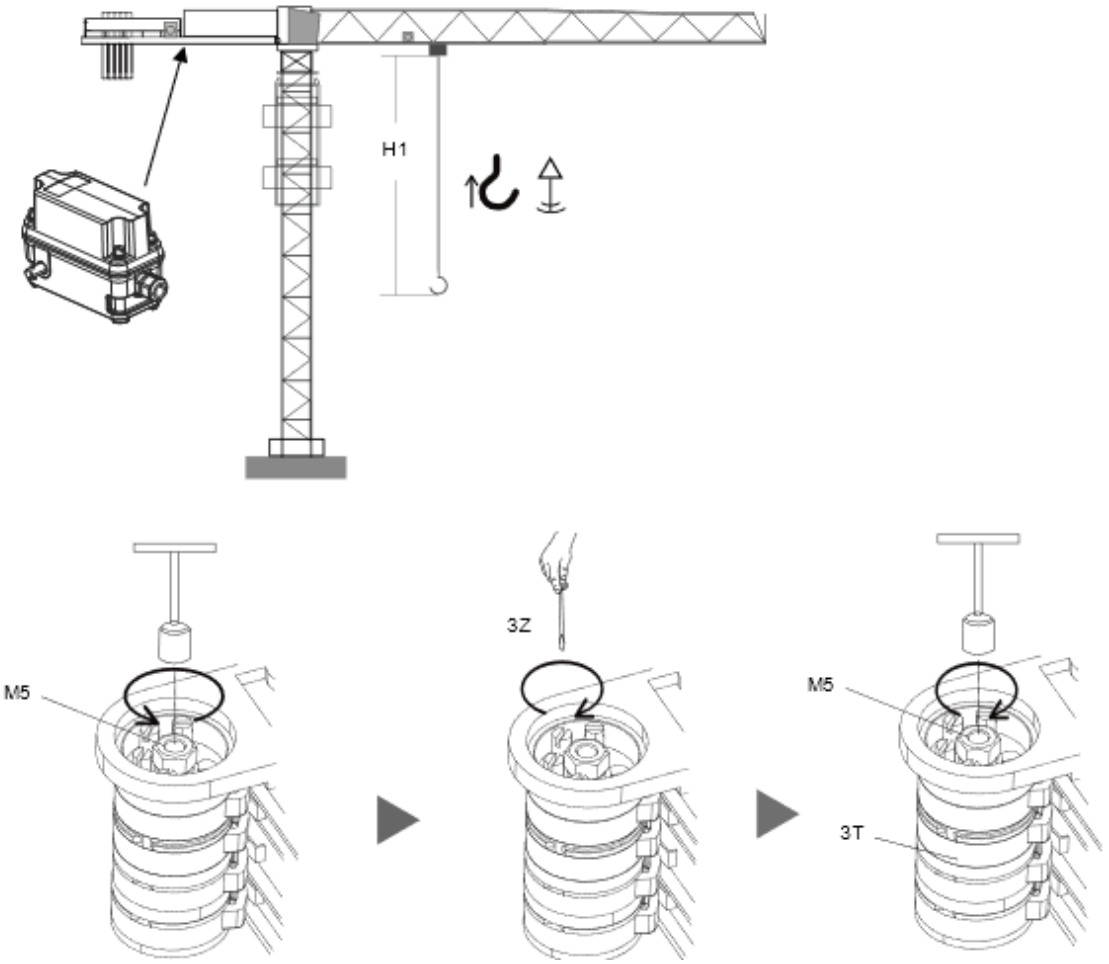


Fig. 4-77 Hoisting up deceleration

■ Hoisting up stop

When the distance between the trolley and the hook pulley is H2, the (4Z) axis is mobilized to make the long cam (4T) press the micro switch (4WK), so that the hook cannot continue to move upward.

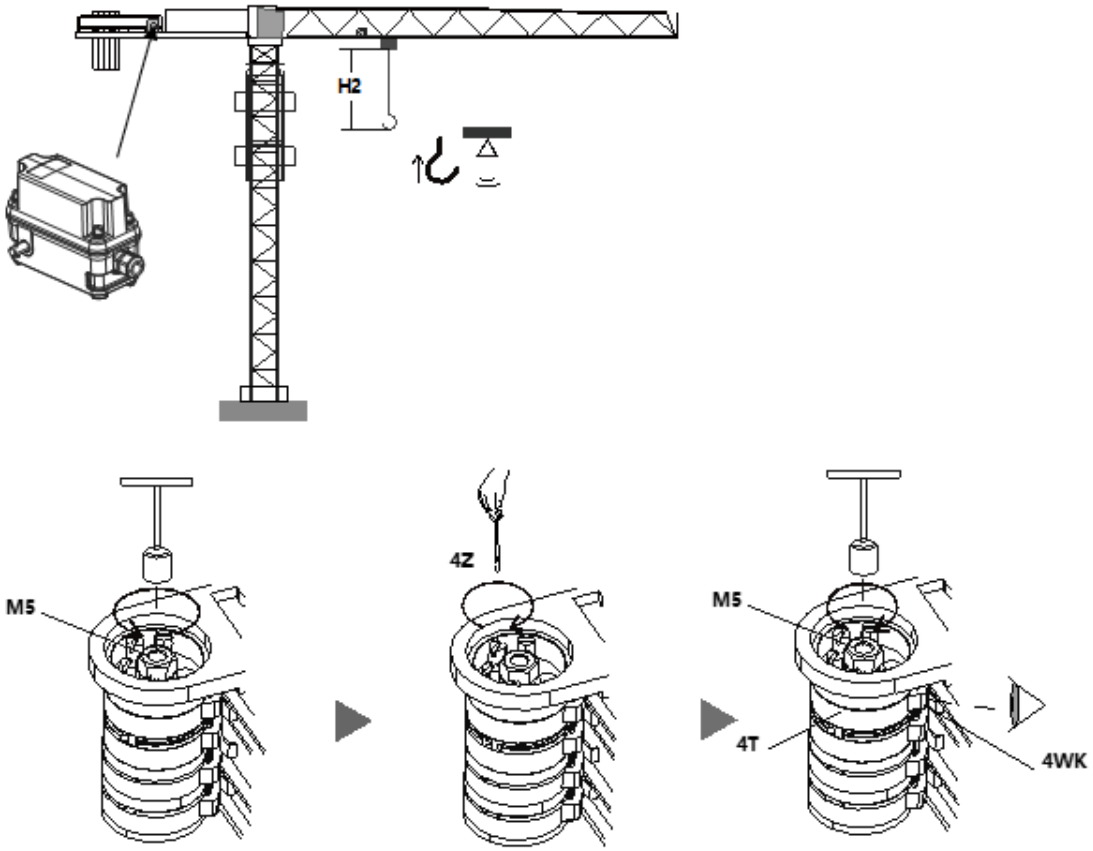


Fig. 4-78 Hoisting up stop

The down hoisting stop principle just same as up hoisting, adjust the switch position.

■ Hoisting down stop

Move the (2Z) axis to make the long cam (2T) press down the micro switch (2WK), so that the hook can stop before it touches the ground (the hook cannot touch the ground to prevent the wire rope from loosening on the wind).

■ Hoisting down deceleration

Move the (1Z) axis to make the long cam (1T) press down the micro switch (1WK), so that the hook can descend at a low speed at H2 before the lower limit position.

4.18.2.3 Trolley limiter

■ Trolleying outward deceleration

The trolley is driven to L1 from the boom tip buffer, and the (3Z) axis is mobilized, so that the long cam (3T) presses the micro switch (3WK), so that the trolley can only run outwards at a low speed.

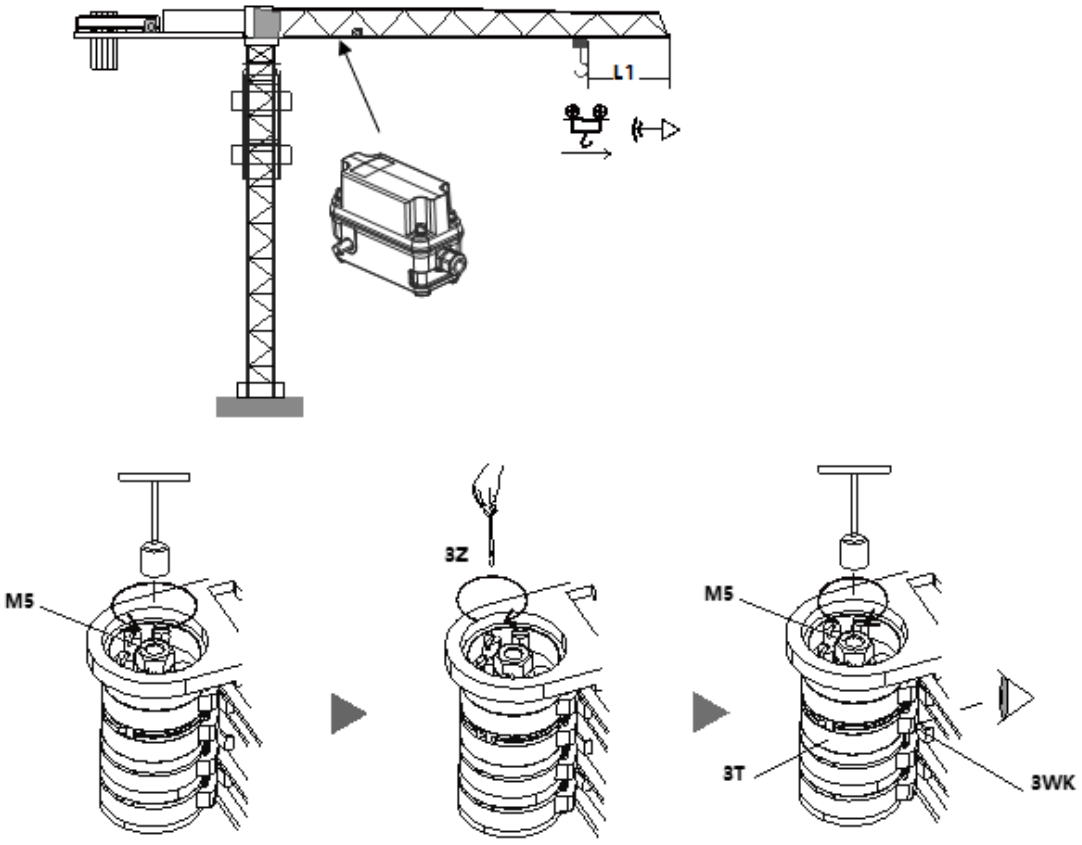


Fig. 4-79 Trolleying outward deceleration

■ Trolleying outward stop

The trolley is driven to L2 from the boom tip buffer, and the (4Z) axis is mobilized, so that the long cam (4T) presses the micro switch (4WK), so that the trolley cannot continue to run outwards.

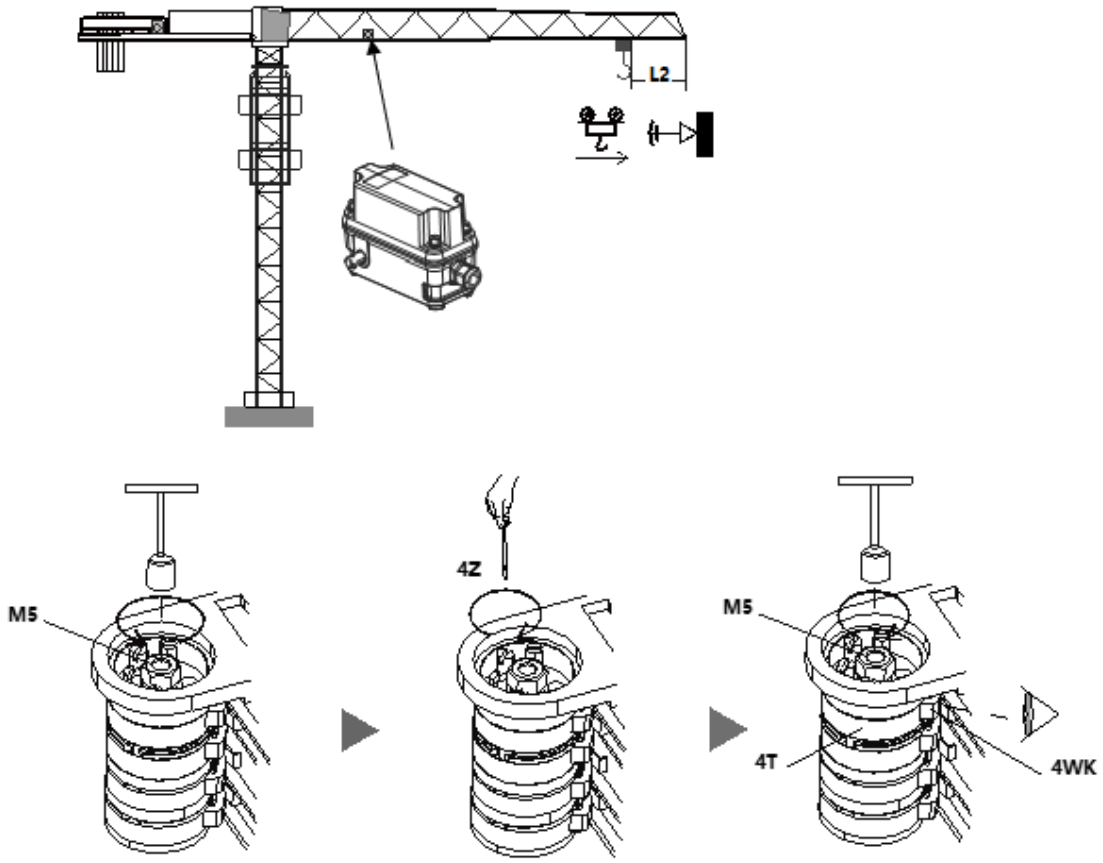


Fig. 4-80 Trolleying outward stop

■ Trolleying inward deceleration

Drive the trolley to L1 from the boom root buffer, mobilize the (1Z) axis, so that the long cam (1T) presses the micro switch (1WK), so that the trolley can only run inward at a low speed.

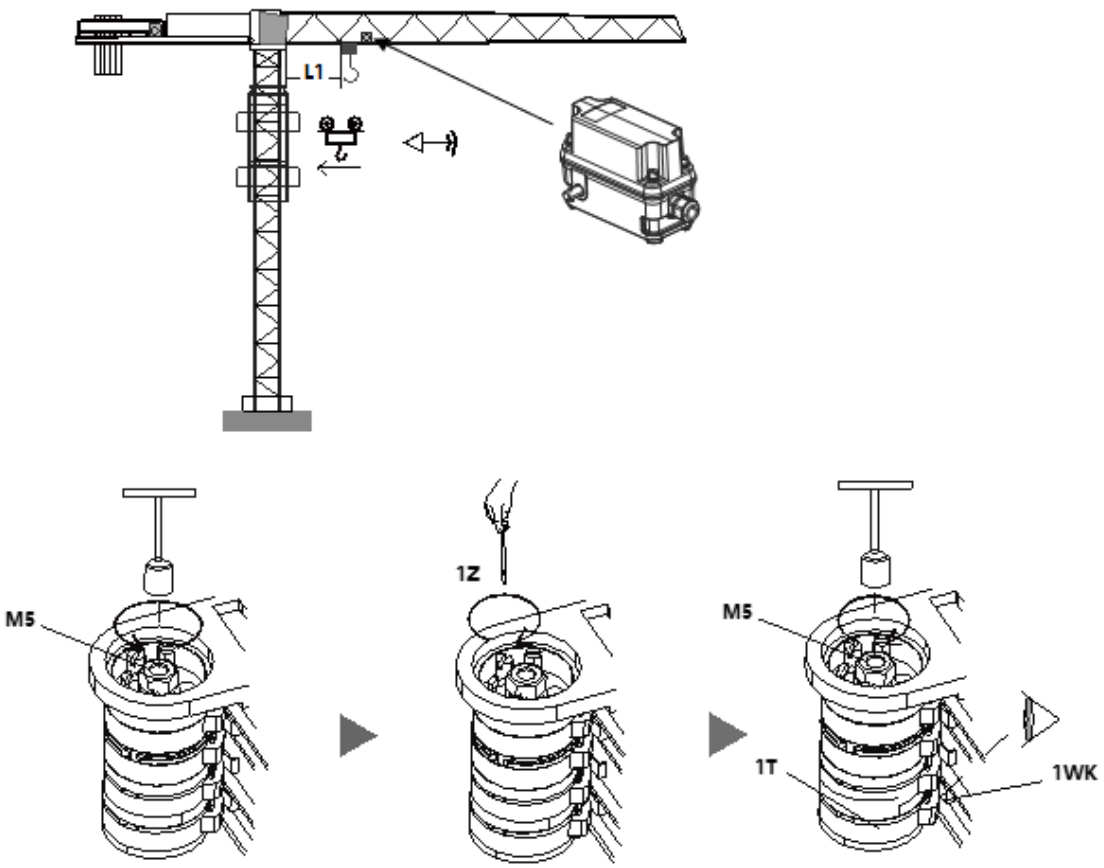


Fig. 4-81 Trolleying inward deceleration

■ Trolleying inward stop

The load trolley is luffed to L2 meters away from the boom root buffer, and the (2Z) axis is mobilized, so that the long cam (2T) presses the micro switch (2WK), so that the trolley cannot continue to run inward.

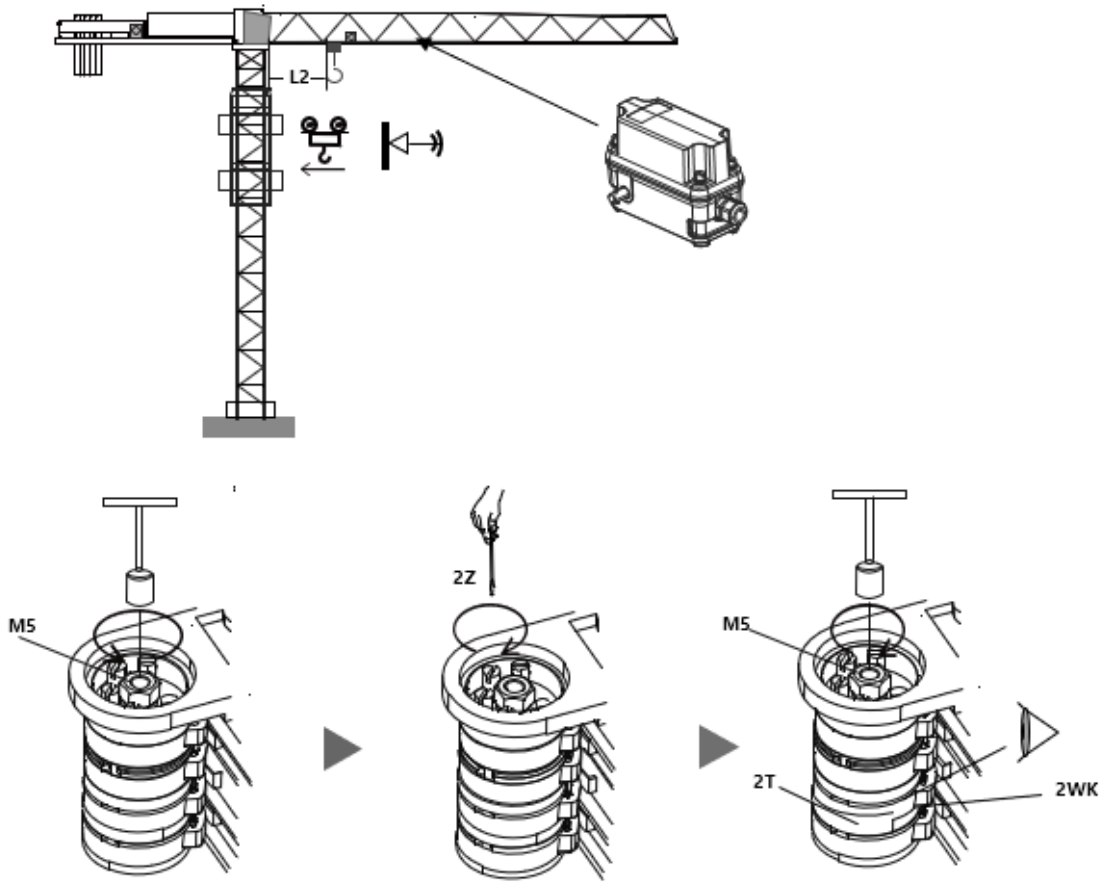


Fig. 4-82 Trolleying inward stop

4.18.2.4 Slewing limiter

■ Slewing leftward stop

Adjust the slewing limiter when the cable is in a free state; rotate RA1 counterclockwise to 540° (1.5 circles), mobilize the adjustment shaft (4Z) to make the long cam (4T) move until the micro switch (4WK) is switched instantaneously, and then tighten the M5 nut.

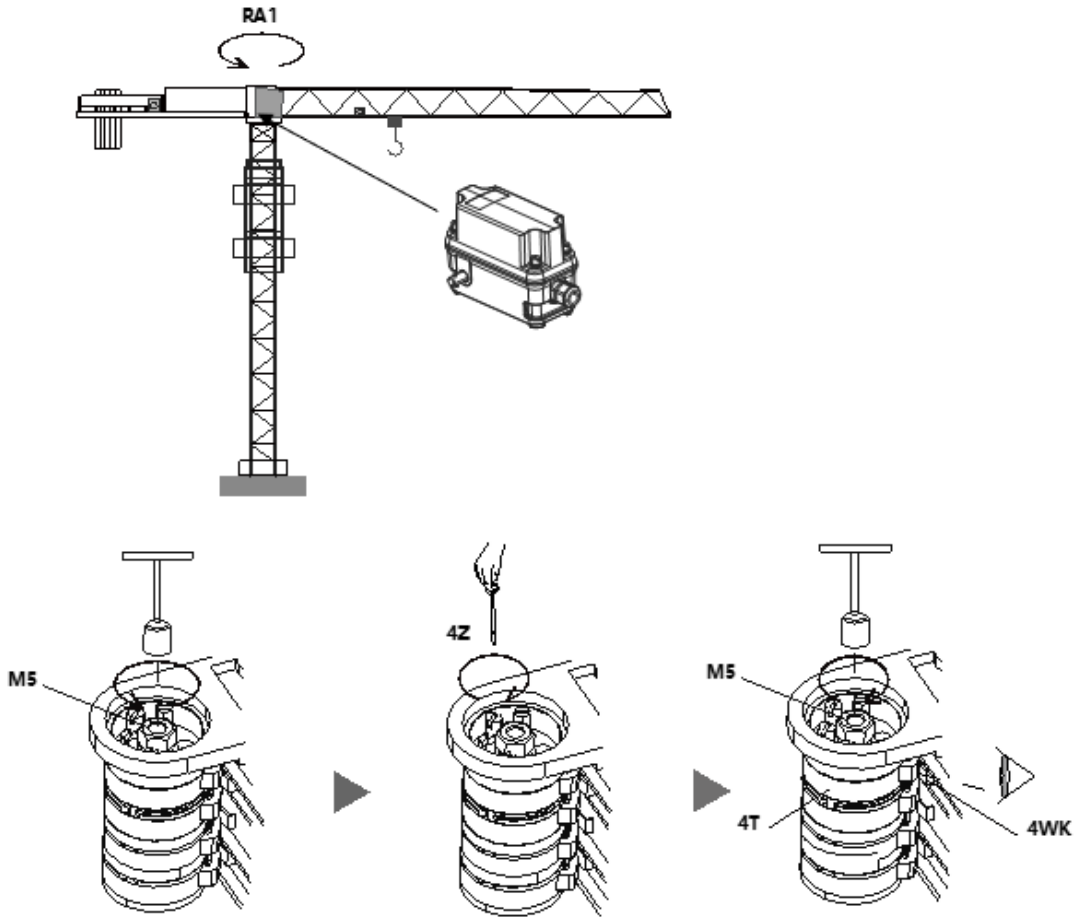


Fig. 4-83 Slewing leftward stop

■ Slewing rightwards stop

After completing the adjustment of the leftwards slewing stop, rotate RA2 clockwise to 1080° (3 turns), mobilize the adjustment shaft (2Z), make the long cam (2T) move to the micro switch (2WK) momentarily switch, and tighten the M5 nut.

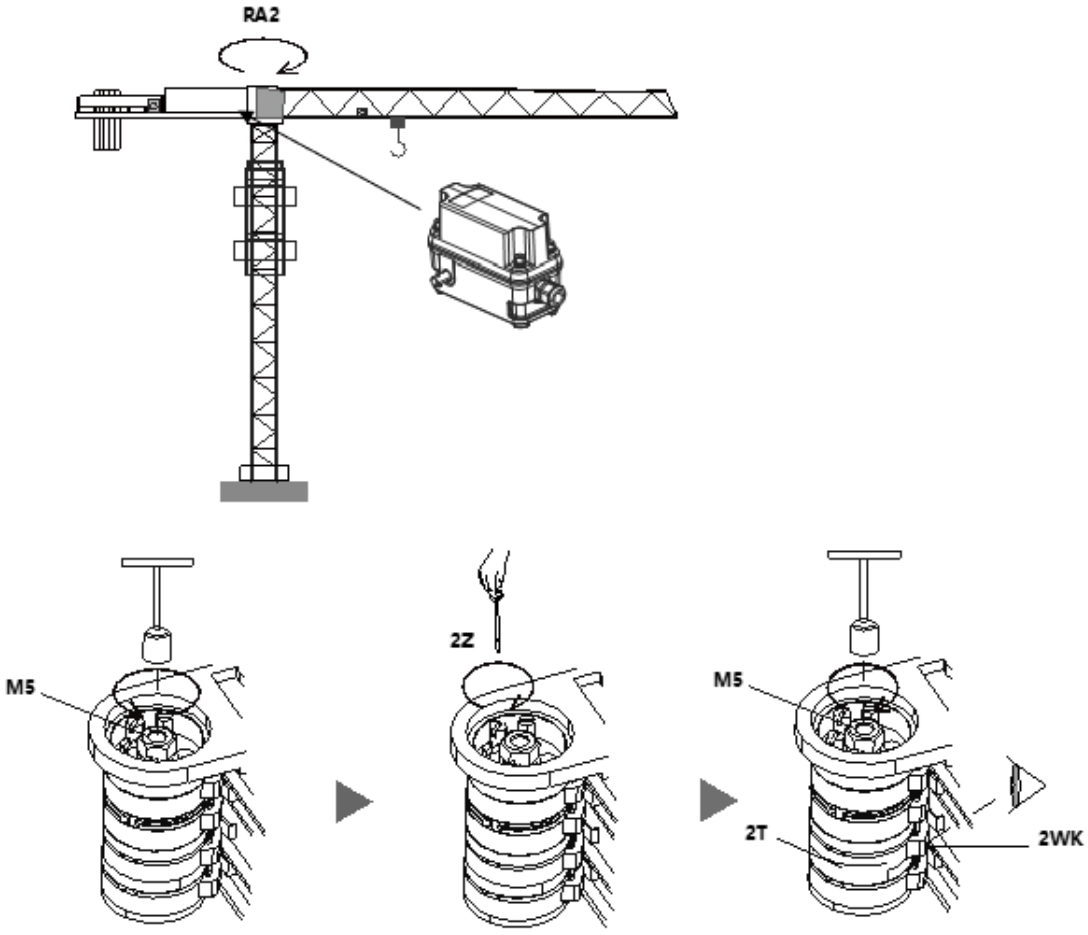


Fig. 4-84 Slewing rightwards stop

■ Multi-function limiter adjusts parameters

Table 4-8 Multi-function limiter adjust parameters

Hoisting limiter			Trolley limiter	
Fall	**H1(m)**	**H2(m)**	**L1(m)**	**L2(m)**
	5	1.5	5	0.5
	3	1.5		

4.18.3 Overload protection device

4.18.3.1 Load moment limiter

■ Function

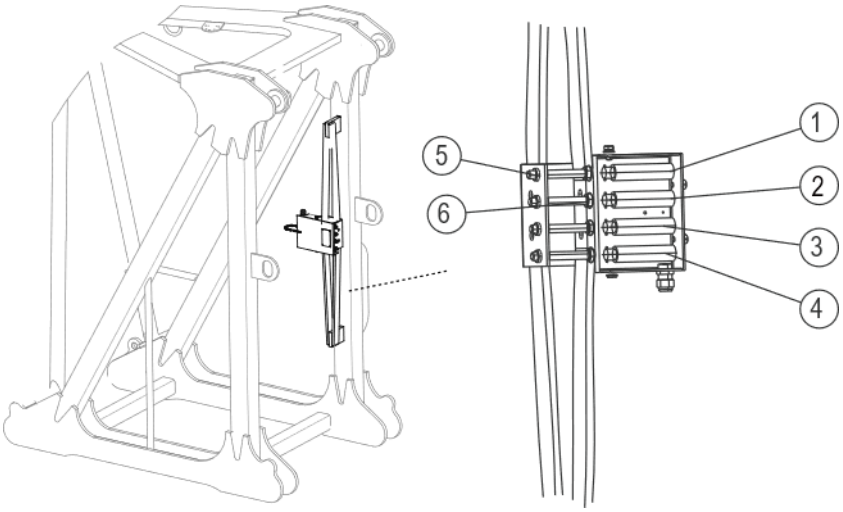
The design of the tower crane is based on a certain maximum load moment. It is strictly forbidden to exceed this maximum load moment when the tower crane is working.

The function of the load moment limiter is to prevent the working moment of the tower crane from exceeding the rated maximum lifting moment.

■ The working principle of load moment limiter

The load moment limiter is composed of a bow-shaped plate that magnifies the deformation and several limit switches (Fig. 4-85). There are several adjustable bolts on the plate. The bolts correspond to the travel switch. Under the action of the load torque, the adjustable bolt (6) Contact with the travel switch (1-4) to output overload deformation signal to remind the operator or make the operator's operation invalid.

According to the clearance between adjustable bolt and limit switch, the switch acts within the safety control circuits subjected to load moment.



(1) Travel switch SMA2
(2) Travel switch SMA1
(3) Travel switch SML2
(4) Travel switch SML1
(5) Anti-loosen nut
(6) Adjustable bolt

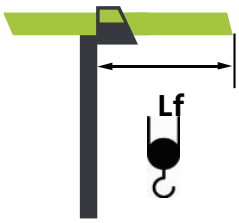
Fig. 4-85 Load moment limiter

- **The adjustment of the load moment limiter should be carried out at the independent height! The independent height is marked in "Technical Parameters of Tower Crane". When the adjustment is made beyond the independent height or the large height, the weight of the lifting weight should be subtracted from the weight of the wire rope exceeding the height and the additional weight of the hook.**
- **After adjustment, lock the locknut.**

■ Adjustment method

Adjust the individual switches of the load moment limiter shown in the diagram above (Fig. 4-85) according to the parameters in the table below. The specific adjustment method is shown in the back of the table.

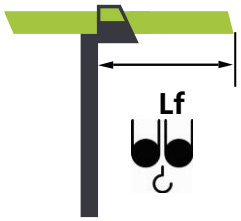
Table 4-9 Adjustment parameters(2-fall)



Lf/m	X/kg	Y/kg	W/kg	Ld/m	Lw/m	L/m	L'/m
70	2500	2750	5000	32.71	36.79	40.88	44.97
65	3100	3410	5000	35.58	40.03	44.48	48.93
60	3700	4070	5000	37.65	42.35	47.06	51.76
55	4400	4840	5000	39.63	44.58	49.53	54.49
50	5000	5500	5000	40.00	45.00	50.00	/
45	5000	5500	5000	36.00	40.50	45.00	/
40	5000	5500	5000	32.00	36.00	40.00	/
35	5000	5500	5000	28.00	31.50	35.00	/
30	5000	5500	5000	24.00	27.00	30.00	/

Lf: *Jib length*
X: *Rated weight on jib* X
Y: *110% rated weight on jib* X
W: *Maximum rated weight*
Ld: *80% of* ***L***
Lw: *90% of* ***L***
L: *Maximum trolley distance of* ***W***
L': *110% of* ***L***

Table 4-10 Adjustment parameters(4-fall)



Lf/m	X/kg	Y/kg	W/kg	Ld/m	Lw/m	L/m	L'/m
70	2408	2648	10000	17.99	20.24	22.49	24.74
65	3008	3308	10000	19.54	21.98	24.42	26.87
60	3608	3968	10000	20.65	23.23	25.81	28.39
55	4308	4738	10000	21.71	24.43	27.14	29.85
50	5108	5618	10000	22.62	25.45	28.28	31.11
45	6008	6608	10000	23.27	26.18	29.09	32.00
40	6808	7488	10000	22.98	25.85	28.73	31.60
35	7808	8588	10000	22.60	25.43	28.25	31.08
30	9108	10018	10000	22.13	24.89	27.66	/

Lf: *Jib length*
X: *Rated weight on jib* X
Y: *110% rated weight on jib* X
W: *Maximum rated weight*
Ld: *80% of* ***L***
Lw: *90% of* ***L***
L: *Maximum trolley distance of* ***W***
L': *110% of* ***L***

■ Load moment deceleration

Lift the maximum rated lifting weight W at a small amplitude to 1m above the ground, and trolley outward at a normal speed. When Ld is reached, adjust the load limiter bolt so that SMA2 (1) is triggered, and the trolley outward automatically switch to low speed.

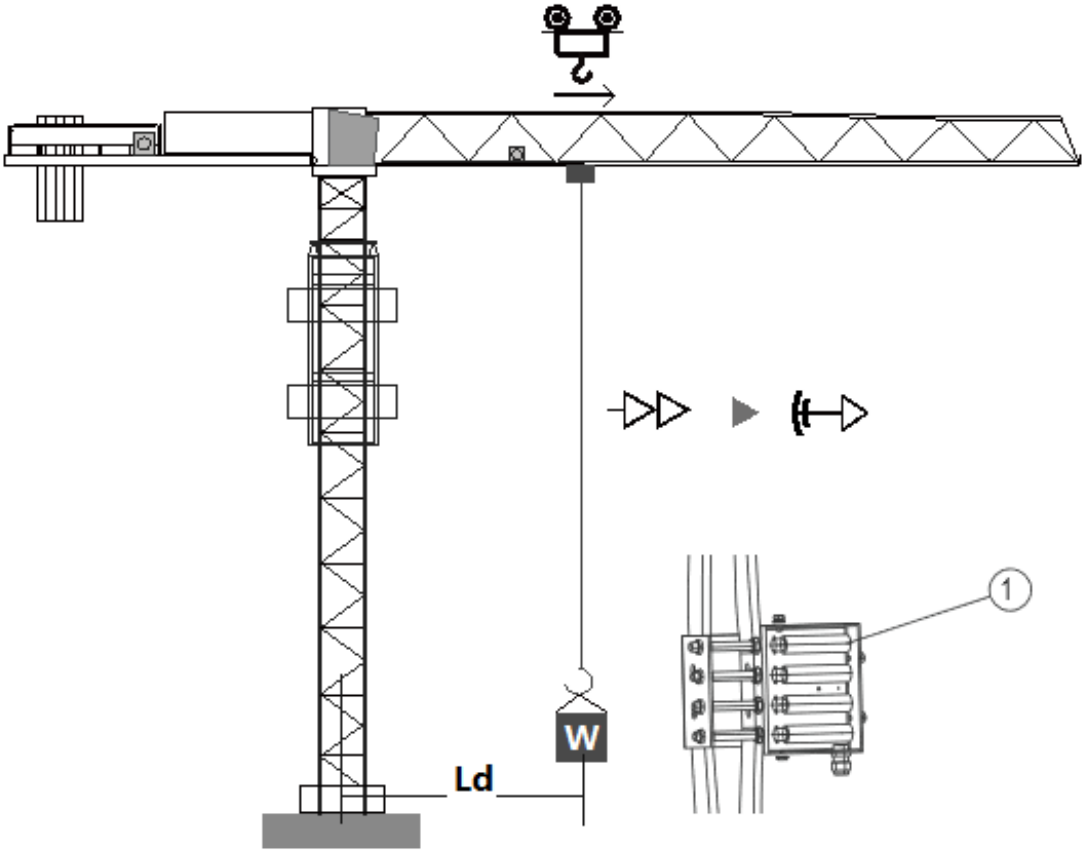


Fig. 4-86 Adjustment of trolley moment limiter

■ Load moment early warning

If the trolley continue to outward at a low speed and reaches $L_{w,,}$ the adjusting load moment limiter SMA1 is triggered, 90% moment yellow lights up and alarm.

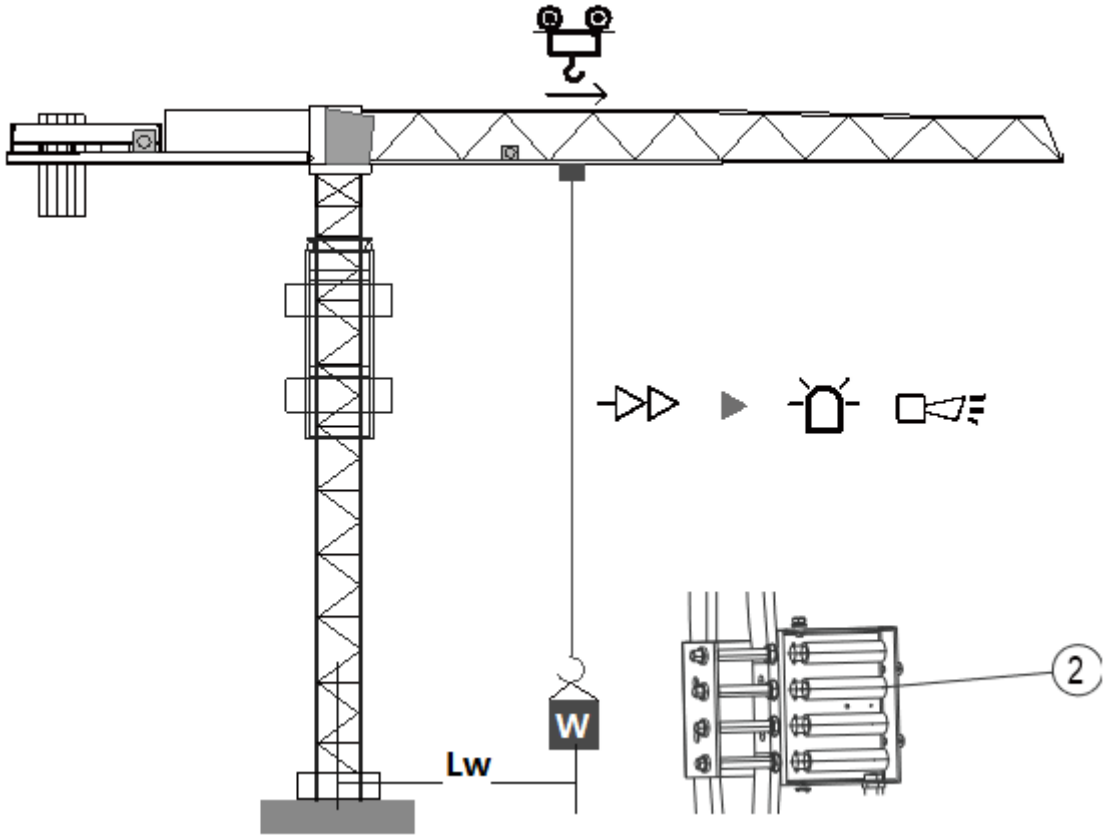


Fig. 4-87 Adjustment of moment limiter early warning

■ Constant load for variable radius

When the trolley reach to the position of L~L', adjust the moment limiter to trigger the SML2(3), then the "100% moment" light is on, and there is warning sound, the trolley out and hoisting up movements are limited.

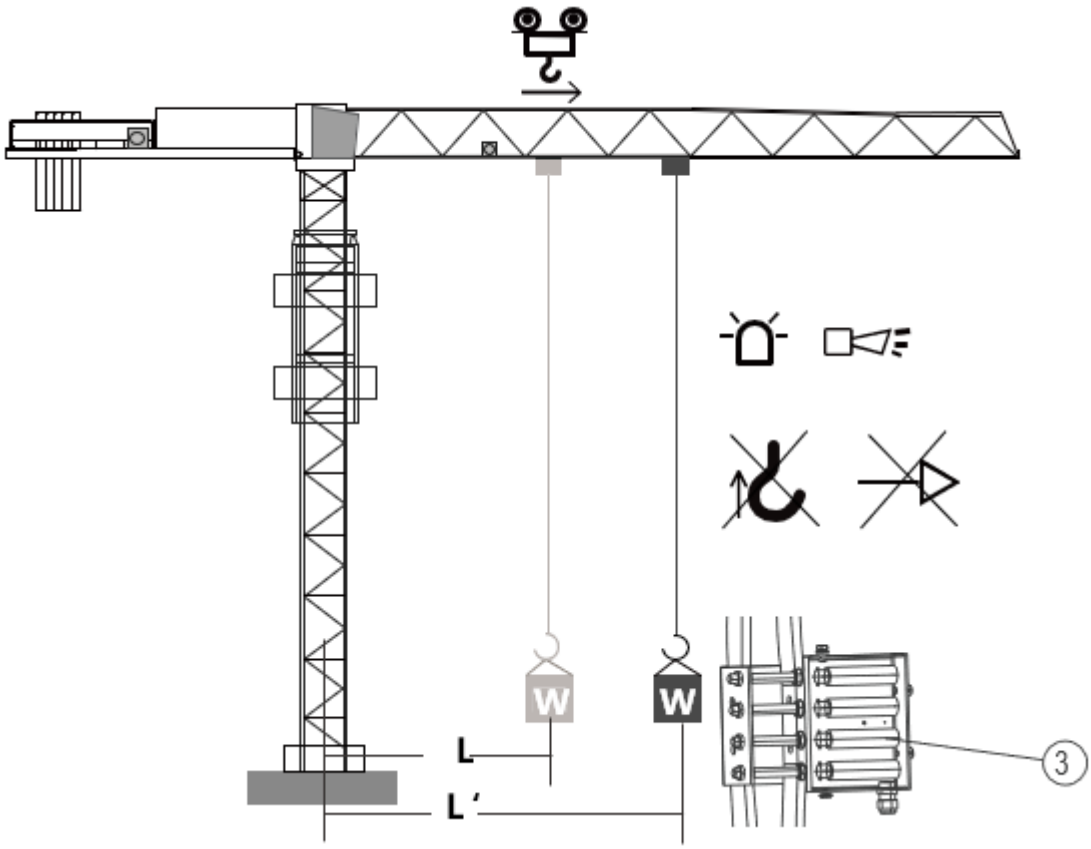


Fig. 4-88 Adjustment of constant load for variable radius

■ Constant radius for variable load

The normal permit maximum load at the jib end is X, without any moment limiter being triggered, the hoisting is normal. When the load to Y, the adjusting moment limiter SML1(4) is triggered. At this time, the hoisting up power is cut off, the 100% moment red lights up and alarm, the hoisting up is restricted.

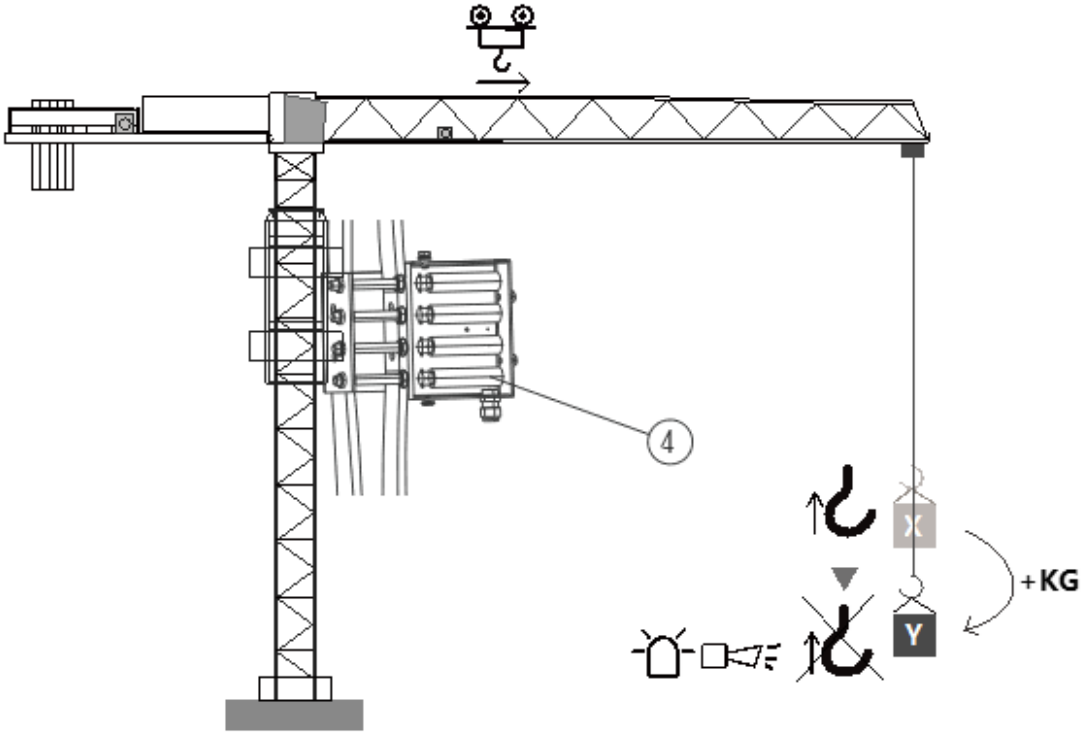


Fig. 4-89 Adjustment of constant radius for variable load

■ **Seal**

After adjusting and checking moment limiter, close the rain cover of moment limiter, and then wear it with steel wire through the hole of the rain cover and add lead seal.

4.18.3.2 Load limiter

■ **Function**

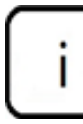
It is prohibited to exceed the maximum load capacity of tower crane during operation. Load limit switches are used to prevent the tower crane from exceeding the maximum load capacity.

■ **Working principle**

For most tower crane models, the load moment limit switch is a dynamometric ring consisting of metal strips, adjustable screws, several limits switch etc. Each screw corresponds to one limit switch. During HOIST operation, certain force running over the hoisting rope is applied to the dynamometric ring, and will cause the metal strips to deflect. This deflection of metal strips allows the adjustable screws to contact and act on the limit switch, which would alert the crane operator in case of any overload situation via acoustic and optical signals.

This system allows the contactors to act on the safety circuit depending on the loads to be controlled, when appropriately adjusting the gap between adjustable screw and limit switch.

For some special models, the load moment limit is fitted with a pin sensor.



- This system allows the contactors to act on the safety circuit depending on the loads to be controlled, when appropriately adjusting the gap between adjustable screw and limit switch.
- The load limit switch has been pre-calibrated at the factory and needs to be checked on site. If the deviation is too large, please adjust it according to the following adjustment steps.

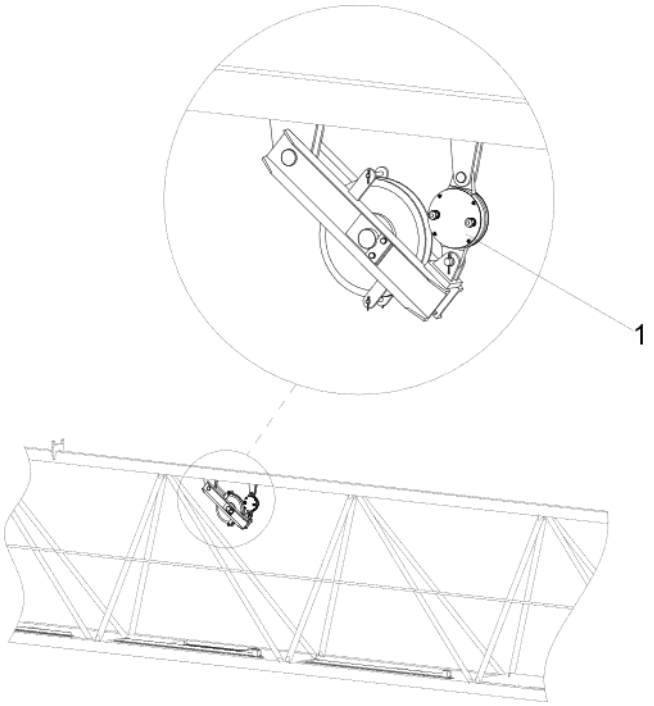


Fig. 4-90 Load limiter

■ **Installation and using of the load limiter**

Fix the load limiter to the position of the jib (jib Ⅰ or Ⅱ) by the hole (4) and a pin. The cover can be opened by screw out the nut (1). You can use the adjust wrench (3) on the cover back to adjust the adjusting switch inside. Connect the lines through the hole (2).

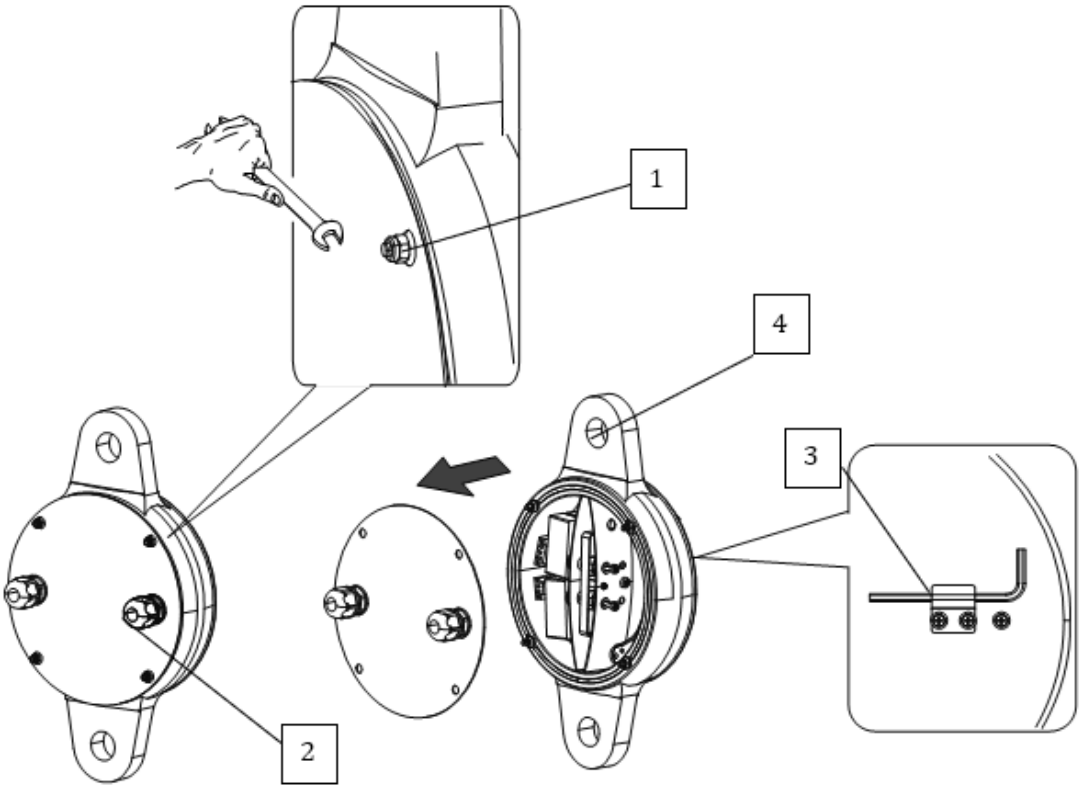


Fig. 4-91 Installation of load limiter

The figure above is for instruction only, it doesn't refer to the limiter of your crane in particular, but you can take it as a reference.

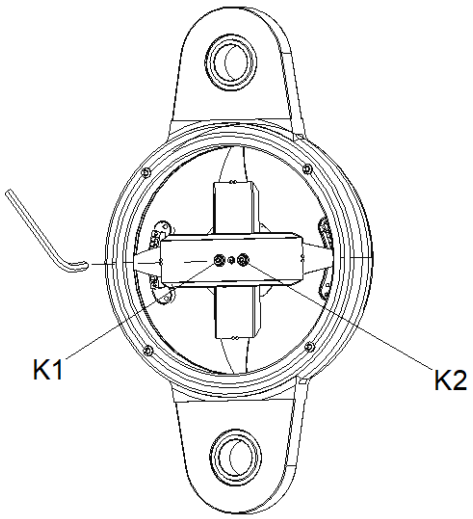


Fig. 4-92 Switch of load limiter

■ **Adjusting for High-speed hoisting**

Hoisting load A at the minimum radius, the hoist speed can be reach at high speed, add 10% weight, and then adjust load limit switch K2 is triggered. At this time, the high-speed hoisting radius is restricted, “50% rated load” yellow lights up, the height of hoisting is restricted at low speed.

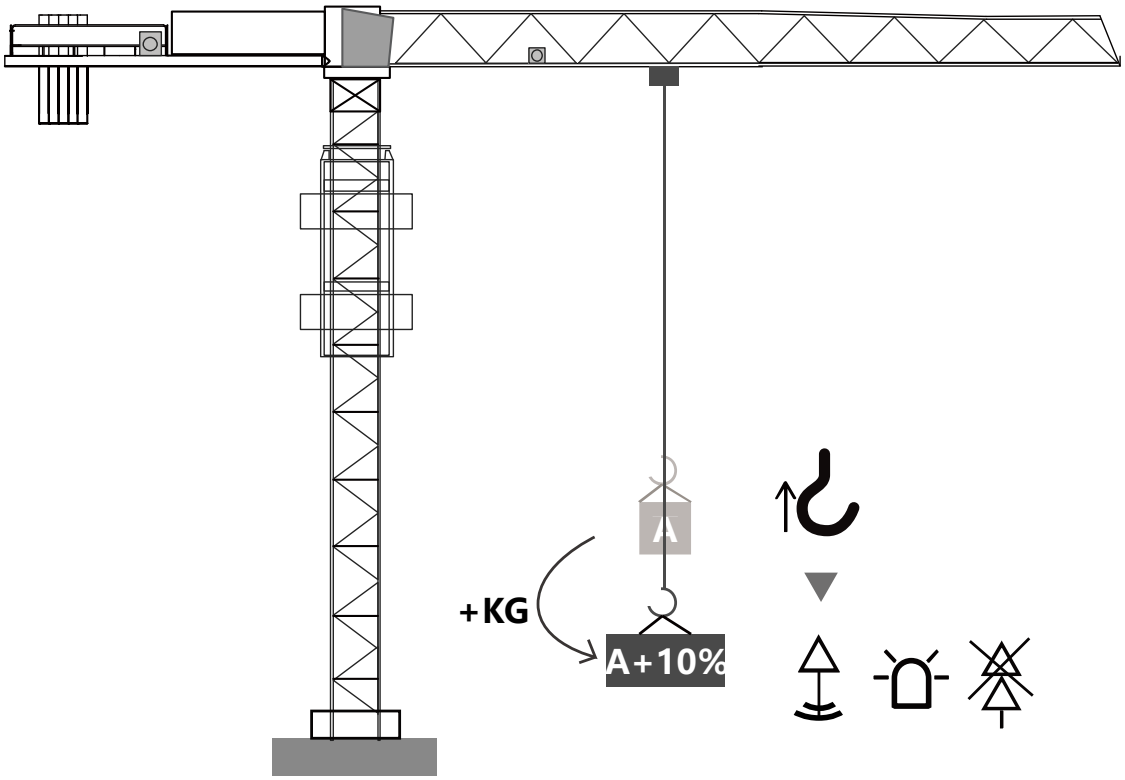


Fig. 4-93 High-speed hoisting for 50% rated load

■ **Adjusting for maximum hoisting load**

Hoisting load B at the minimum radius, the hoist speed can be reach at low speed, add 10% weight, and then adjust load limit switch K1 is triggered. At this time, “100% load” red lights up and alarm, the upward hoist actions are restricted.

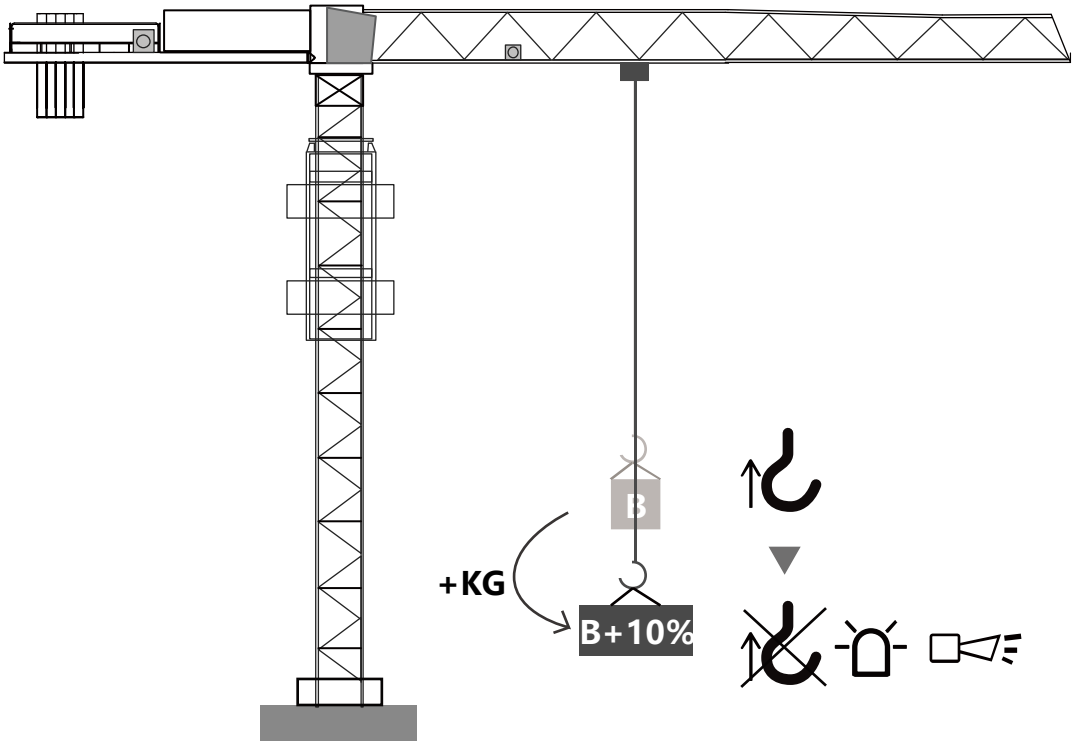


Fig. 4-94 Adjusting for maximum hoisting load

■ Adjust parameter table of load limit switch

Table 4-11 Adjust parameter table of load limit switch

Fall	A (kg)	A+10% (kg)	B (kg)	B+10% (kg)
	2500	2750	5000	5500
	5000	5500	10000	11000

■ **Seal**

After adjusting and checking load limit switch, close the rain cover, and tightening the bolts, and then wear it with steel wire and add lead seal.

4.18.4 Anemometer and obstruction light setup

4.18.4.1 Anemometer setup

If tower crane height over 50m, should install anemometer. The anemometer co-work with safety monitor system. When wind speed over the maximum in service wind speed, alarming stop working.

Anemometer installed at the tower crane's top. Shows in fig 7-90, the base (1) connects with tower crane's top through the install plate bolt. Wiring through the wire junction gate (2), and using fan (3) for speed measurement.

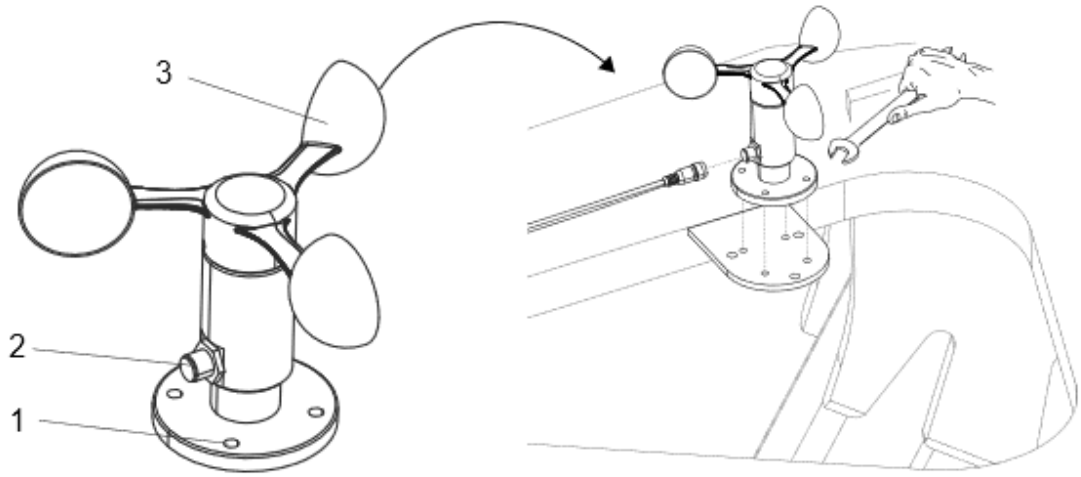


Fig. 4-95 Anemometer

4.18.4.2 Waring and display record device

- Sound signal

For example, the signals below will produce automatically by the sound warning ways:

- The tower crane starts and self-checks: short buzzer sound for 5 times;
- Warning of over load: constant buzzer sound;
- The tower crane working: intermittent double buzzer sounds.

There will be special sounds according to the local regulations or rules. **Know the tones and last time of each signal!**

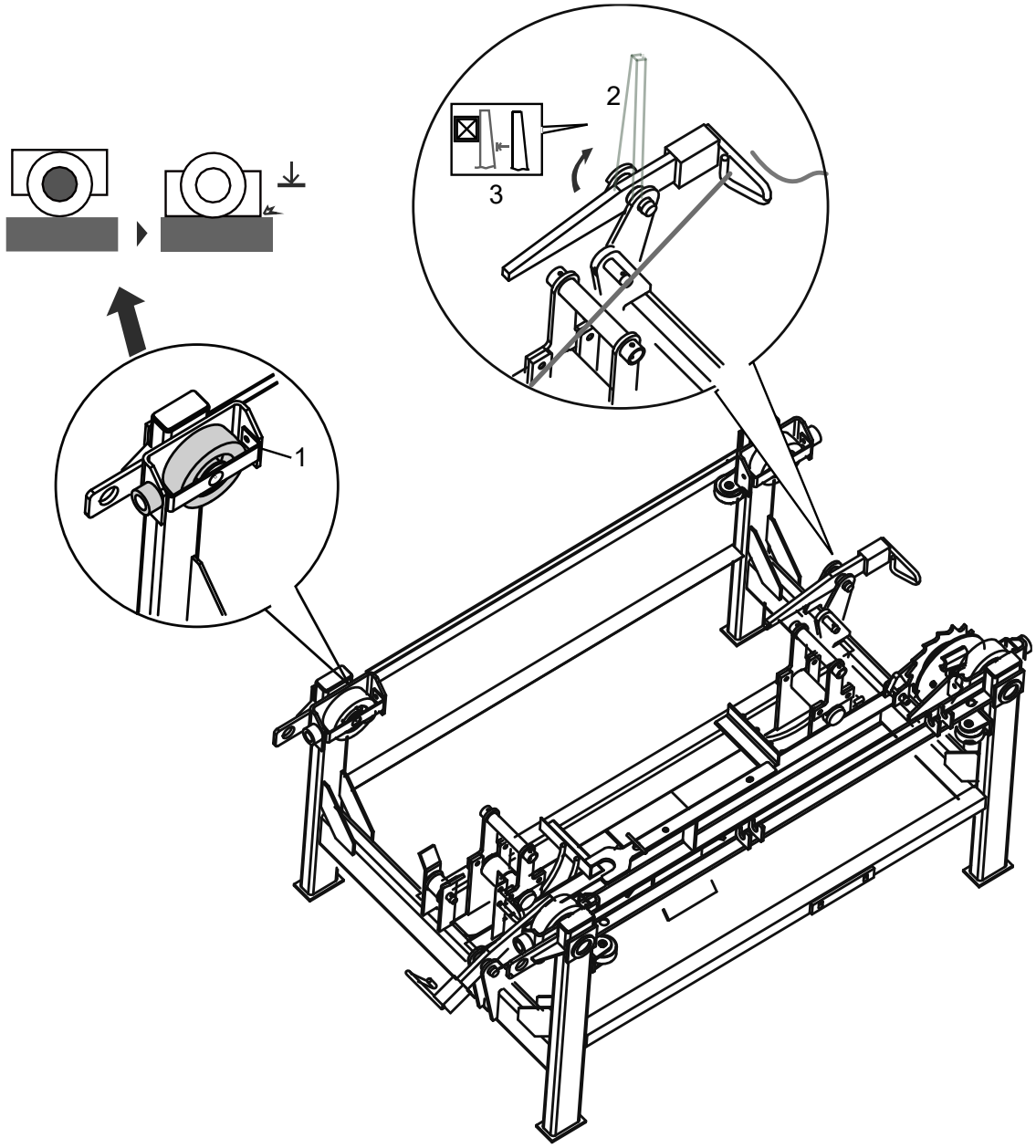
- Light signals

For example, the light signals below indicate particular dangers:

- Wind speed warning at working: flashing orange light.
- Load over 90% of the rated load: flashing orange light (with buzzer warning).
- Limiter failure: flashing red light.

4.18.5 Trolley safety protection device

The safety protection device of the trolley is shown in the following figure:



(1) Axle break protection device (2) Rope break protection device (3) Brake rod

Fig. 4-96 Trolley safety protection device

- Rope break protection device

See Figure 7-91, under the normal working state of the trolley, the wire rope is in a tensioned state, and the broken rope protection device (2) is in a horizontal state; when the rope is broken, the broken rope protection device rotates to a vertical position under the action of gravity at the tail. In the straight state, at this time, the brake lever (3) of the device will be in contact with the web rod on the bottom surface of the boom, and the movement of the trolley will be blocked and the operation will be stopped automatically.

- Axle break protection device

See Figure 7-91, when the roller breaks the axle, the trolley loses the support of the roller and moves downward, and the lower end of the axle break protection device (1) is in contact with the lower chord of the boom. Under the action of the four axle break protection devices, the trolley continues to stay on the lower string of the boom to ensure that it will not fall due to the broken axle.

4.18.6 Hook safety device

The hook safety device is shown in figure (1) below, it is in close contact with the hook end face (2) during use, and can only be opened in one direction into the hook. When lifting heavy objects, the objects in the hook will be restrained in the hook by the safety device to prevent decoupling.

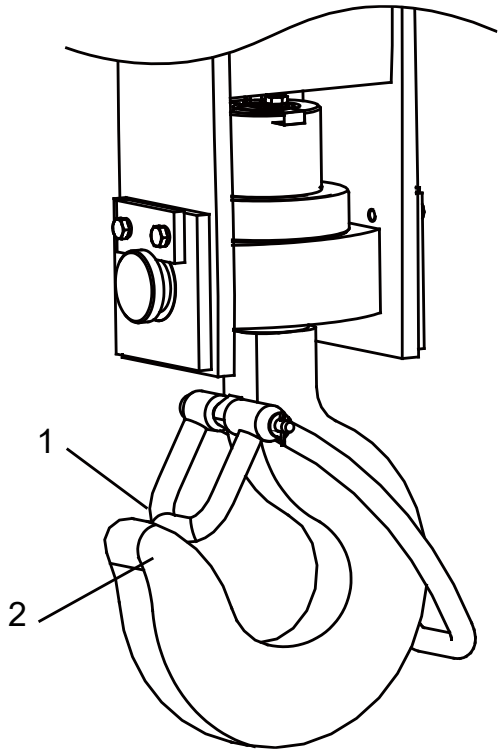


Fig. 4-97 Hook safety device

4.19 Test

To confirm the tower crane's readiness, an acceptance test shall be performed. The test shall include at least the following items:

- Nameplate of the tower crane and the grades;
- Tests of drive mechanism, limiter and indicator;
- Safety devices;
- In compliance with the load tests 4.19.1 and 4.19.2

4.19.1 Function test without load

All functions (such as braking, system controlling and limiting etc.) shall be tested for reliability throughout the whole range of admissible movements up to the maximum operating speed (such as hoisting, trolley and slewing).

- When testing, the temperature should be -15~40°C, the wind speed can’t be over 8.3m/s.
- When testing the trolley speed, total time of trolleying, slewing speed, working speed and side perpendicularity, the wind speed can’t be over 3m/s.
- The error range of the power voltage should be ±10%.
- The participators must have relevant certification.

4.19.2 Load tests

4.19.2.1 Nominal load tests

The load at the maximum amplitude is 25%, 50%, 75%, 100% separately to the nominal load, the tests should comply with the acquirements in 4.19.1, all the tests should be reliable.

4.19.2.2 Static tests with load 125% of the rated capacity

After the success of the no-load test and the nominal load test, proceed the static overload tests. The load tests result for different jib lengths show as Table 4-12.

- Test at 4-fall.
- Hoist the rated load to the position 100~200mm above ground, standstill then add the load to 125% in several times, measure the load height, measure again after 10min, compare the heights.
- There should be no ruptures, permanent deformations or damages affecting the function or safety of the crane and parts connecting loose.

Table 4-12 Static tests with load 125% of the rated capacity

Item / Jib length(m)	Radius Ⅰ(m)	Load Ⅰ(t)	Radius Ⅱ(m)	Load Ⅱ(t)
70	22.49	12.5	70	3.01
65	24.42	12.5	65	3.76
60	25.81	12.5	60	4.51
55	27.14	12.5	55	5.38
50	28.28	12.5	50	6.38
45	29.09	12.5	45	7.51
40	28.73	12.5	40	8.51
35	28.25	12.5	35	9.76
30	27.66	12.5	30	11.38

- *It is forbidden to trolley and slew at the static overload test.*
- *It is forbidden to adjust the brake at the static overload test.*
- *It is allowed to adjust load moment limiter and load limiter at the static overload test.*

4.19.2.3 Dynamic tests with load 110% of the rated capacity

The load tests result for different jib lengths shows as Table 4-13.

Test at 2-fall or 4-fall.

- **Working condition** Ⅰ: Trolley to the maximum radius of maximum load, loads by 110% maximum load. Test method:
  - Hoisting: Hoist up and down at the rated speed in the whole hoisting range.
  - Trolleying: Trolley in and out at the rated speed in the whole trolleying range.
  - Slewing: Slewing left and right at the rated speed in the whole slewing range. (for the tower crane which can't slew around, the slewing test angle should exceed the max angle.)
- **Working condition** Ⅱ: Trolley to the maximum radius, loads by 110% rated load at the maximum radius. Test method:
  - Hoisting: Hoist up and down at the rated speed in the whole hoisting range.
  - Trolleying: Trolley in and out at the rated speed in the whole trolleying range.
  - Slewing: Slewing left and right at the rated speed in the whole slewing range. (for the tower crane which can't slew around, the slewing test angle should exceed the maximum angle.)

- **Requirements**:

Test according to the indication above, check if the mechanisms are flexible and their brakes are reliable. Check if there is any loose or break in the mechanisms or structure parts.

Table 4-13 Dynamic tests with 110% of the rated capacity

Item / Jib length(m)	Radius Ⅰ(m)	Load Ⅰ(t)	Radius Ⅱ(m)	Load Ⅱ(t)
70	22.49	11	70	2.65
65	24.42	11	65	3.31
60	25.81	11	60	3.97
55	27.14	11	55	4.74
50	28.28	11	50	5.62
45	29.09	11	45	6.61
40	28.73	11	40	7.49
35	28.25	11	35	8.59
30	27.66	11	30	10.02

4.19.2.4 Operation of overload test circuit

If 110% and 125% overload weight test is needed at the construction site, the following steps should be followed for circuit operation:

1) When the tower crane is not operation, pull out the XP16 at the lower part of the driving kit in the driver's cab, connect the spare 100% load unlimiting test pug to XS16, and then temporarily the mechanical limit of 105% load.
2) Rotate the mode section key switch to "Mechanical" mode, when the electronic load limit is not involved in the control, then the overload hoisting test can be performed.
3) After the completion of test, open the mode selection key and rotate it to the "electromechanical" mode on the interface of "load weight calibration". Remove the "100% weight unlimiting test plug" and connect the weight limiter plug, the system will resume normal operation.

- This operation must be carried out by professional testers.
- The operation shall be carried out in strict accordance with the test process, and illegal driving and taking the plane during the test are prohibited.
- Once test is completed, remove the "100% weight unrestricted test plug",
- This "100% load unrestricted test plug" is guaranteed to be used for temporary overload test on construction site, and must not be removed

4.20 Dismantling

4.20.1 General notes

1) Due to the climbing mechanism out of service for a long time, conduct maintenance and test-run for the climbing mechanism before moving the tower crane out of the construction site.
2) Before dismantling of tower crane, maintenance and test-run of the climbing mechanism is necessary.
3) Check limiters, slewing mechanism brakes and similar for reliability during test-run.
4) It is prohibited to use the slewing mechanism, trolley and hosting mechanism before the tower crane mast sections have been dismantled and the slewing ring support has not been connected to the tower body by eight pins.
5) Check frequently the main stressed parts of the climbing mechanism, as the tower crane dismantling is a heavy duty and successive work for the climbing mechanism.
6) While the climbing mechanism is working, all operating personnel are required to focus their attention on observing the relative positions of moving parts for normal condition (e.g. between guide rollers and main chord rods, between Telescopic cage and crane tower.). In case of any deviation during the telescopic cage is being lifted, stop and lower climbing immediately.
7) Carry out dismantling when the wind speed is lower than 14m/s atop the tower crane. Take care of the stockpile location of dismantled parts because the working site is limited for tower crane dismantling after the buildings have been constructed. Any slight carelessness might cause serious accident.

- **Users are required to strictly follow the Instructions-specified rules to dismantle tower crane. Operators shall have been trained and with certificates. Any slight neglect will cause machine damage, personal injury or death.**
- **Pay great attention to the two moving mast lugs during inlet or dismantle of additional mast sections. Inspect if the lugs are still in proper level condition.**
- **Pay great attention to the two climbing latches during inlet or dismantle of tower section. Inspect if the latches are still in proper level condition. Slewing the tower crane to the dismantling area where there shall be no obstacles influencing the operation. Carry out tower crane dismantling according to the sequence. Its steps are in opposition to the steps of tower crane erection. Strictly follow the instructions specified rules in all cases.**

4.20.2 Dismantling sequences

1) Dismantle mast sections.
2) Removing the hoisting rope.
3) Dismantle counter ballasts remain from counter jib, only keep a counter ballast block.
4) Dismantle the jib.
5) Dismantle the last counter ballast block.
6) Dismantle the counter jib (include hoisting mechanism).
7) Dismantle the slewing unit.
8) Dismantle the transition section, climbing equipment and the mounting system.
9) Dismantle the rest tower sections and base tower section.

4.20.3 Preparations before dismantling

Make sure that no obstacle will interfere during the dismantling operations.

For cranes with travelling gear:

- Bring the crane to the dismantling area.
- Fold down the rail clamps of the bogies and tighten them onto the rails.

4.20.3.1 Dismantling the tower section

Remove the tower sections in turn, refer to ***Section 0***.

When the climbing equipment is climbing down, a dedicated person must be assigned to take charge of the hanger plate, step change climbing lever and guide rollers, and to check if the climbing equipment is seized by obstructions, ensuring the climbing equipment climbs down successfully.

4.20.3.2 Dismantling the hook and the hoisting wire rope

- Lower the hook to the ground, remove the connection between the hoist wire rope and the anti-twisting device on the jib, start the hoist mechanism and recover all the wire ropes.

4.20.3.3 Dismantling the electrical control wire

- Disconnect the circuit of the electronic system that affects the lifting of the tower components and gather it at one end.

4.20.3.4 Dismantling the part counter ballasts

- Dismantle the counter ballast piece by piece in reverse order of installing sequence the counter ballast. Only leave the first **3.0t** counter ballast block.

4.20.3.5 Dismantling the jib assembly

1) Before dismantling, check the jib assembly to see if component-to-component is still connected by power cable.

2) Arrange hoisting rope at hook points. (reference the record point when the jib was lifting);
3) Dismantle the connection pin and bolts of jib and counter jib.
4) Lower the jib and lay it down on the sleeper-cushioned support.

4.20.3.6 Dismantling the last one counter ballast

- Remove the last one counter ballast block, and lift it in the proper position on the ground.

4.20.3.7 Dismantling the hoisting mechanism

- Sling the hoisting mechanism, remove the connecting pin shaft between the hoisting mechanism and the counter jib, and sling it in an appropriate position on the ground.

4.20.3.8 Dismantling the counter jib

1) Hang the rear counter jib part, lift the support frame for counter jib tie bars, dismantle the pins connecting the rear counter jib part and the from counter jib.
2) Take the position pins of rear counter jib part and the front counter jib section as the fulcrum, slowly lift the rear counter jib part and rotate around the fulcrum, so that tie bar is in a relaxed state, the tie bar falls on the support frame, and remove the connecting pin of the tie bars on the rear counter jib part and the front counter jib section.
3) Hoist the rear counter jib part up and put it down onto the ground.
4) Hoist the front counter jib up, dismantle the connecting of it and turntable, then put it down to the proper position on the ground.

4.20.3.9 Dismantling the slewing unit

- Sling slewing unit, dismantling the connecting pin shaft between the slewing support and the transition section, and sling it in an appropriate position on the ground.

4.20.3.10 Dismantling the transition section, climbing equipment and the tower section

- Sling the climbing equipment, slowly hoist it out along the main chord of the tower section to the ground.
- Dismantling the tower section and the mast section in turn. Chassis fixed tower crane to remove.

- *The dismantled crane needs to be checked and maintained by technical personnel and trained maintenance personnel.*
- *Check main stressed structural members for metal fatigue; weld fissure, structural deformation, etc. Check tower crane parts for damage or collision injury.*
- *After completion of checks, repair the defects found and defects potential. Carry out rust removing and painting.*

5 OPERATION AND CONTROL

5.1 Driving safety requirements for tower crane

Please read the requirements in ***Chapter 2 <SAFETY INSTRUCTION>*** of this manual carefully.

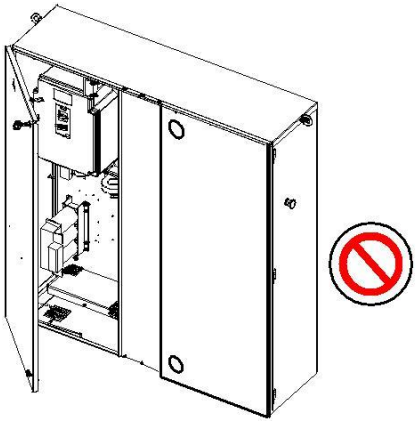
The driver needs to read the manual before operating.

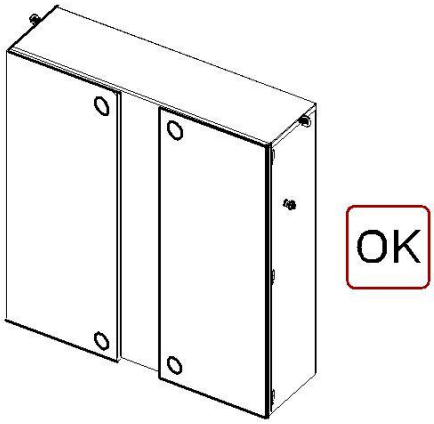
5.2 Attention for operation

- Operate the crane only all the safety devices are in good condition.
- Adjust the limiters according to the instruction handbook strictly.
- Sufficient lighting shall be provided to the working area for night working.
- Keep all platforms, ladders, rails, and railings from dirt.
- No unauthorized persons are allowed climb the crane!
- People who have been approved can climb up or down the tower crane after the tower operators stopping the crane!
- Test run before working, work after confirming the tower crane is in good condition.
- Whistle before action every time.
- Don’t lay the hook onto the ground in order to avoid disordering the ropes.
- Operators should give some relevant warning signals on occasion.
- Stop working immediately once some defects harming tower crane operation safety are found.
- The tower crane driver should observer the state of the tower crane in the cabin during the climbing and descending process, when the tower crane is abnormal, the driver should handle the problem in time.
- When the tower crane rises and falls, no one is allowed stand under the tower crane without permission

5.3 Specific safety instructions

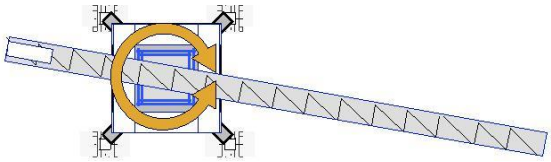
When the crane is in service, all the control panel doors must be locked.





The crane driver must position the jib in the direction of the wind before any weathervane operation.

At each operation in the slewing area of the slewing crane part, the crane driver must be extremely vigilant (crushing hazard).

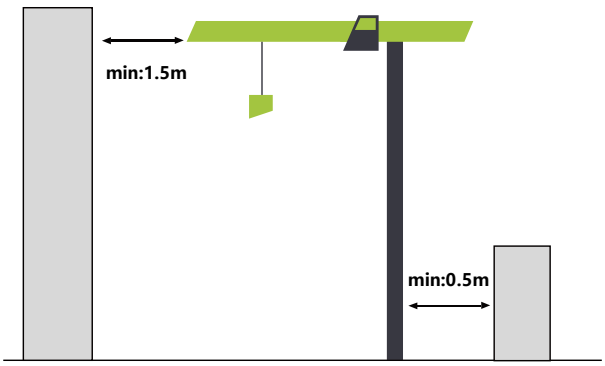


It is compulsory to put the control unit out of service as soon as the crane driver lays it down or no longer controls the crane.

5.4 Preparation before operation

5.4.1 Inspection before operation

Table 5-1 Check list before operation

Item	Content
Common	Check the wind speed, the maximum allowed wind speed is 20 m/s when the tower crane is working; The maximum allowable wind speed is 14 m/s when the tower is erected and climbing up; Check the environment temperature, the normal working temperature range of the tower crane is: -20℃ ~ +40℃; Check the working voltage of the tower crane; Check the safe distance of the cable from the largest rotating part of the tower crane; Check the distance between the tower crane and surrounding buildings.  Make sure that all central ballasts and counter ballasts are of the correct weight, quantity, and proper placement; Check whether the tower crane foundation is in good condition; Make sure all gears and bearings, etc. are well lubricated, such as slewing rings; When in lightning area, customers need to equip their own lightning protection devices to ensure that lightning protection devices are installed according to local requirements and that the tower crane is properly grounded.
Base	Check whether the connecting bolts of the outriggers and the base tower section are correctly installed and tightened or whether the anchor bolts are tightened; Check the cable routing to prevent damage.
Mast	Check whether the high-strength bolts between the tower sections are installed correctly and whether the pre-tightening torque meets the requirements;

Item	Content
	Check whether the ladder, platform, etc. are firmly connected.
Climbing equipment	Check the connection to the transition section; Check whether the rollers and the support bar are flexible and reliable, and whether the connection is firm; Check whether the ladder, platform, etc. are firmly connected.
Transition section	Check whether the ladder, platform, etc. are firmly connected; Check whether the connection with the standard section, climbing equipment and slewing support is firm.
Slewing unit	Check the tightness of the bolts connected to the slewing bearing; Check whether the mounting device trolley is clear of obstruction; Check cable routing; Check whether the ladder, platform, etc. are firmly connected; Check whether the connecting pins between the turntable and slewing tower, slewing support and the tower section are correctly installed.
Cabin	Check the connection of the cabin; Check internal circuit connections; It is strictly forbidden to store lubricating oil, oil cotton yarn and other flammable items in the cabin.
Jib	Check if the connecting pins, baffles, washers and cotter are correct installation of pins everywhere; Check the fastening of platforms, ladders, passages, and gondolas; Check the winding and tightening of the hoisting wire rope.
Counter jib	Check the correctness of the installation of connecting pins, shaft end shields and pivots; Check the installation of the counter jib railing and the walkway to ensure that the walkway is free of debris; The hoisting wire rope roller can rotate freely.
Hook	Check the hook for defects that affect its use; Check whether the specifications and models of the hoisting wire rope meet the requirements; Check wear and tear of the wire ropes and pulleys.
Mechanism	Check the installation and operation of each mechanism; Adjust the brake clearance of each mechanism right position; Check the trolley mechanism. When the trolley reaches the max. and min. radius, the wire rope on the drum should have at least 3 safety rings; Check that the wire rope is wound correctly on the drum;

Item	Content
	Check whether the compression of each wire rope head is loose.
Safety equipment	Check whether each safety protection device is adjusted according to the requirements of this operation manual; Check that all safety devices are reliable; The limiter must be re-adjusted every time after climbing, the jib length is changed, or after a period of use.
Electronic control system	The insulation resistance of the main loop control loop to ground should not be less than 0.5 MΩ; The grounding resistance of the mast to the ground should not be greater than 4Ω.
Lubricating	Check lubrication according to Maintenance Manual.

5.4.2 Check after power on

After every power-on, before starting the tower crane, the operator must check the following in the empty hook state:

- Whether each switch button (especially the "emergency stop button"), operating handle, brake, travel limit and protection switch work normally;
- Safety monitoring system in the cabin is firmly installed, and whether the communication cable is connected reliably;
- Whether the limit protection switches are well adjusted;
- After each limit protection switch is activated, whether the electronic control system can perform the corresponding protection function;
- If any abnormality is found, it should be stopped immediately for maintenance;
- The tower crane shall not be put into operation until the failure or potential safety hazard has been eliminated.

Each mechanism of this series of tower cranes uses variable frequency speed drive, and each frequency converter will generate a certain high-frequency leakage current during operation, which is determined by the inherent output characteristics of the frequency converter. The leakage current of each frequency converter may be greater than 100mA. In order to ensure the normal use of the tower crane, the B-type (delayed) leakage protection circuit breaker in accordance with IEC 60755 and VDE 0664-100 standards should be selected on the power supply of the construction site, and Please ensure that all parts of the tower crane are reliably grounded.

5.4.3 Tower crane startup

After confirming that the inspection and preparation are done before starting, and the main power switch QF is closed, press the green start button of the linkage platform to start the tower crane

directly.

The start button is located on the right linkage table panel, it is a dual function button, namely: start and electric whistle function. When the main power switch QF of the main control cabin is closed, the left and right linkage table handles are in the zero position, the grid voltage phase sequence is normal, and the components of the startup circuit are running normally, press this button to start the system.

- *When the system starts, the green "start" indicator on the left linkage stage is on, indicating that the electric control system is successfully powered on.*
- *The driver will hear the buzzer beep 5 times within 2 seconds, and at the same time the alarm light on the right linkage platform flashes 5 times, indicating that the alarm device is normal.*

When the electronic control system is successfully started, the operation of each mechanism can be carried out. When using the operating handle, the self-reset button on the top of the handle should be pressed down to release the self-locking before pushing.

When the handle is pushed, the buzzer in the linkage station will emit a short "beep" every time it enters a gear.

When the sound and light alarm signal occurs, the electronic control system will automatically limit the relevant movement (such as prohibiting the movement of a certain mechanism, slowing down the movement in a certain direction, etc.).

The requirements for the working environment are relatively high. Such as poor quality of power supply (low or high voltage, unbalanced three-phase), power supply fluctuation, high ambient temperature, frequency converter overload, motor overload, frequency converter overheating, output phase loss, output side ground fault, etc. Frequency converter stops.

In most cases, this does not mean that the frequency converter has been damaged, but the built-in automatic fault protection function of the frequency converter comes into play and enters a protective shutdown state. Under normal circumstances, after the power supply returns to the normal range or the corresponding fault is eliminated, press the " ENTER " key of the digital operator on the frequency converter panel, and the frequency converter can return to the running state; or restart the power supply after a few minutes. control system, the frequency converter can automatically reset and enter the running state.

If the frequency converter stops frequently, first judge, if it is caused by the poor quality of the power supply, stop working temporarily, and start the operation after the power supply is normal; If it is caused by other faults or unknown reasons, you should suspend use, and promptly notify our company to send personnel to deal with it. Please do not repair or modify parameters by yourself, so as to avoid further damage.

All internal parameters of the frequency converter are not allowed to be changed by non-manufacturer personnel without the permission of the manufacturer's professionals (such as designers and professional after-sales service personnel).

5.4.4 Safety device calibration

Tower crane safety protection devices mainly include: moment limiter, hoisting limiter, height limiter, trolley limiter, slewing limiter and anemograph.

Starting the tower crane for the first time, the safety protection device of the tower crane needs to be calibrated, and the tower crane can be used normally only after the safety protection device of the tower crane is confirmed to be effective.

Detailed calibration methods, see ***Section 4.15***.

5.4.5 Tower crane operation

5.4.5.1 Hoisting and lowering operation

The hoisting operation is controlled by the handle on the right linkage table, pull inwards when it goes up, and push it outwards when it goes down. There are five gears for hoisting and lowering, corresponding to five speeds, and must be switched gear by gear when changing gears.

In some occasions, the driver wants to hoist the hook to the bottom of the trolley, but it cannot be realized due to the limiter. At this time, operator can press the "Bypass" button on the left linkage table with his left hand, and right hand operate the handle on the right linkage table to hoist the hook to the limit position. The operator should pay attention to the position of the hook to avoid collision.

1) In addition to the above basic operations, it also has the following customization functions: Micro-speed and jog functions: press the micro-speed button on the right linkage table at any time to turn on the micro-speed function (the speed of gears 1 to 5 is reduced to about half of the normal operating speed, subject to the actual micro-speed operating speed); Press the micro-speed button, and then operate and keep the button pressed, after the gear is reset to zero, activate the function of jogging without closing the brake. If there is no hoisting action within the set time (the default setting is 5 seconds), the brake will be braked, exit the jog mode; If you release the jog button within 5 seconds, the brake will immediately hold the brake and exit the jog without closing mode.
2) Speed with load function: When the weight load is over 50%, it is allowed to turn the handle to the 3rd gear of the base frequency. At this time, the frequency converter will automatically adjust to the maximum allowable speed according to the load weight, which can improve the hoisting efficiency.

3) Anti-slip hook function: When the frequency conversion hoisting system is not in operation, it still detects the state of the hoisting mechanism at all times. To maintain the relative height of the hoisting weight, prevent the hoisting weight from falling, and issue an alarm prompt, the up and down movement of the main hook is limited to the 2nd gear of the fundamental frequency, and the inward and outward movement of the trolley is limited to the 2nd gear. Left and right movement of the arm is limited to 2nd gear.

When the anti-slip hook function is on, the display shows "the tower crane has entered the hovering anti-slip hook state ", and the system automatically enters the hovering state. At this time, the personnel under the tower must be immediately notified to evacuate the dangerous area, At the safety situation, lower the hoisting weight to a suitable place on the ground, and then notify the relevant professionals to check the cause of the failure. When the protection function is activated, do not press the emergency stop switch or cut off the power supply of the control system and the hoisting frequency converter, otherwise the anti-slip hook function will fail, and even emergency hazards will occur, which is very dangerous!

5.4.5.2 Trolley operation

The trolley operation method is as follows: the trolley operation is controlled by the handle on the left linkage table, when the radius is trolleyed outward, the handle is pushed forward vertically, and when the radius is inward, the handle is pulled vertically inward. There are five gears for outward and inward trolley. Corresponds to five speeds from low to high.

In some occasions, the driver wants to drive the trolley to the base of the arm, but it cannot be realized due to the limiter. The handle on the linkage table can drive the trolley to the limit position. The operator should pay attention to the position of the trolley to avoid collision.

1) In addition to the above basic operations, it also has the following customization functions: Trolley anti-vehicle function: During operation, shift the gear in the opposite direction of the operation, and the anti-vehicle operation can be performed to enhance the trolley deceleration force.
2) Trolley reduce-sway function: see ***Section 5.4.5.4*** for details.

5.4.5.3 Slewing operation

The slewing operation is controlled by the handle of the left linkage table. When turning left, turn the handle horizontally to the left, and when turning right, turn the handle horizontally to the right. The left and right directions of the handle are divided into five gears, corresponding to five rotation speeds from low to high. Gear changes also require gear-to-gear switching. During operation, press the jog button on the side of the left linkage table handle to speed up the rotation start speed.

In addition to the above basic operations, it also has the following customization functions:

1) Rotation anti-vehicle function: gear to the opposite direction of operation, can carry out anti -travel operation to enhance the slewing deceleration force.
2) Slewing reduce-sway function: see ***Section 5.4.5.4*** for details.

- **Due to the long jib length, the inertia is high and the slewing operation must be smooth. When accelerating, the handle must be pulled gradually, and when decelerating, it must also be gradually withdrawn;**
- **It is strictly forbidden to use the brake switch when the jib is not stopped;**
- **In use, the following phenomena sometimes occur:**

  It is difficult to start the slewing, and the start time is long;

  The tower crane shakes greatly when it turns to stop;

  The slewing speed is too fast or too slow;

  After working for a period of time, the rotary motor heats up seriously;

  The slewing brake fails to open;

  At this time, you should first check the power supply and the slewing frequency converter. If it is normal, please notify our company to send personnel for maintenance.

5.4.5.4 Trolley, slewing reduce-sway function description

Reduce-sway function is built in a special frequency converter, which is a set of control programs specially developed for tower crane applications. In some workplaces where the smooth operation of the hoisting weight is required, this function can be turned on to realize the reduce-sway of the trolley and slewing mechanism, and the operator can effectively eliminate the motion of hoisting weight without the need for the operator to perform complicated operations such as following the hook. The reduce-sway function improves the safety of the operation and reduces the work intensity and skill requirements of the tower and cable workers.

This feature can be turned on or off through an on-screen option. If the reduce-sway function is not turned on, the tower crane's trolley and slewing will run in the normal mode.

Use of the reduce-sway function:

- Turn on trolley or slewing reduce-sway on the display screen, and set the length of the sling (the distance from the hook to the center of gravity of the hoist) according to the actual situation. The reduce-sway function of trolley and slewing can be turned on or off respectively;
- After hanging the sling, hoisting the heavy object to the required height, and keeping the hoisting weight basically in a static state, you can operate the handle to perform trolley or slewing motion;
- In the reduce-sway mode, the anti-vehicle operation can also be performed to enhance the deceleration;
- During the operation of the mechanism, if the deceleration limit signal is triggered, the control system will immediately exit the reduce-sway mode and enter the normal operation mode to

avoid the overtravel movement of the mechanism;

- If you need to exit the reduce-sway mode temporarily (such as jogging into position, etc.), please press the button on the side of the handle of the left linkage table, the system will immediately exit the reduce-sway mode and enter the normal operation mode, and the mechanism stops running for a period of time. After a period of time, you can return to the reduce-sway mode;
- Reduce-sway can be turned off via an on-screen option.

- Speed curve will be automatically changed according to the mathematical model of reduce-sway during trolley or slewing operation. When the operator starts and stops the trolley or slewing mechanism, the acceleration and deceleration rhythm will change, and the acceleration and deceleration distance will be extended to a certain extent. When using the reduce-sway function, the operator should try the operation several times in advance to adapt to the running characteristics of this mode. If you can't adapt to the operating habits, you can turn off the reduce-sway function on the screen.
- In outdoor applications, the effect of wind may affect the effect of reduce-sway function.
- Please set the length of the sling correctly (that is, the distance from the hook to the center of gravity of the hoist) according to the actual situation.
- It is necessary to ensure that the communication of the control system is normal.
- The pendulum length data sent to the trolley and slewing frequency converters must be accurate, and the calibration pendulum length detection system needs to be adjusted correctly in advance.
- When the pendulum length exceeds a certain length (usually 60 meters by default), the system automatically turns off the anti-slewing function.

5.4.5.5 Travelling operation (optional)

The travelling operation is controlled by the handle on the right linkage stage. Pull the handle to the left to move the bogie forward, and turn the handle to the right to move the bogie back. The left and right directions of the handle are divided into two gears, corresponding to two travelling speeds from low to high. When starting, you should first pull the handle from the middle to the low gear, and then pull it to the high gear; when stopping, you should first return to the low gear from the high gear, and then return to the stop gear.

Except in emergencies, it is strictly forbidden to directly return to the stop gear from the high gear, otherwise it will have a huge impact.

5.4.5.6 Tower crane power off

Each use of the tower crane, the hook should be raised to the top, the trolley should be moved to the base of the jib, the "BYPASS" button and the " slewing brake" button should be pressed, weathervane should be turned on, and the emergency stop button should be pressed to cut off the power supply.

5.4.6 Alarm

When the driver uses the linkage console handle to operate, he will hear a "beep" feedback every time he shifts gears. When operating the electronic control system, the driver should be familiar with the following various alarm signals provided by the system:

5.4.6.1 Moment alarm signal

1) Over moment signal

When the lifting moment exceeds 103% of the maximum allowable value, the electronic control system will respond as follows:

- Red on the linkage table 

The warning light flashes;
- The buzzer in the linkage station emits four continuous beeps of "di di di di".
- Upward movement of the main hook is inhibited, and downward movement is limited to first gear.
- Outward movement of the trolley is inhibited, and inward movement is limited to first gear.
- Left and right slewing motion of the jib is limited to first gear.
- Release method: run down or inward to reduce the weight.

2) Moment warning signal

When the lifting moment exceeds 90% of the maximum allowable value, the electronic control system will respond a s follows:

- Yellow icon on the linkage table 

flashes warning light;
- The buzzer of the linkage station emits two continuous beeps of "Di Di";

- The up and down movement of the main hook is limited to the fundamental frequency gear, which is generally the third gear;
- Outward movement of the trolley is limited to second gear, and inward movement is not restricted.
- Release method: inward slewing

3) Torque warning signal

When the lifting moment exceeds 80% of the maximum allowable value, the electronic control system will respond as follows:

- Yellow icon on the linkage table 

flashes warning light;
- The up and down movement of the main hook is limited to the fundamental frequency gear, which is generally the third gear;
- Outward movement of the trolley is limited to second gear, and inward movement is not restricted;
- Release method: inward slewing.

5.4.6.2 Lifting weight alarm signal

1) Overweight Signal

When the lifting weight exceeds 105% of the maximum allowable value, the electronic control system will respond as follows:

- Red icon on the linkage table 

flashes warning light;
- The buzzer in the linkage station emits three continuous beeps of "di di di";
- Upward movement of the main hook is inhibited, and downward movement is limited to first gear;
- Outward movement of the trolley is inhibited, and inward movement is limited to first gear;
- Left and right slewing motion of the boom is limited to the second gear.
- Release method: run down to reduce the weight.

2) Overweight warning signs

When the lifting weight exceeds 90% of the maximum allowable value, the electronic control system will respond as follows:

- Yellow icon on the linkage table 

flashes warning light;
- The buzzer in the linkage station emits a continuous "beep" alarm sound;
- The up and down movement of the main hook is limited to the fundamental frequency gear, which is generally the third gear;
- Outward and inward movement of the trolley is limited to the fundamental frequency gear;
- Release method: reduce the lifting weight.

3) Overweight warning signs

When the lifting weight exceeds 50% of the maximum allowable value, the electronic control system will respond as follows:

- Yellow icon on the linkage table 

flashes warning light;
- The up and down movement of the main hook is limited to the fundamental frequency gear, which is generally the third gear. (Note: The hoisting speed limit is canceled when the hoisting speed with load function is enabled.)
- The outward and inward movement of the trolley is limited to the fundamental frequency gear plus one gear.
- Release method: reduce the lifting weight.

4) Overweight warning signs

When the lifting weight exceeds 25% of the maximum allowable value, the electronic control system will react as follows:

- The up and down movement of the main hook is limited to the fundamental frequency gear plus one gear, generally four gears. (Note: The hoisting speed limit is canceled when the hoisting speed with load function is enabled.)
- Release method: reduce the lifting weight.

5.4.6.3 Lifting alarm signal

1) Upward stop limit signal

When the lifting hook has reached the maximum allowable value and the upper stop limit is triggered, the electronic control system will respond as follows:

- The upward movement of the main hook is prohibited;
- Release method: lower the main hook.
- Releasing the limit method under specific working conditions:

  When the trolley enters the inner reduction area, press the "Bypass" button; the speed of lifting and upward movement is limited to the first gear. After the working condition is completed, lower the main hook below the upper reduction limit to release the speed limit.

2) Upward deceleration limit signal

When the hook height is close to a certain distance from the upward deceleration limit point and the upward deceleration limit signals are triggered, the electronic control system will respond as follows:

- The upward movement of the main hook is forcibly limited to the first gear.

3) Downward stop limit signal

When the height of the hook is close to the ground and the downward stop limit is triggered, the electronic control system will respond as follows:

- The downward movement of the hook is prohibited;
- Release method: raise the main hook.
- Releasing the limit method under specific working conditions:

Press the "Bypass" button; the downward movement speed is limited to 1st gear. After the working is completed, lift the main hook above the downward limit release the speed limit.

4) Downward deceleration limit signal

When downward, when the height of the hook is close to the downward deceleration limit point and triggers the downward deceleration limit signal, the electronic control system will respond as follows:

- The downward movement of the main hook is forcibly limited to the first gear.

5.4.6.4 Radius alarm signal

1) Trolley outward stop signal

When the trolley moves outward, when the trolley has reached the jib end and the trolley outward stop limit signal is triggered, the electronic control system will respond as follows:

- Outward movement of the trolley is prohibited.

2) Trolley outward deceleration signal

When the trolley moves outward, when the trolley is close to a certain distance from the jib end and triggers the trolley outward deceleration limit, the electronic control system will respond as follows:

- Outward movement of the trolley is forcibly limited to first gear.

3) Trolley inwards stops limit signal

When the trolley is going inside, when the trolley has reached the jib foot and the trolley inwards limit is triggered, the electronic control system will respond as follows:

- Inward movement of the trolley is prohibited.
- Release method under specific conditions:

  Press the "Bypass" button; the trolley inward movement speed is limited to 1st gear. After the working is completed, the speed limit can be lifted by moving the trolley outwards beyond the trolley inwards deceleration limit.

4) Trolley inwards deceleration signal

When the trolley is going inside, when the trolley is close to a certain distance from the jib foot and triggers the inner reduction limit, the electronic control system will respond as follows:

- The inward movement of the trolley is forcibly limited to first gear.

5.4.6.5 Slewing alarm signal

1) Slewing left stop limit signal

When the jib rotates to the left more than one and a half circles and the slewing left stop limit is triggered, the electronic control system will respond as follows:

- Left rotation movement of the jib is prohibited.

2) Slewing left deceleration limit signal

When the jib rotates to the left for more than one and a half circles and triggers the slewing left deceleration limit, the electronic control system will respond as follows:

- The rotation movement of the jib to the left is limited to first gear.

3) Slewing right stop limit signal

When the jib rotates to the right for more than one and a half circles and triggers the slewing right stop limit, the electronic control system will respond as follows:

- Right rotation movement of the jib is prohibited.

4) Slewing right deceleration limit signal

When the jib rotates to the right for more than one and a half circles and triggers the slewing right deceleration limit, the electronic control system will respond as follows:

- Right rotation movement of the jib is limited to first gear.

5.4.7 Other alarms

1) Overvoltage and undervoltage protection alarm

When the external power supply is under or over-voltage, the indicator HU is on (the indicator is on the driving box);

When the power supply voltage is higher or lower than the local standard requirements, the power circuit is disconnected. When the red LED (F1 light) is on, the over-voltage alarm stops; when the red LED (F2 light) is on, the under-voltage alarm stops;

Take China as an example, when the power supply voltage is greater than 110% of the rated voltage or lower than 90% of the rated voltage, the power supply circuit will be automatically cut off, and the overvoltage and undervoltage indicator lights on the driving box will be on. If the voltmeter on the drive box is in a low voltage or high voltage state for a long time, please do not start and work the tower crane, so as to avoid mechanical shock and possible danger when the power circuit is cut off and shutdown, and may also damage the motor and electrical element.

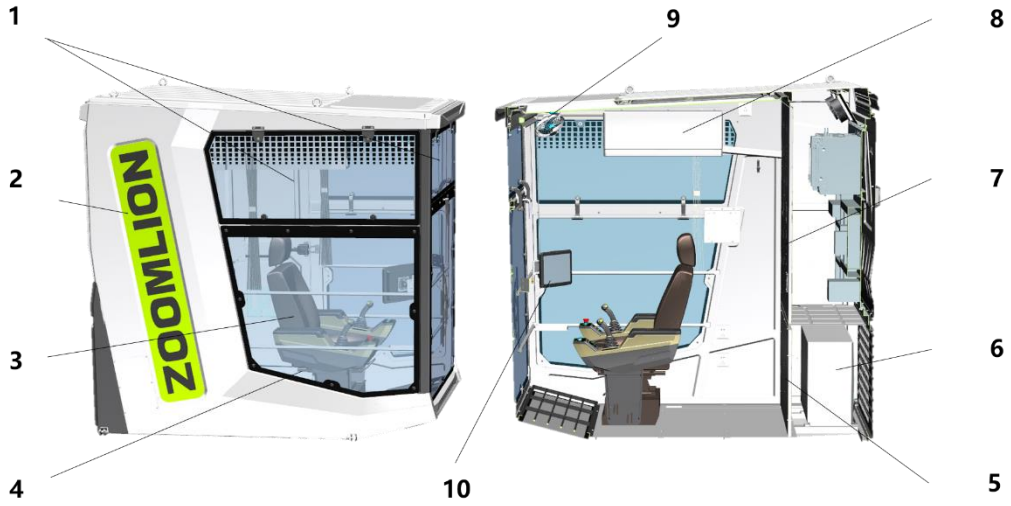
2) Phase sequence protection alarm

When the phase sequence of the external power supply is incorrect or lacks phase, the yellow LED light on the phase sequence relay is off, the power circuit is disconnected, and the start indicator light is off (the indicator light is on the linkage table).

5.5 Instruction of control unit

5.5.1 Overview

The cabin is the control center of the tower crane, the main layout is shown in figure below:



(1)	Push window	(2)	Customizable LOGO
(3)	Console	(4)	Fix window
(5)	Removable plate	(6)	Air conditioning external unit
(7)	Panel door	(8)	Air conditioning internal unit
(9)	Fan	(10)	Monitor

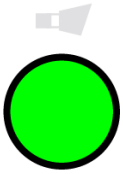
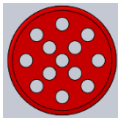
Fig. 5-2 Cabin

5.5.2 Control panel, control instrument, man-machine interface description

Fig. 5-3 Linkage console

5.5.3 How to operate

The linkage console in the driver's cab is the console of the tower crane, which is installed on the left and right sides of the driver's cab seat (See the attached table for the explanation of the keys).

No.	Icon	Name	Function Description
1		Emergency stop button	In case of emergency, cut off the power and control power of the tower crane. Not to be used in non-emergency situations After the button is pressed, it needs to be rotated to release.
2		Electric whistle/start button (green)	Electric whistle control button. The power-on start button of the whole machine.
3		Over 50% rated lifting capacity warning light (yellow)	When the hoisting weight exceeds 50% of the rated lifting weight, the warning light will be on, and the buzzer will sound an alarm (see Article 7).
		Over 105% rated lifting capacity warning light (red)	When the hoisting weight exceeds 105% of the rated lifting weight, the alarm light will be on, and the buzzer will sound an alarm (see Article 7).
4		Over 90% rated moment warning light (yellow)	When the load moment exceeds 90% of the rated moment, the warning light will be on, and the buzzer will sound an alarm (see Article 7).
		Over 100% rated moment warning light (red)	When the load moment exceeds 103% of the rated moment, the alarm light will be on, and the buzzer will sound an alarm (see Article 7).
5		Buzzer	Self-test beeps 5 times at startup 5 seconds every 15 seconds when there is no GPS signal 4 beeps every 0.5 seconds when the moment is exceeded 2 beeps every 0.5 seconds during moment warning 3 beeps every 0.5 seconds when overweight 1 sound every 0.5 seconds during weight warning 1 sound when the operating gear changes 1 sound when the weathervane is released The linkage table stick point fault or PLC fault buzzer keeps ringing

No.	Icon	Name	Function Description
6		Walking to the left operation direction indication	Effective with walking mechanism When the right linkage table handle is operated in this direction, the walking will run to the left.
7		Walking right operation direction indication	Effective with walking mechanism When the right linkage table handle is operated in this direction, the walking will run to the right.
8		Hook up operation direction indication	When the handle of the right linkage table is operated in this direction, the hook will run upwards.
9		Hook lowering operation instructions	When the handle of the right linkage table is operated in this direction, the hook runs downward.
10		Right linkage platform jog button (green)	Lift function switch: Press this switch to activate the hoisting micro-speed function. After the hoisting operation is performed and the gear position returns to zero, the jog does not close the brake function is activated; until the switch is released to return to the zero position, the hoisting brake will hold the brake after 5 seconds, and the micro-speed will be activated. function release.
11		Bypass button	For details, please refer to the relevant chapters of "System Prompts and Alarm Signals"
12		Climbing start button	
13		Slewing brake button	Slewing brake button switch, see "How to use slewing brake and weathervane release" for details.
14		Start light (green)	After the whole machine is powered on, the indicator light is on.
15		Rotary weathervane release indicator (blue)	After the weathervane is released, the indicator light is on.

No.	Icon	Name	Function Description
16		Over / under voltage indicator	When the indicator lights on, don't start the tower crane! Or the electrical equipment may be damaged.
17		Inward trolley operation direction indication	When the left linkage table handle is operated in this direction, the trolley mechanism runs inward.
18		Outward trolley operation direction indication	When the left linkage table handle is operated in this direction, the trolley mechanism runs outward.
19		Rotate left operation direction indicator	When the left linkage table handle is operated in this direction, the slewing mechanism rotates to the left.
20		Rotate right operation direction indicator	When the left linkage table handle is operated in this direction, the slewing mechanism rotates to the right.
21		Left linkage table jog button (green)	Rotary jog function switch: Pressing this switch will activate the jog function of the rotation; until the handle returns to the zero position, the jog function is released.

5.5.4 Driving box

The drive box is installed in the driver's cabin. It is the core part of the control system. Components such as the controller and the intermediate relay of the safety device are installed in the driving box.

1) The main switch devices and their functions in the cabin are shown in the table below:

Table 5-4 Driving box switch devices

No.	Device code	Device function	Remark
1	QF3	24V power protection switch	This circuit breaker will make the tower crane inoperable
2	QFE	Cab power leakage protection switch	It is used for short circuit protection of various lamps, fans and air conditioners in the driver's cab. When the lighting circuit breaker is closed (pull the small handle of the circuit breaker up), the lighting circuit is powered (single-phase 220V)
3	SPM	Mode selector switch	2 working mode options: electromechanical mode, mechanical mode. When the electronic safety device is not calibrated or fails, the mechanical mode can be turned on. At this time, only the mechanical safety device works, and the speed of hoisting, turning and trolley is limited to 4th gear.

If the switch in the above table is an air switch, the switch handle is turned up to be in the "on" state; if the switch in the above table is an electromagnetic protection circuit breaker, the switch handle is rotated clockwise until the handle is in the vertical state to be in the "on" state.

2) The device code and function description of the door panel of the driving cabin are shown in the following table:

Table 5-5 Cabin door components

No.	Device Diagram	Device code	Device function	Notice
1		PV	Power supply voltage indication	The normal value of the line voltage of the power supply should be: 380V±10%
2		HU	Power over and under voltage indicator	When the overvoltage and undervoltage indicators are on, do not start the tower crane, otherwise the related electrical equipment may be damaged.
3		SPP	Climbing operation switch	

5.5.5 Main control cabin

The main control cabin is installed on the rotary platform and is the main component of the control system. The main power switch, hoisting controller, rotary controller, trolley controller, heater, cooling fan and other components are installed in the main control cabin.

■ The main switch devices and their functions in the cabin are shown in the table below:

Table 5-6 Main switch components of the main control cabin

No.	Device code	Device function	Remark
1	QFHB	Lifting brake power switch	
2	QFHC	Lifting motor cooling fan power switch	
3	QFP	Climbing mechanism main power switch	
4	QFFE	Main control cabin heating and cooling power supply circuit leakage protection switch	For some models, this switch is in the driving box. Subject to the actual device arrangement.
5	QF1	Voltmeter protection switch	
6	QF4	Transformer and Power Monitor Power Switch	
7	QF6	Controller, control circuit power switch	
8	QF8	Slewing brake power switch	

- The device code and function description of the main control cabin door panel are shown in the following table:

Table 5-7 Main control cabin door components

No.	Device Diagram	Device code	Device function	Notice
1		QF	Tower crane control system main power switch	Rotate the handle clockwise, when the handle mark points to ON, the main power switch is closed; rotate counterclockwise, when the handle mark points to OFF, the main power switch is cut off.
2		SEM2	Emergency stop button	It is used to cut off the power and control power of the tower crane in an emergency. Do not use the emergency stop button to stop in non-emergency situations. Otherwise, it will have a great impact on the tower body structure, and even cause more serious safety accidents. The button is self-locking. After pressing, it needs to be rotated to release. Before starting the tower crane, please confirm that the emergency stop button is in the released state.

- *Main control cabin door is only allowed to be opened when the QF handle points to OFF. Similarly, the main control cabin door is only allowed to be closed when the QF handle points to OFF. Don't violently open and close the main control cabin door to avoid damage related parts.*
- *In an emergency, the emergency stop switch must be pressed immediately;*
- *When the hoisting mechanism of the tower crane entering the hovering state due to the anti-slip hook function is activated, do not press the emergency stop button;*
- *When the driver gets off work or leaves the cab for some reason, or when the tower crane is overhauled, the emergency stop button must be pressed when all the tower crane mechanisms are in a stopped state.*

- Heating, dehumidification and heat dissipation in the main control cabin

➢ Heater: After the power is turned on, the temperature and humidity conditions are automatically detected, and the heater is started when the temperature is ≤ 0 ℃ or the humidity is ≥ 80% .

➢ Cooling fan: After the power is turned on, the temperature will be automatically detected. When the temperature is ≥ 40 ℃, the fan in the cabin will exhaust air to the outside.

- *If the working conditions of the heater or cooling fan are reached, and the cooling fan and heater do not work, please check whether the components are damaged.*
- *Working power of the heater and the cooling fan is U1, N; that is, after the power supply of the knife switch box is turned on, as long as the working conditions of the heater and the cooling fan are reached, it will start to work.*

5.5.6 Resistance box

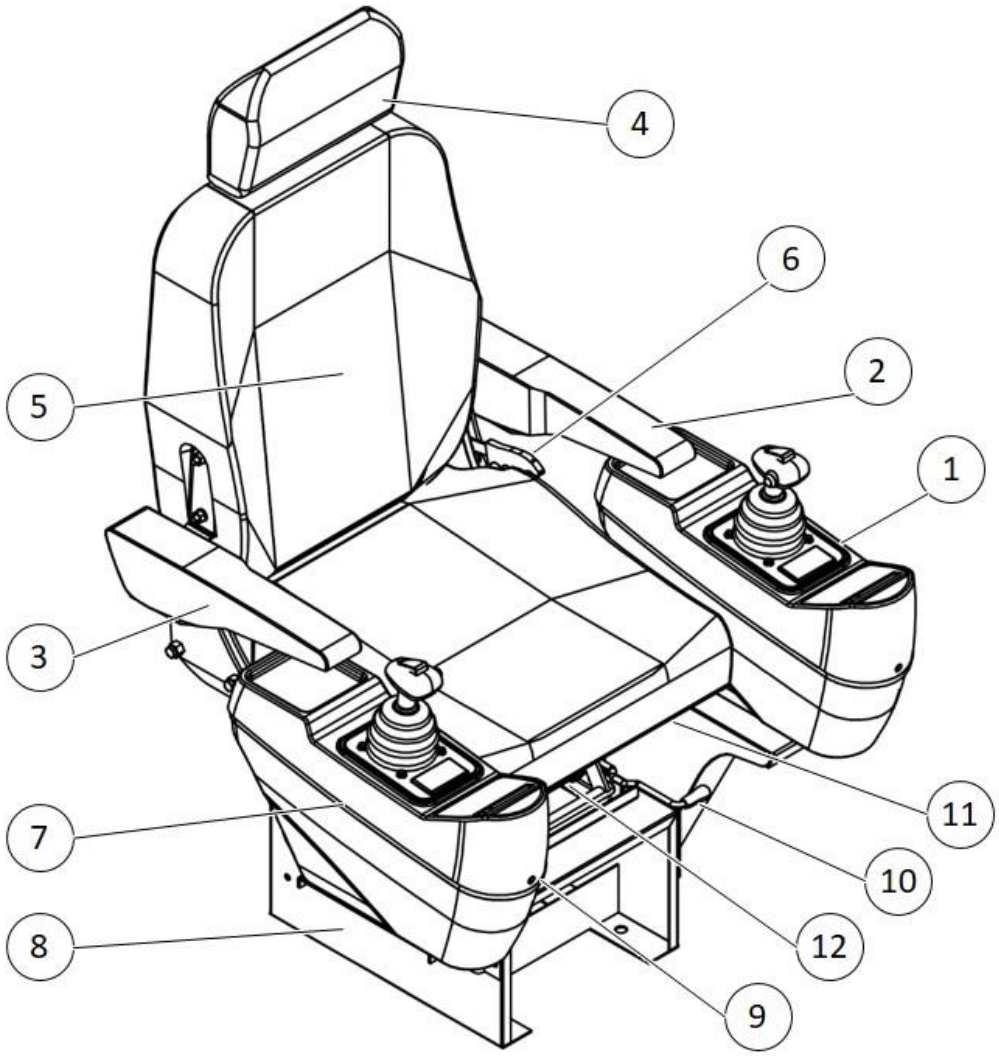
The resistance box is the energy release element of the tower crane control system. Its main function is to release the residual electric energy generated by the lifting and downward movement and the braking process of each mechanism. Please operate in strict accordance with the precautions. Improper operation may cause the resistance box to be burned, resulting in tower crane failure.

Fig. 5-8 Resistance box

- *Before running the tower crane, please confirm that its wiring is correct and reliable, otherwise it may cause equipment damage;*
- *When laying cables around the mounting bracket of the resistance box, make sure that the distance between the cables and the outer casing of the resistance box is at least 15cm;*
- *The resistance box is a heating component, please ensure that it is well ventilated and must not be blocked or covered;*
- *Do not stack debris near the resistance box, otherwise it will cause a fire hazard.*
- *The surface of the resistance box is hot, do not touch it, otherwise there is a danger of burns.*

5.5.7 Seat adjustment

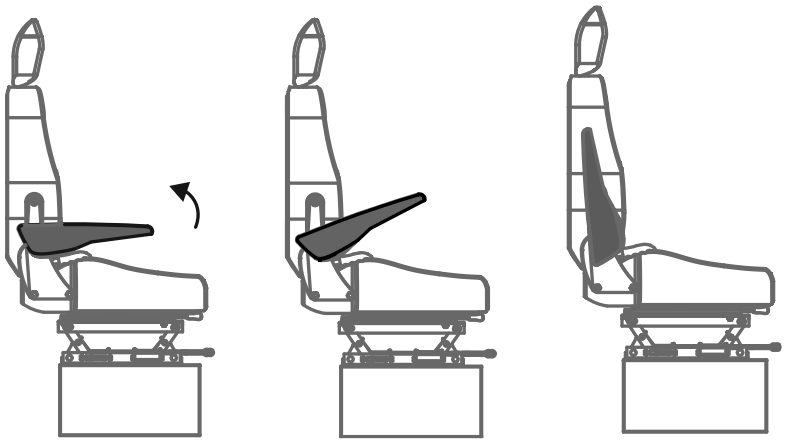
Main components of the linkage table seat are shown in the following figure:



(1)	Left linkage station	(2)	Right armrest
(3)	Left armrest	(4)	Headrest
(5)	Backrest	(6)	Backrest adjustment handle
(7)	Right linkage body	(8)	Base
(9)	Right lift unlock handle	(10)	Left lift unlock handle
(11)	Slide rail	(12)	Slide rail unlock handle

Fig. 5-9 Seat assembly

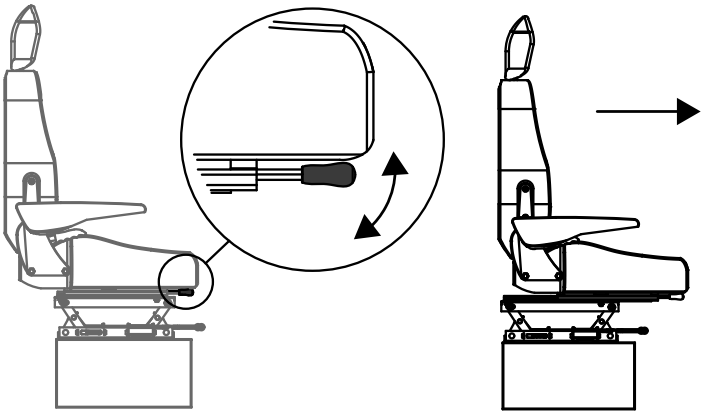
5.5.7.1 Left and right armrest adjustment



- Adjustment range: 110°

Pull the armrest up to adjust, there are three position in total, there is a clear prompt sound, the highest gear is pulled up and then pressed down to return to the original position.

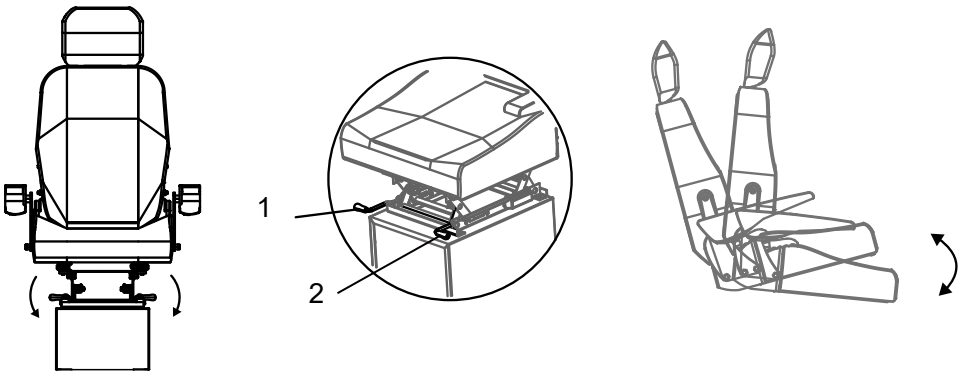
5.5.7.2 Seat slide adjustment:



- Adjustment range: front and rear 0 ~ 120mm.

Pull the unlocking lever up, move the seat forward (backward) to the desired position, release the handle, and hear a "click" sound, the slide rail can be locked.

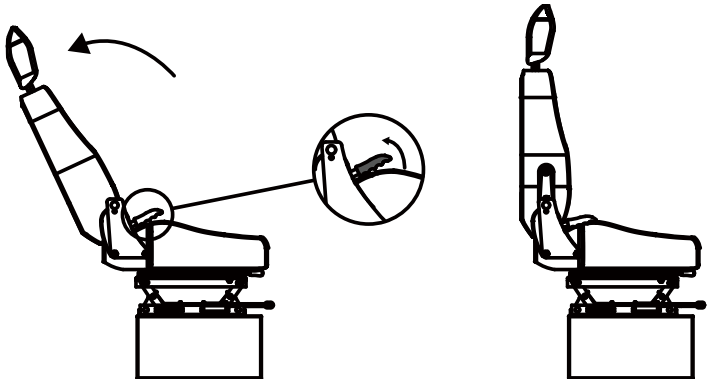
5.5.7.3 Seat up and down adjustment



- Adjustment range: There are four positions for up and down adjustment.

Press the left adjustment handle (2) to control the up and down adjustment of the entire front of the seat, and the right (1) to control the rear up and down adjustment, release the handle to complete the adjustment.

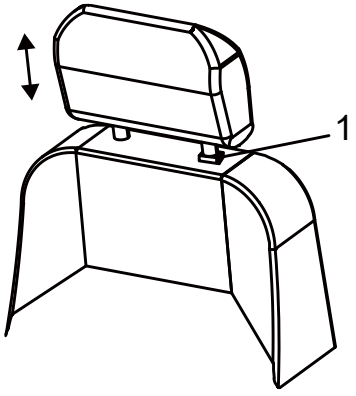
5.5.7.4 Backrest angle adjustment:



- Adjustment range: 86°~140° .

Pull the adjustment handle up, adjust the backrest to the desired position, and release the handle.

5.5.7.5 headrest adjustment



- Adjustment range: 0~80mm, a total of four positions.

Just lift it up and adjust it to a suitable position, adjust it down and press and hold the unlock button (1) and adjust it to a suitable position.

5.6 Parameter adjustment of electrical components and instruments

Voltage monitoring relay in the main control cabin is shown in Fig. 5-10.

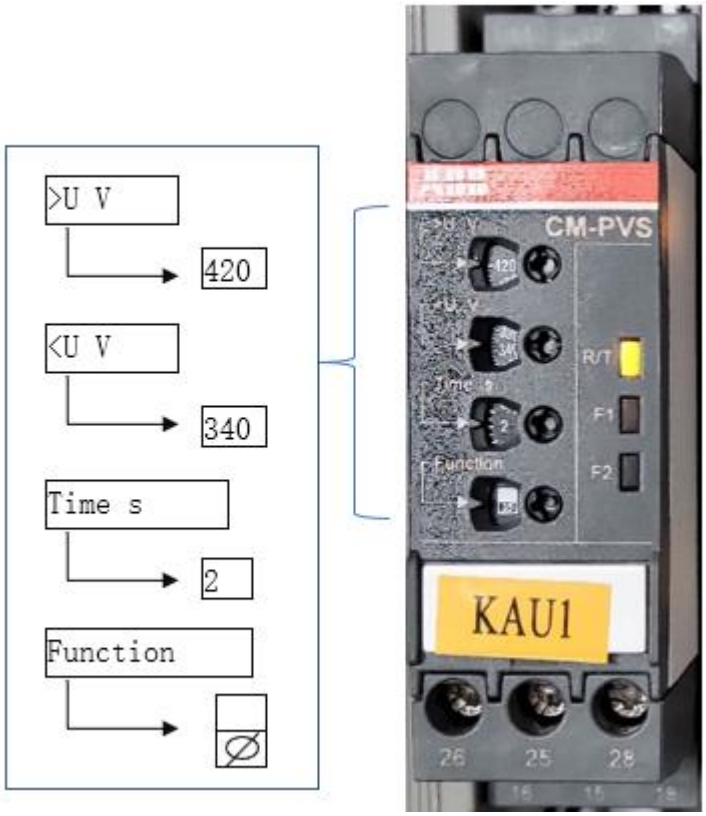


Fig. 5-10 Main control cabin voltage monitoring relay setting value

Fig. 5-11 Device Settings Checklist

Device code	Describe	Set value
ST	Cooling fan temperature setting value Heater working temperature setting value	+40℃ 0℃
SRH	Heating humidity RH setting value	+80%
KAU1	Overvoltage protection value (>U): Undervoltage protection value (<U): Delay time (Time): Working mode (Function):	420V 340V 2S ∅Reset delay + no phase sequence monitoring

5.7 Slewing brake use and weathervane release method

5.7.1 Overview of slewing brakes

The brake of the inverter motor with weathervane is normally closed, that is, the brake is powered off and released when it is powered on.

The slewing moment motor of tower crane is composed of main motor, brake (with weathervane). The electromagnetic brake is a power-off brake, and its structure (see Fig. 5-12).

Release when power on:

When the electromagnetic brake excitation coil (1) is supplied with the specified direct current, electromagnetic suction force is generated, the brake armature (3) is attracted, the friction disc (4) is driven, and the brake spring (2) is compressed, so that the brake disc (5) is in a released state, and the shaft can rotate freely.

Brake when power off:

When the power is off, the electromagnetic suction force disappears, and the brake spring pushes the friction disc, so that the brake disc is in the braking state, and the shaft cannot rotate freely.

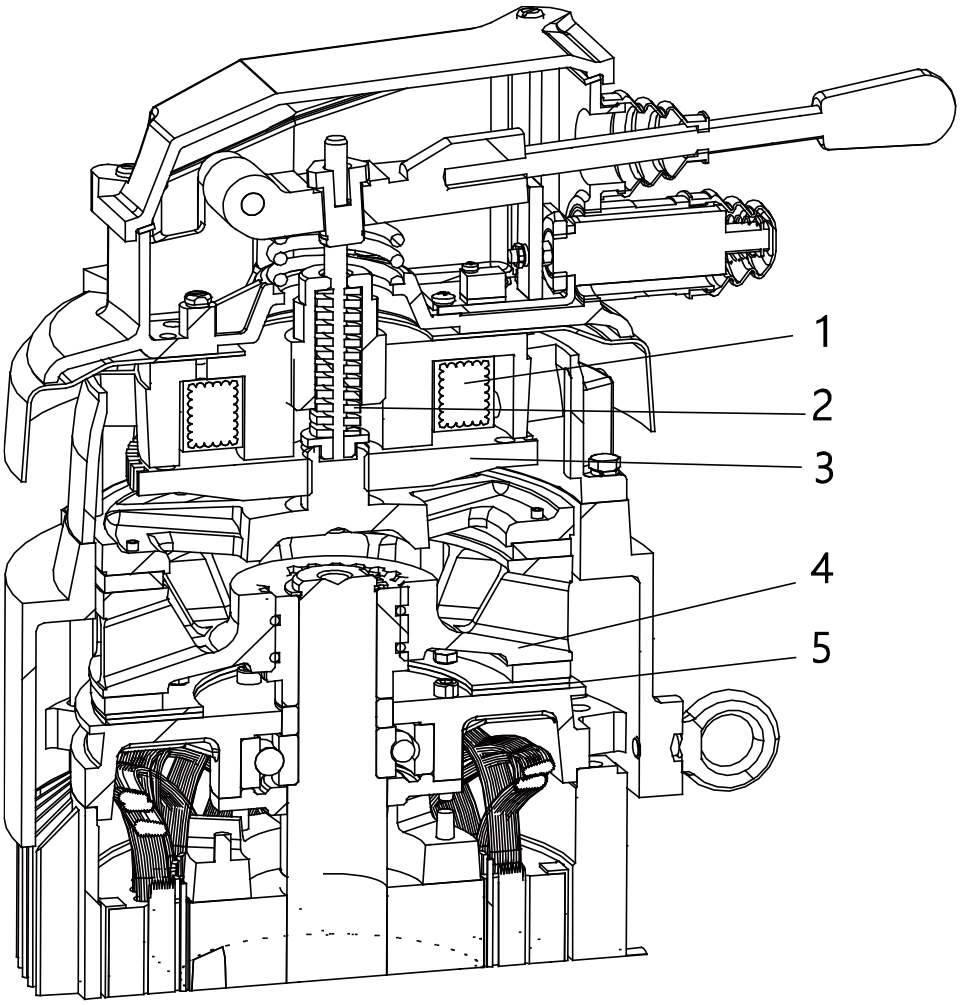


Fig. 5-12 The slewing brake

5.7.2 Slewing electromagnetic brake logic description

1) When the tower is slewing, the brake will be opened immediately upon electrification;
2) Operating handle is reset to zero, after a delay of 15 seconds, the rotary brake will automatically power off and brake;
3) 15-second delay after the operation handle is reset to zero, if you encounter strong winds or need to brake manually, you can press and hold the "wind flag release button" on the far right on the left linkage platform for 0.5 seconds, or you can immediately use the Slewing brake;
4) During the slewing operation, if you encounter an emergency and need to brake immediately, you can also press and hold the "wind flag release button" on the far right on the left linkage platform for 0.5 seconds to make the slewing brake power off and brake.
5) Whenever the brake goes from open to closed, that is, from power on to power off, a buzzer "beep" will be heard.

When you press and hold the weathervane release button, the slewing output will be disconnected. At this time, be sure to return the slewing handle to the zero position as soon as possible, re-operate the slewing gear, and the slewing brake will be automatically released.

5.7.3 Rotary weathervane release instructions

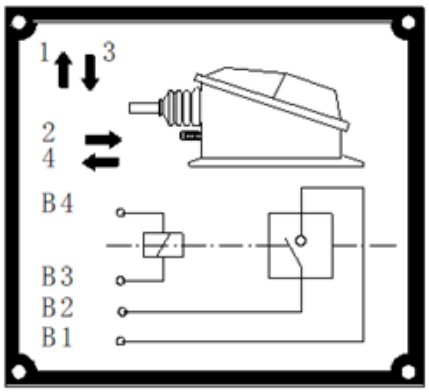
"Weathervane release button" (with light) is a button that can be used to realize both emergency braking of the slewing brake and electric release of the slewing brake.

The tower crane operator needs to set the tower crane in a free rotation state after get off work to prevent the danger of the tower falling due to strong winds.

Description: The electric weathervane is used in conjunction with the power-off brake to achieve the electric release and manual release of the electromagnetic brake. After it's released, even when the tower crane is power off, the brake is open, and the tower crane can rotate freely with the wind.

1) Rotary weathervane electric release instructions

The structure of the electric wind flag (see Fig. 5-12), when the electromagnetic brake excitation coil is first connected to the specified DC power, and then the wind flag electromagnet excitation coil is connected to the DC power, the wind flag armature is attracted, and then the direct current of electromagnetic brake excitation coil is disconnected, at this time, the armature of the weathervane supports the weathervane release lever, so that the electromagnetic brake friction disc connected to the weathervane release lever through the release screw cannot move in the direction of the brake disc, so that the brake disc is in a released state, and finally it should be immediately disconnect the DC power of the weathervane electromagnet excitation coil to achieve the function of electric release of the electromagnetic brake. (Note: The excitation coil of the electromagnet of weathervane cannot be energized for a long time, otherwise the excitation coil of the electric weathervane electromagnet will be burned.) The wiring instruction diagram of the electric weathervane is shown in Fig. 5-13.



B1, B2:	Weathervane micro-move switch (keep open)	**1, 3:**	Direction of weathervane release lever
B3, B4:	Connect to coil of the electromagnet	**2, 4:**	Direction of weathervane push handle

Fig. 5-13 The wiring instruction diagram of the electric weathervane

Condition: The slewing gear handle is reset to zero and the slewing brake is power off.

Operation: Press and hold the "Weathervane release button" and "bypass button" at the same time, hold for more than 1 second, the rotating vane will automatically release.

Logic: Press and hold the "weathervane release button" and "bypass button" for 1 second, the slewing electromagnetic brake is powered on, the weathervane electromagnetic coil is powered on after 1 second, and the slewing electromagnetic brake is powered off after 1 second, the rear weathervane solenoid is powered off after 1 second.

Success sign: After successful release, the brake on the slewing motor with brake will be heard twice “Dong”, and then the light of the "weathervane release" button on the left linkage platform will turn on, indicating that the electric release is successful.

- *Electric release can only be operated 30 seconds after the slewing motor stops (or the handle returns to zero), otherwise it will cause the motor brake to work abnormally, which will affect the safety of the tower crane in serious cases;*
- *If it cannot be released successfully, please check the "Failure Analysis" below.*

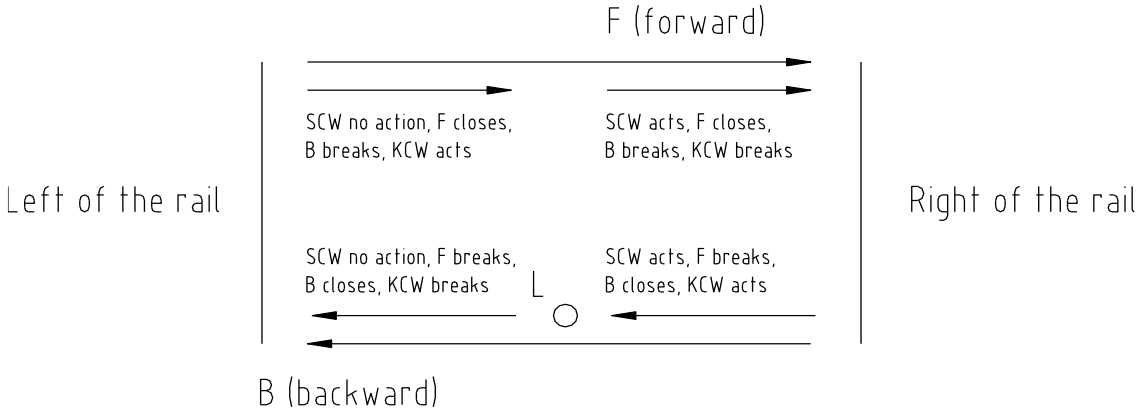
2) Instructions for manual release of rotary vane

First move the release lever to the rear of the motor, then push the weathervane push handle inward to make the weather indicator electromagnet armature support the weathervane release lever, then release the weathervane release lever, and finally release the electric weathervane push handle to achieve Manual release function. The functions of electric release and manual release of the weathervane are used to keep the motor in a released state when the tower crane is not working for a long time, so that the tower jib can rotate freely with the wind and adjust to the downwind direction, so that the windward area of the tower jib is minimized and windward resistance is minimized.

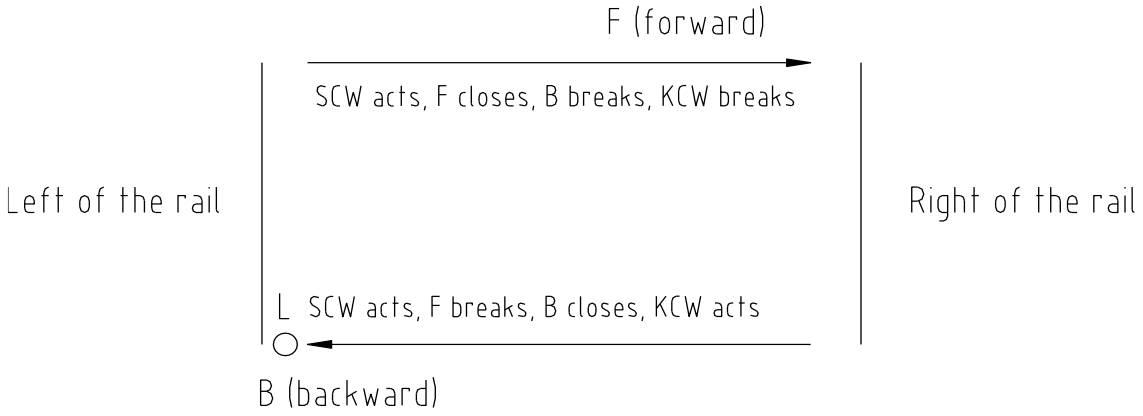
Manual release is a very reliable release method. If the electric release is unsuccessful, or the electric release is not assured, manual release can be used.

5.8 Cable drum adjustment method

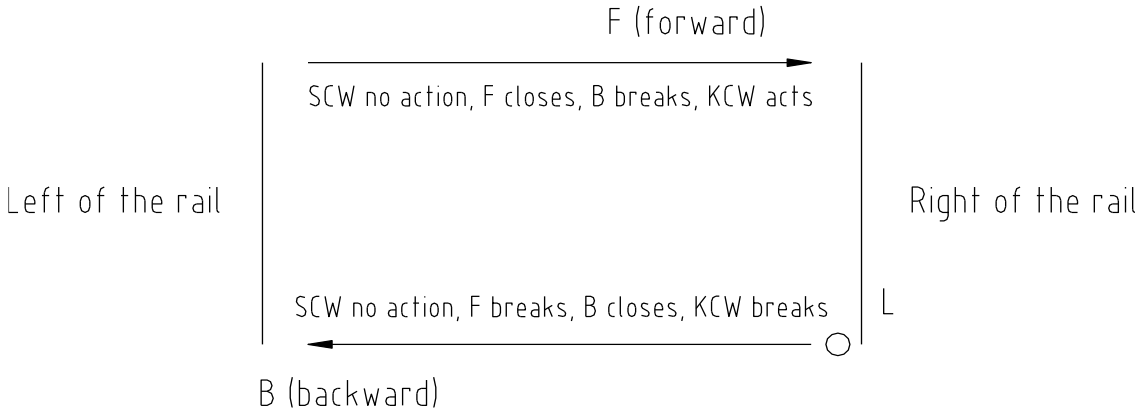
5.8.1 The cable anchorage point is in the middle of the track



5.8.2 The cable anchorage point is on the left side of the track



5.8.3 The cable anchorage point is on the right side of the track



Note:

○—— Location of cable anchorage points

L—— Limit switch position

SCW has two pairs of contacts, one is normally open and the other is normally closed

SCW action means that the normally open contact is closed and the normally closed contact is open

SCW no action means that the normally open contact is disconnected and the normally closed contact is closed

5.9 Operation after working

- Normal operation after working

Notes for non-working state:

When the tower crane is finished construction and stops being used, the hook should be raised to a safe position to ensure that when the jib rotates freely 360°, the hook will not hang or touch any objects on the site), keep the hook in an empty state, and the weathervane brake must be released.

Set each operating handle to the zero position, cut off the main circuit breaker of cabin, close the doors and windows of the cabin, and disconnect the main switch of the power box at the bottom of the tower crane after the driver goes down to the ground.

Anti-strong typhoon safety measures and plans

- Please refer to our company's tower crane anti-typhoon supplementary manual.

Remove the hoisting weight, lift the hook to the highest point, and drive the trolley to the minimum radius of the jib foot!

The weathervane brake must be released in the non-working state to ensure that the tower crane jib rotates freely with the wind! Make sure that there are no obstacles in the slewing range of the boom, and there are no excess objects on the hook to avoid accidents such as breaking the jib or falling tower when the strong wind comes!

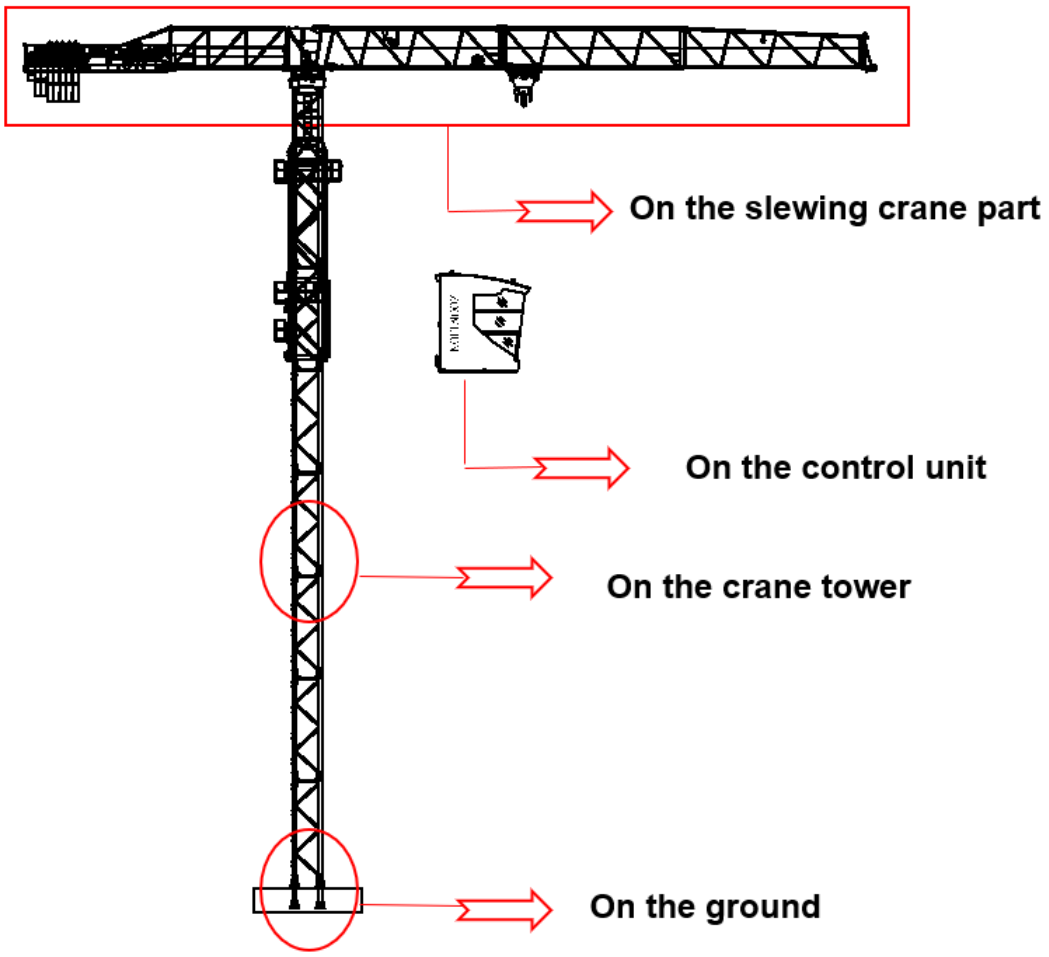
- For the travelling tower crane, use the rail clamp to fix the tower crane on the track to prevent it from moving along the track!

5.10 Operation cautions

5.10.1 Checks to be carried out before operation

The execution of the crane erection and the safety require a certain number of operations or checks to be carried out according to the following description:

5.10.1.1 Synopsis



Before starting work, every founded anomaly must be transmitted to the site foreman.

5.10.1.2 On the ground

- Check the presence and the position of the stops.
- Check that the track is freed and horizontal.
- Check the correct grounding at the 4 track ends
- Check the passage and the fixing of the supply cable.
- Take the key and the instructions from the site foreman.
- Turn the switch of the site control panel to ON
- Check that the wind speed does not exceed 20m/s
- Unlock the rail clamps
- Check the position and the fixing of the ballast.

5.10.1.3 On the crane tower

- Use the permissible accesses
- Check the presence and the state of the connections
- Check that no article hinders the access platforms

5.10.1.4 On the slewing crane part

- Check the position and the fixing of the ballast.
- From the permissible accesses, check the correct winding, the state, and the tensioning of the ropes.
- Clean and grease the fleeting pulley (according to the model)

5.10.1.5 On the control unit

- Check the presence of the powder-type fire extinguisher
- Press successively upon the ON button (the horn is activated), then on the emergency stop button (movement stop)
- Reset the stop button
- Press upon the ON button and check the functioning of all the movements by means of the control switches
- Check the dead man position of the control switches
- Check the functioning of the displays.
- Check the control of the slewing brake
- By the means of the test button, test the functioning of the sound signal and the signal lamps (flashing lamps) located outside the cab and on the display block (configuration according to model and option)
- Check the functioning of the lighting and the windscreen wipers
- Check without load the functioning of the limit switches
- Check the state of the hook safety catch

All the operations for putting into service of the crane serve to ensure its working under correct driving and safety conditions.

Overall, all these operations can be split up into several groups:

- Checking and carrying out of mounting operations in order to avoid any hindrance as regards the good working order of the crane or safety.
- Carrying out the adjustments of the various safety devices and the working conditions of the crane.

For carrying out any adjustment or maintenance operation and in order to reach the control unit, use the devices provided on the crane.

5.10.2 Checks to be carried out after erection

The execution of the crane erection and the safety require a certain number of operations or checks to be carried out according to the following description:

5.10.2.1 Lower part

Concerned crane parts	Operations to be carried out
Access	➢ Check the fitting of the ladders and back loops, replace damaged parts.
Crane tower	➢ Check the fitting and locking of the mast connecting pins ➢ Check that the indicating plates are present and legible.

5.10.2.2 Slewing crane part

Concerned crane parts	Operations to be carried out
Jib and counter jib	➢ Check the correct installation of the electric supply cable ➢ Check the correct reeving of the hoist and travelling ropes

5.10.3 Operating safety instructions

5.10.3.1 Requirement to the operators

- The crane operator is over 18 years of age.
- The crane operator is reliable, and is physically and mentally adept.
- The crane operator has been instructed in operation of the crane and is familiar with all risks of accident.
- The crane operator has provided proof of qualification to the employer regarding operation of the crane.
- The employer has designated the crane operator for operation of the crane is writing.
- The crane operator must have read and fully understand the instruction manual, in particularly the chapters concerning notes on safety, as well as operation and control.
- The crane operator must have read and fully understood the local guidelines valid for accident-prevention.
- The crane operator is familiar with the location and operation of fire extinguishers and has been instructed in the onsite possibilities for fire detection and firefighting.

5.10.3.2 Protective equipment

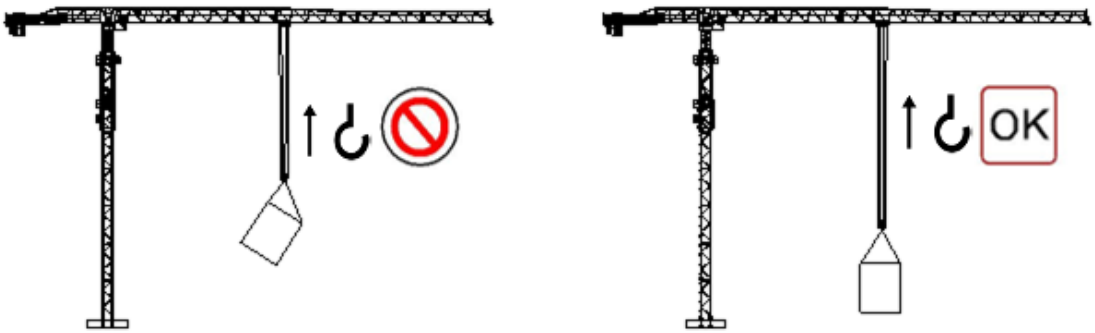
The following must be worn:

- **Safety helmet**
- **Safety boots**
- **Safety harness (e.g. for trolley travelling in the event of power failure)**

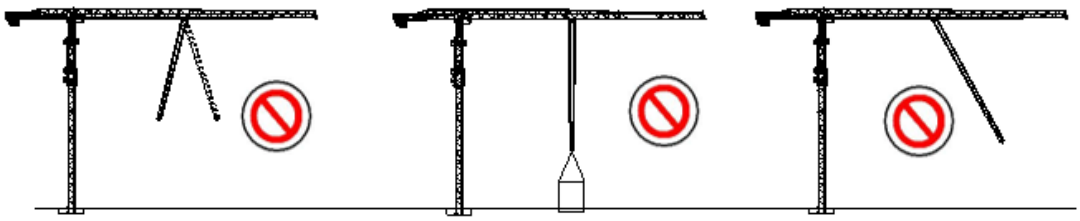
5.10.3.3 Forbidden of operation

It is strictly forbidden to lift a load the weight of which exceeds the crane capacity. Consult the technical data for handling of loads when their surface/lifted load ratio exceeds $1\mathrm{m}^2/\mathrm{t}$.

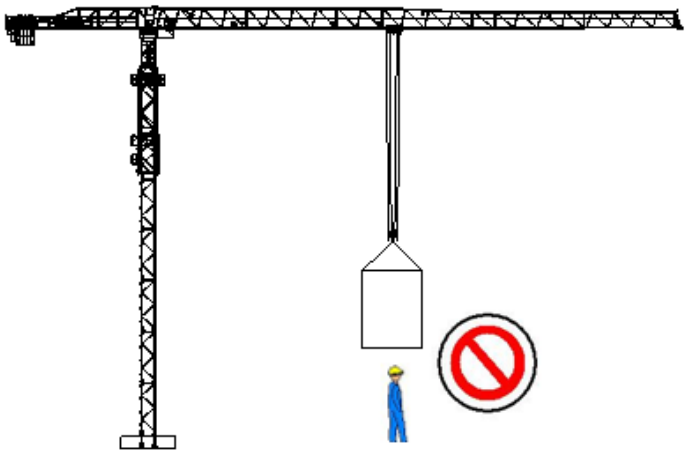
- It is forbidden to lift an incorrectly slung load.



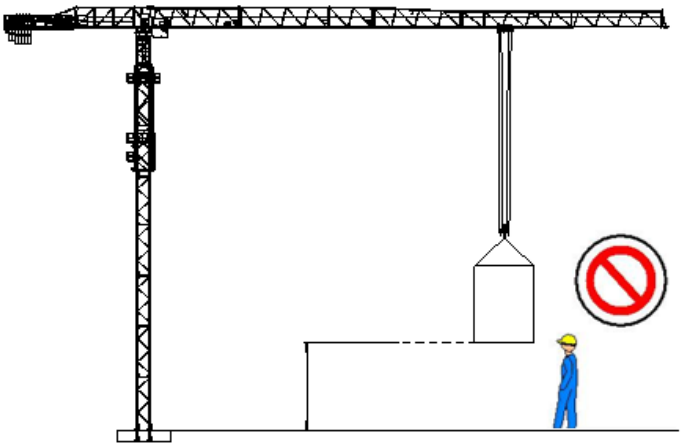
- It is forbidden to generate load swinging, to lift a load adhering to the ground and to lift a load in oblique direction.



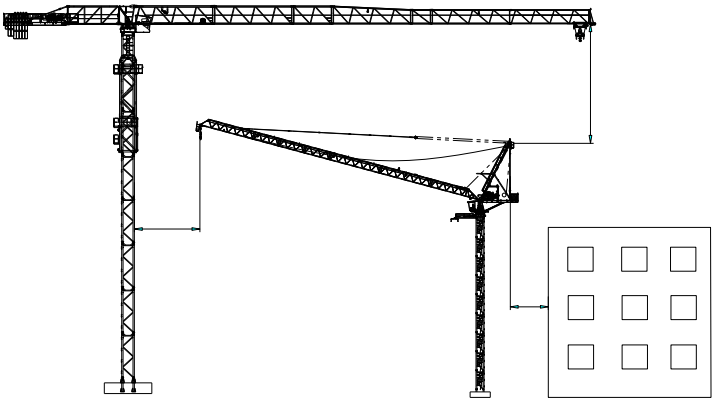
- It is forbidden to slew a load over the staff and roads.



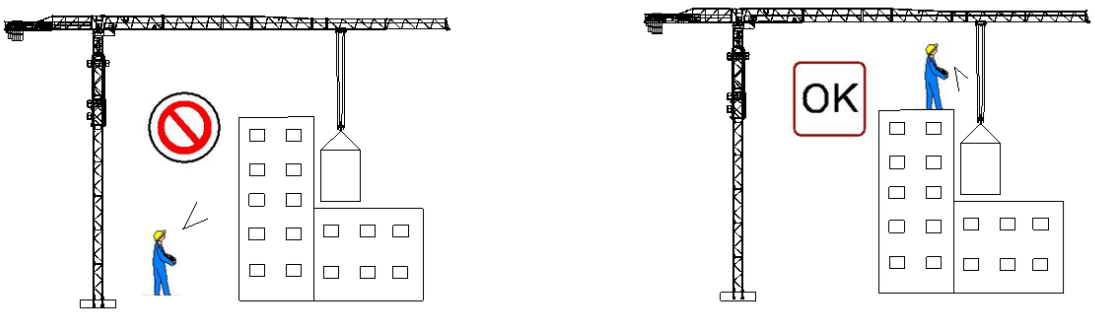
- It is forbidden to handle a load in a space lower than 2 m from the ground.



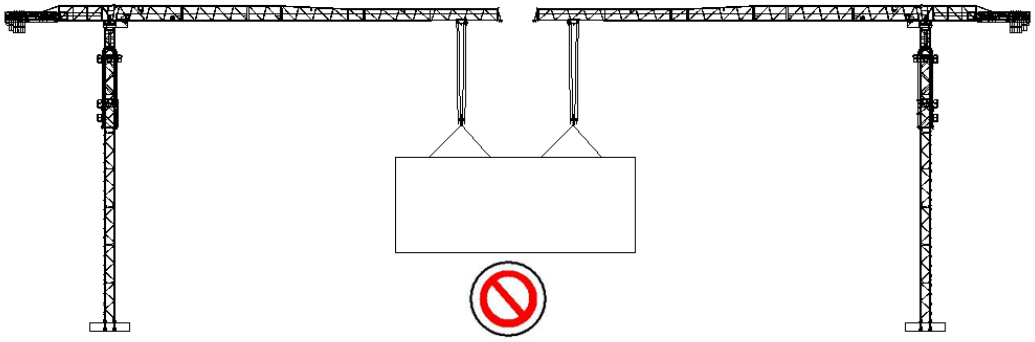
- It is forbidden to erect a crane without observing the prescribed distances.



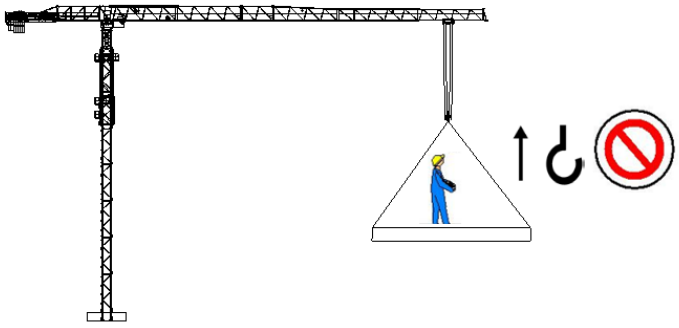
- It is forbidden to handle a load which is not visible without somebody's help.



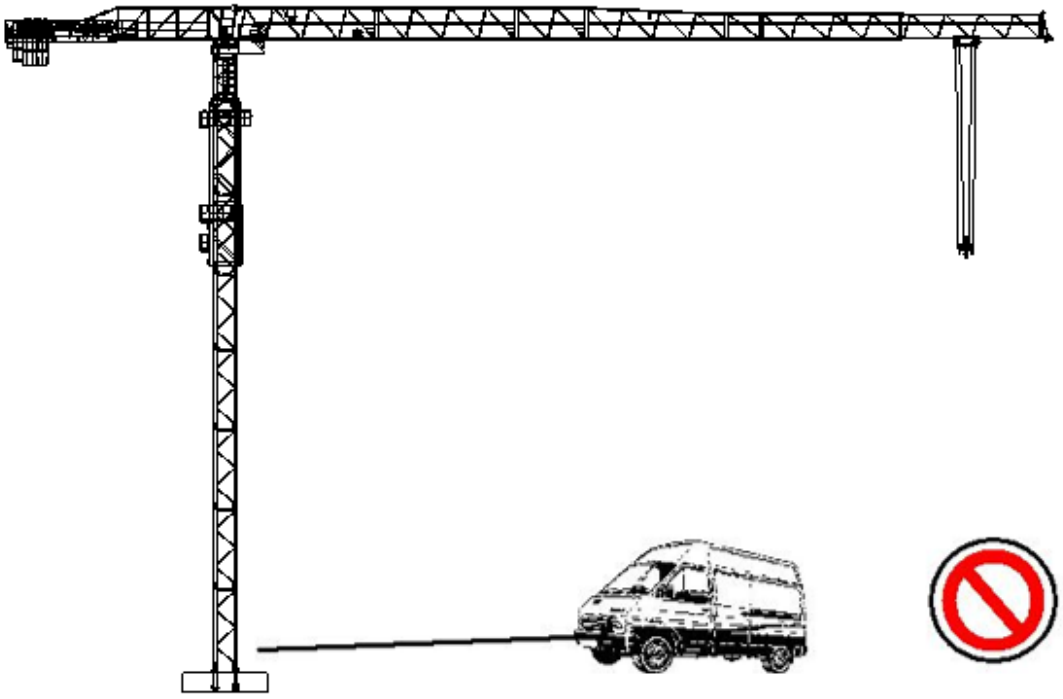
- It is forbidden to lift a load by means of several cranes.



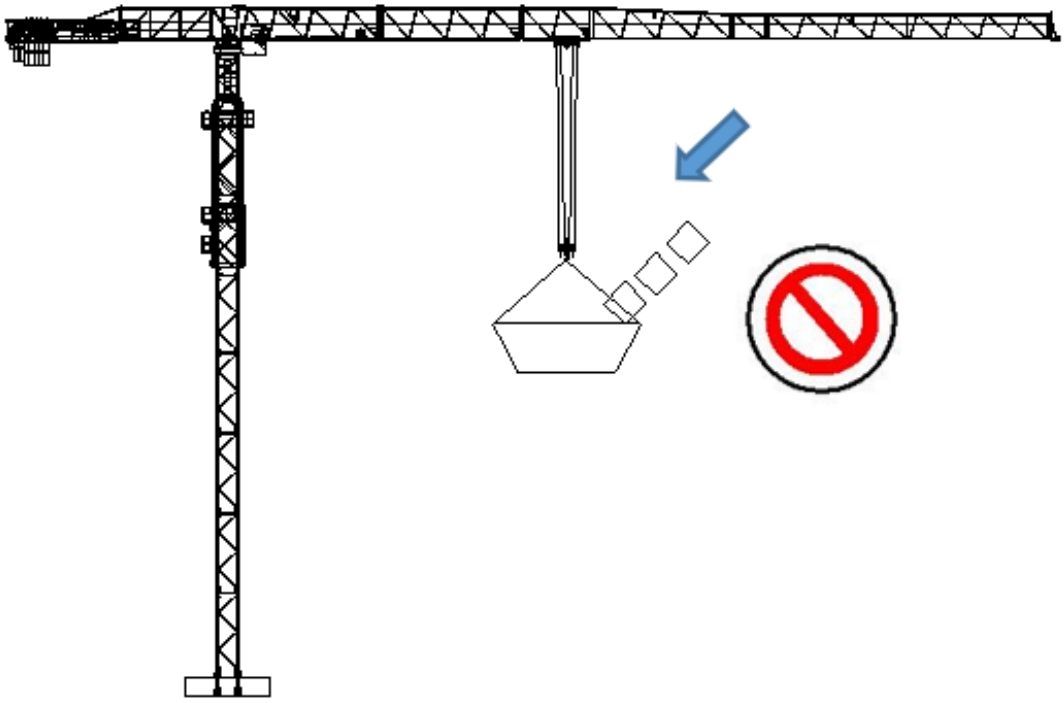
- It is forbidden to lift persons.



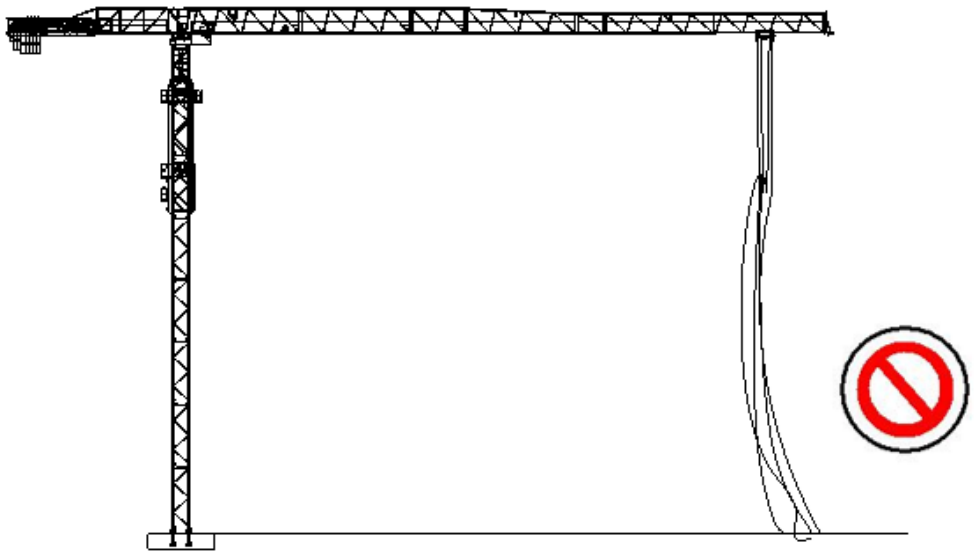
- It is forbidden to use the crane as a pulling device for a load even a rolling one.



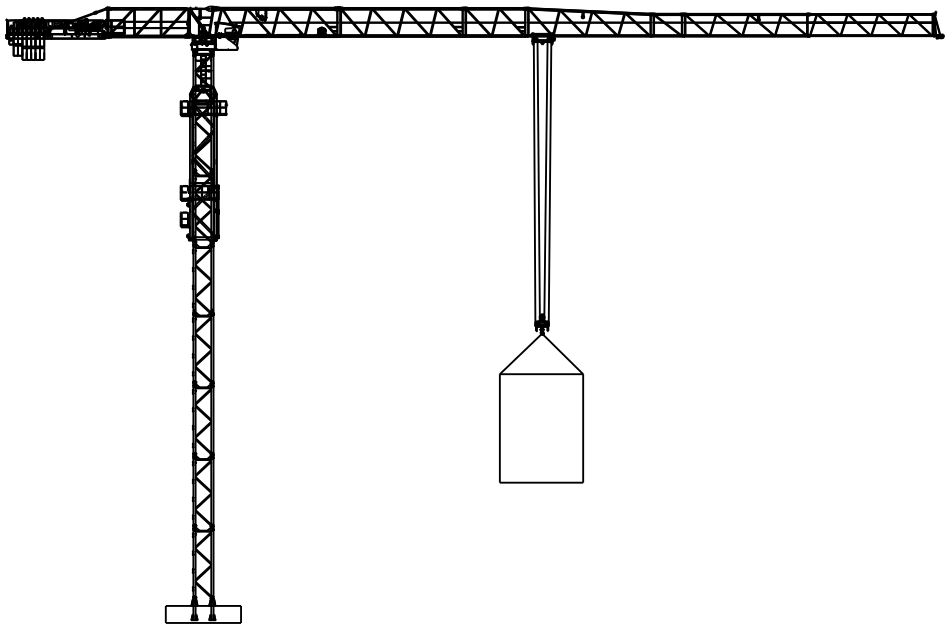
- It is forbidden to fill a grab (or other container) if this one is hooked to the crane, and to stack big objects which could be unstable and fall to the ground.



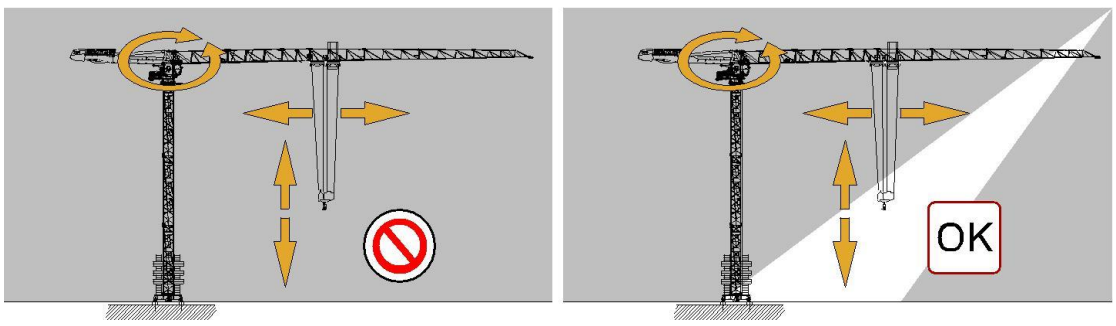
- It is forbidden to lay down the pulley block and to let it on the ground, with slackened ropes.



- It is forbidden load hooked when crane in rest period.



- It is forbidden to work in dimness areas.



- During the normal crane operation, do not stop the movements with the stop button.

- It is forbidden to work until the limit switches, so stop a little bit before.

It is forbidden to modify or to neutralize the moment cutouts, the load limiters, the limit switches, and the interference control system.

5.10.4 Combined operation

By operating the handles of the linkage platform, you can conduct the combine operations of lifting, slewing and trolleying. Pay attention to the following points during the operations:

- During the combined working of the mechanisms, if the system trips, it may because the power supply have no sufficient capacity or fluctuates sharply.
- When there is any mechanism runs too fast and it causes the load shaking, it is not recommended to conduct the combine operations.

5.10.5 Starting up and brake movement

- Starting up

Open the electric switch and turn on the start bottom which on the control unit to starting up the crane.

- Emergency stop

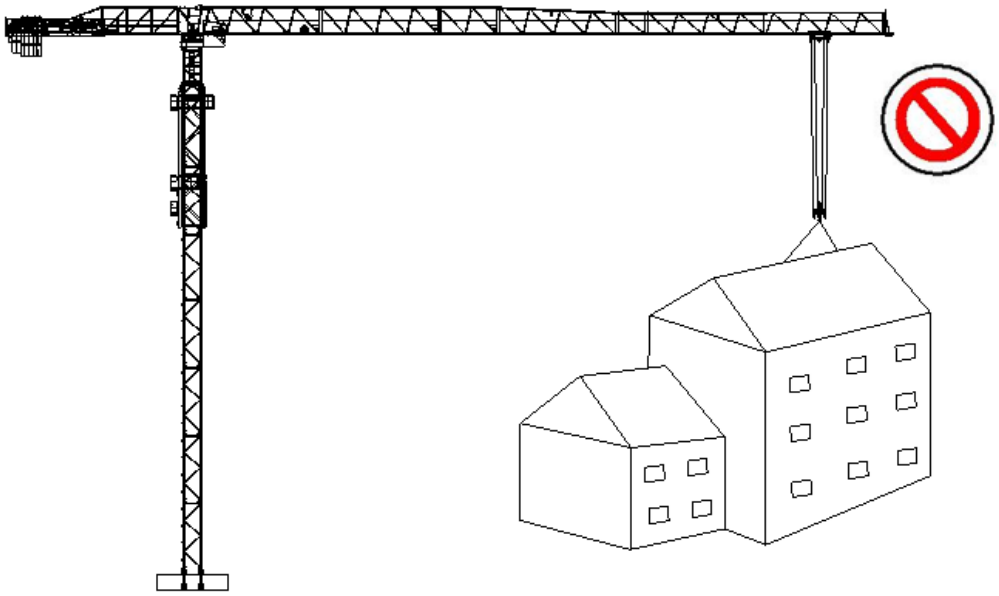
Only when emergency happens, use the “EMERGENCY STOP” Button to stop all movement of the crane.

- Slewing brake

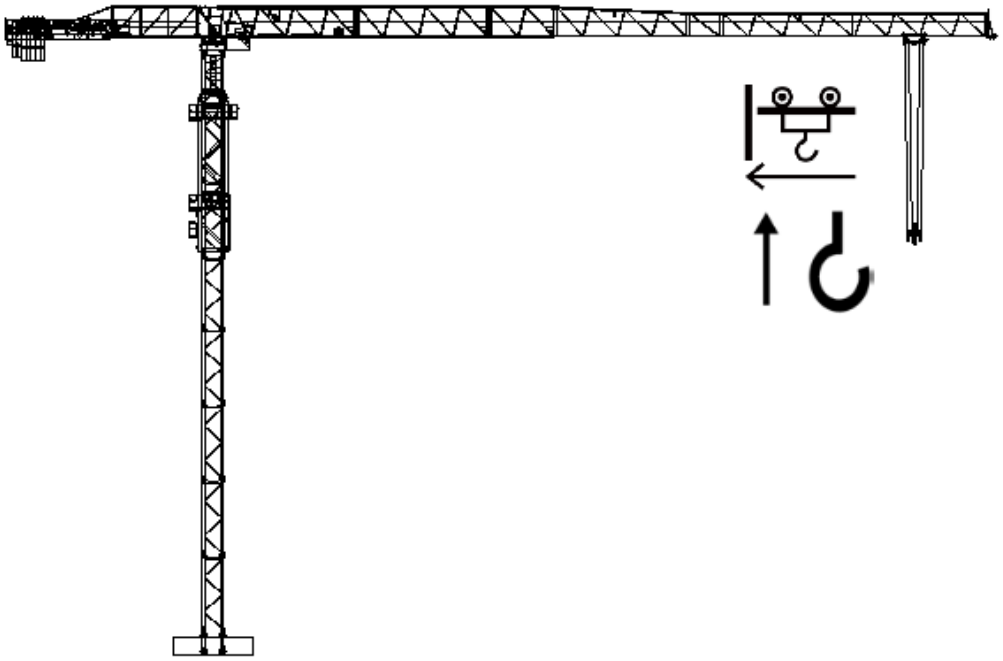
Brake switch is on the control unit, use it to stop the crane slewing or release it.

5.10.6 Stopping crane

It is strictly forbidden to hinder the slewing of the jib, as for example, by hooking the pulley block on a fixed point. The crane must compulsorily be in WEATHERVANE position.



- Position the jib in wind direction, lower the load to the ground, raise the hook without load and move the trolley to the jib foot.



6 MAINTENANCE AND INSPECTION

This chapter has been compiled for maintenance personnel who have been designated by the contracting company to keep the crane in nominal operating condition. The maintenance personnel will obtain an overview of all essential maintenance and inspection tasks stipulated in the maintenance and inspection chart.

Especially:

- check the good working order of the crane components.
- carry out the periodically checking.
- carry out the adjustments.
- identify and repair the malfunctioning or failures.
- carry out the greasing.

All maintenance and inspection deadlines can be planned meticulously using the interval specifications.

This part does not comprise instructions in order to carry out:

- repairs requiring a specific tool or which must be carried out in the workshop.
- important operations like overhauling, repairing.

6.1 Lubrication

The lubrication table recommends the type of lubricant to be used and the different lubrication points. Lubricate thoroughly and regularly, since lubrication carried out according to our instructions helps to prevent failures and premature wear.

- **Any repair and maintenance work must only be carried out after the crane has been out of service;**
- **Clean grease nipples and oil drain plugs before lubricating work;**
- **Only the correct use of suitable high-quality lubricants as recommended by a specialist supplier will ensure maximum performance and avoid faults and their consequences;**
- **Only use high quality brand-name lubricants.**

6.1.1 Lubricants table

Table 6-1 Requirements of lubricants for ZOOMLION tower crane are see follows

No.	Parts Description	Lubricating location	Specification of lubricants	Oil
1	Wire rope	Hoisting rope Trolley rope	Graphite Calcium-based grease ZG-SSY1405-65	Cleans Spray grease
2	Gearbox	Gearbox of hoisting mechanism	Fully synthetic gear lubrication oil 4408 (IOS viscosity 320)	According to the label on the gear box
		Gearbox of trolley mechanism	Fully synthetic gear lubrication oil 4408 (IOS viscosity 320)	
		Gearbox of slewing mechanism	1, Environmental temperature -20℃~40℃, 000# general lithium-based grease; 2, Environmental temperature -50℃~-20℃, 7023B# low temperature grease.	
3	Rolling bearing	Drum bearing	N0.2 general purpose lithium base grease.	/
		Slewing ring bearing		/
4	Slewing ring	Raceway, Tooth surface	1, Raceway,2# extreme pressure lithium base grease 2, Tooth surface, N0.2 general purpose lithium base grease	/
5	Pulley	All pulley	N0.2 general purpose lithium base grease.	/
6	Anti-twist device	Bearing	N0.2 general purpose lithium base grease.	/
7	Rope roller	Pulley shaft	N0.2 general purpose lithium base grease.	/
8	Hydraulic pump station	Oil tank	Hydraulic oil for anti-wear L-HM 46	/
9	Hook	Bearing	N0.2 general purpose lithium base grease.	/
10	Electro-hydraulic thrust	Brake	I-30℃	/

6.1.2 Lubrication for bearing

6.1.2.1 The function of lubrication

There should be sufficient lubrication during the working hours of the bearings to achieve effective and reliable movement. The function of bearing lubrication is as follow:

- Avoid or lessen direct metal contact among rolling element, raceway, and cage of a bearing to reduce wear.
- Oil membrane formed on the friction surface can enlarge the bearing area of the parts and lessen the contact stress to achieve the benefits of prolonging rolling contact fatigue life.
- Lubricant has a certain effect of antirust and anticorrosion.
- Grease can improve sealing performance and prevent the invasion of outer pollution.
- Lubrication has a certain effect of damping and noise-reducing.

6.1.2.2 Grease

The general used grease in the bearings of tower cranes is Calcium-based grease.1. Filling amount of grease.

The filling amount of grease varies with the structure of bearing, space, operation speed and the different kinds of grease. The filling amount of grease is consisting of two parts, one filled in the inside of bearings, the other filled in the bearing seats.

The filling amount of grease could be decided by the ratio of allowed limiting rotational speed to practical working speed. The factor shows in Table 6-2:

Table 6-2 The factor shows in table

Speed radio(limit/n=A)	Filling amount
A≤1.25	Grease accounts for 1/3 of the free space of the interior of the bearing
1.25＜A≤5	Grease accounts for 1/3 to 2/3 of the free space of the interior of the bearing
A＞5	Grease accounts for above 2/3 of the free space of the interior of the bearing

6.2 Safety notes

6.2.1 Requirement on personnel

The maintenance personnel must be designated by the operating company. Maintenance of the crane requires specialist knowledge of crane technology. The operating company is responsible for all damage caused as a direct result of improper maintenance.

6.2.2 Safety measures

- Switch off the crane and secure against incorrect or unauthorized restart.
- If there is any danger of falling objects: Cordon off the danger area or secure the area with warning signs.

6.2.3 Protective equipment for personnel

The following must be worn:

- Safety helmet
- Protective gloves
- Safety boots
- Safety harness when working above head height
- High-visibility clothing

6.3 Required maintenance and inspections

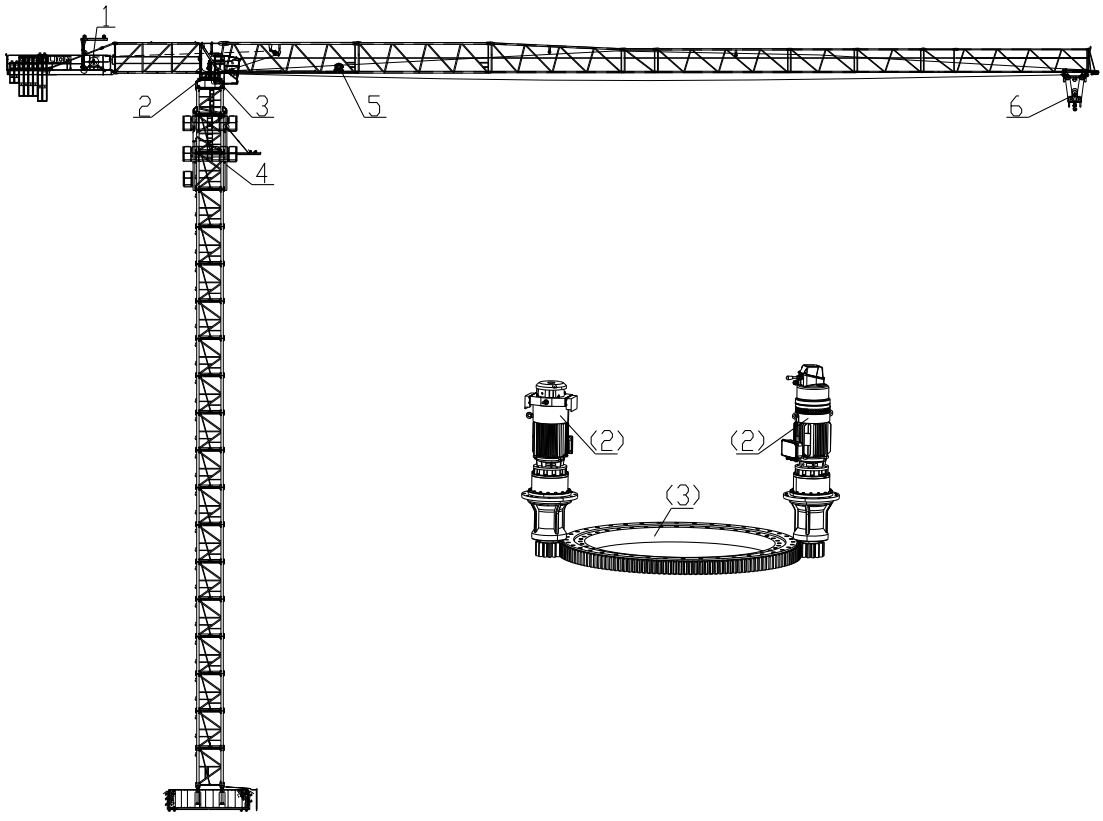


Fig. 6-1 Parts required for maintenance

1.	Hoisting mechanism	2.	Slewing mechanism
3.	Slewing ring	4.	Climbing equipment
5.	Trolley mechanism	6.	Hook

The designated personnel must carry out the maintenance and inspection tasks according to task guidelines as follows:

Maintenance/inspection intervals	Task to be performed
Check when starting up the crane and before every erection.	Slewing ring③: Grease the ball track and gear teeth
	Check the wire ropes and rope end fittings
	Check the hook⑥
	Telescoping equipment④: Grease the Pins and guide section rollers
	Check the twist compensator during every erection
	Grease all Pins during every erection
	Check each framework part and connective part
	Check each electric control implement and security implement
	Check the quality and quantity of the oil in the reducer of hoisting mechanism
	Check the quality and quantity of the oil in the climbing mechanism
Daily check	Slewing mechanism ② brake
	Trolley mechanism ⑤ brake
	Hoisting mechanism ① brake
	Travelling mechanism brake
	Rope release implement
Weekly maintenance	Slewing ring③—Grease the gear teeth, see Fig. 6-1
	Check the electric control implement, cable and electric wire
	Check the security implement (load moment limiter, load limiter, trolling limiter, slewing limiter, hoisting limiter)
Monthly maintenance	Grease the wire ropes
	Grease the rope pulleys
	Grease the winch drum bearing
	Fill with hydraulic oil in the climbing pump station
	Inspect the high-tensile bolt connections 1 month after erection
	Travel gear: Grease the wheel bearings and the inside face of the flanges
	Hoisting gear①: Fill the gearbox with Oil
	Check the stability of the vital framework, important weld and connection parts (bolts and pins)

Maintenance/inspection intervals	Task to be performed
Half-yearly maintenance	Grease all lubricating nipples
	Check the twist compensator
	Motor bearing: change oil after 1500 operation hours, once a year at least
Yearly maintenance	Inspect the high-tensile bolt connections and grease the bolt
	Check the hook⑥
	Check freedom of the movement of the hinged joint of front window of the cabin and lubricate it regularly
After 2000 operation hours	Oil change in the reduction of slewing mechanism②
	Oil change in the reduction of hoist mechanism①
	Oil change in the reduction of trolley mechanism⑤
	Oil change in the brake of hoisting mechanism ①
	Oil change in the trolley travel gearbox
	Oil change in climbing mechanism④ after 2400 operation hours

Table 6-3 Common bolt pre-tightening force (friction coefficient μ=0.14)

Bolt performance grade	8.8	10.9
Thread specifications	Actual use of pre-tightening force N·m	Actual use of pre-tightening force N·m
M8	22.5	31.5
M10	44	62
M12	77.5	110
M14	120	170
M16	190	265
M18	260	365
M20	370	520
M22	500	700
M24	640	900
M27	950	1350
M30	1300	1800

6.4 Hoisting mechanism

6.4.1 Overview

The structure of the hoisting mechanism is shown in the figure below which layout as "—" type. The three-phase asynchronous frequency motor with axial flow fan. The electromagnetic failure brake installed at the empennage of the motor. Planetary reducer which motor output torque to reducer through coupling. The reducer output end flange connected to drum by bolt. There are five gears in the process of hoisting or falling. The first and second gears are transition gears which can be used for slowly locating operation.

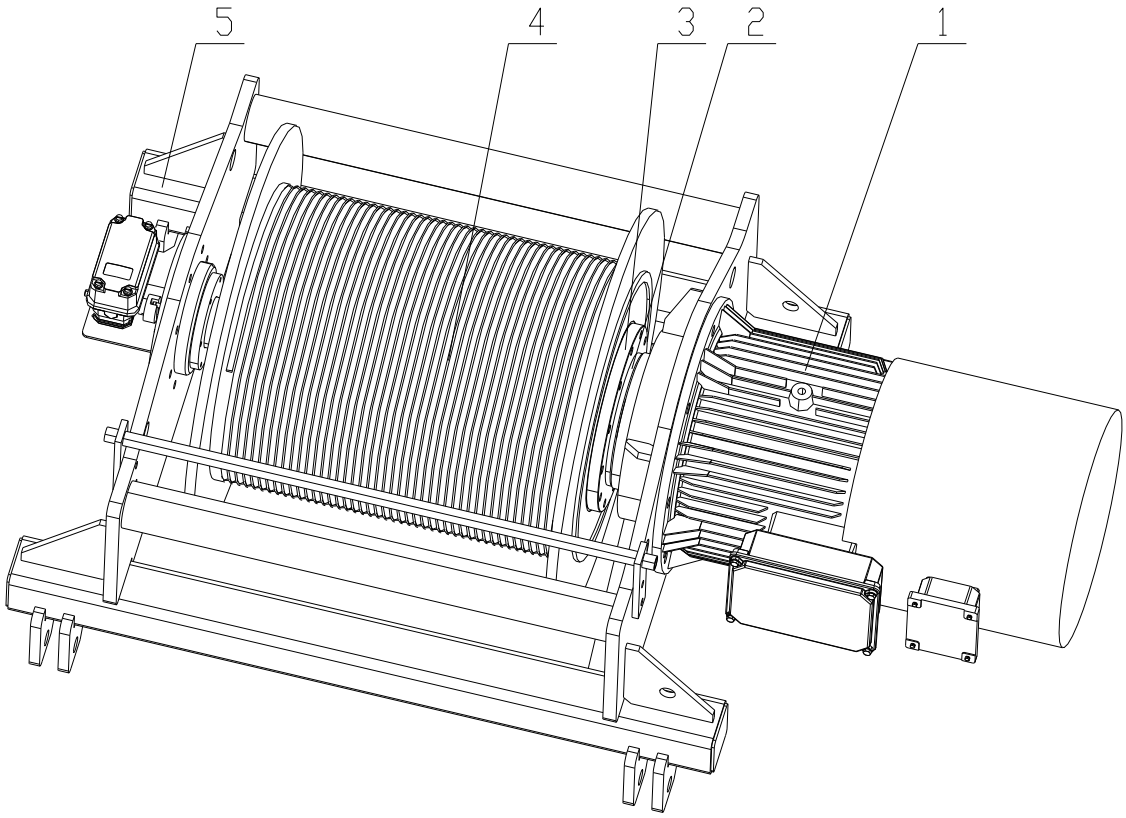


Fig. 6-2 Hoisting mechanism

(1) Motor
(2) Coupling
(3) Reducer
(4) Drum
(5) Frame

6.4.2 Adjustment and maintenance of the brake

Model and relevant parameter for hoisting mechanism brake shows in Table 6-4.

Table 6-4 Relevant parameter of brake

Brake	Rated automatic torque	Rated air gap	Adjustment of gap	Min allowable friction sheet thickness
SPZ600A (500)	M_B	S_L	S_{Lmax}	a_{min}
	N.m	mm	mm	mm
	500	≥0.5	1.2	15.8

Make sure drum not rotation unexpected leads to accidents before any debugging for brake.

6.4.2.1 Brake wear

Brake friction plates and machinery can cause functional wear. In order to be able to operate safely and without obstruction, it is necessary to periodically inspect, debug and replace the brake if necessary.

The different wear causes are described in Table 6-5 below. Important influencing when calculating the service life of the brake and determining the maintenance cycle that must be observed.

Table 6-5 Brake wear reason statistics

Part	Reason	Function	Factors
Friction plate	Operation stops	Friction plate wear	Actual wear
	Emergency stop		
	Motor repeated wear in the start and stop		
Moving iron core and static iron	Brake plate friction	Moving iron core and static iron brake	Actual friction
Brake disc panting	Relative movement and collision between splines	Meshing wear	Number of start / stop cycles
Moving iron core support	Load transformation and collision between moving iron core, guide bolts and screws	Transformation for moving iron core, guide bolts and screws	Number of start / stop cycles
Spring	Spring shear stress generated by axial load circulation and radial reversal clearance through the armature	Decline of elastic storage force fatigue fracture	Number of switch brake

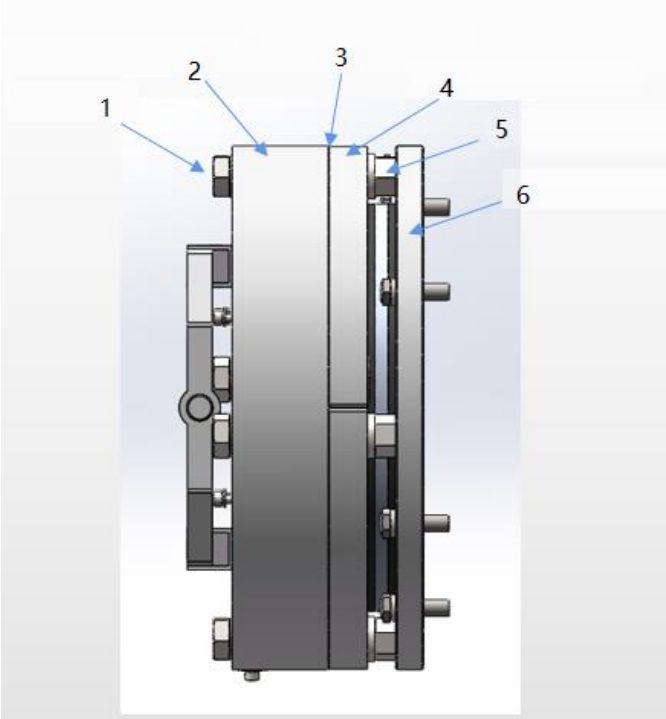
6.4.2.2 Maintenance period of brake

To ensure safety and no fault running, please check and maintenance the brake regularly.

For the brake essential maintenance period first according to the load of brake in service. All wear cause must be considering when calculate the maintenance period. Check brake in time when the braking action delayed, slippery hook or alarm. SPZ type brake maintenance period according service situation, otherwise, the maintenance period is 3 months

6.4.2.3 Readjust gap

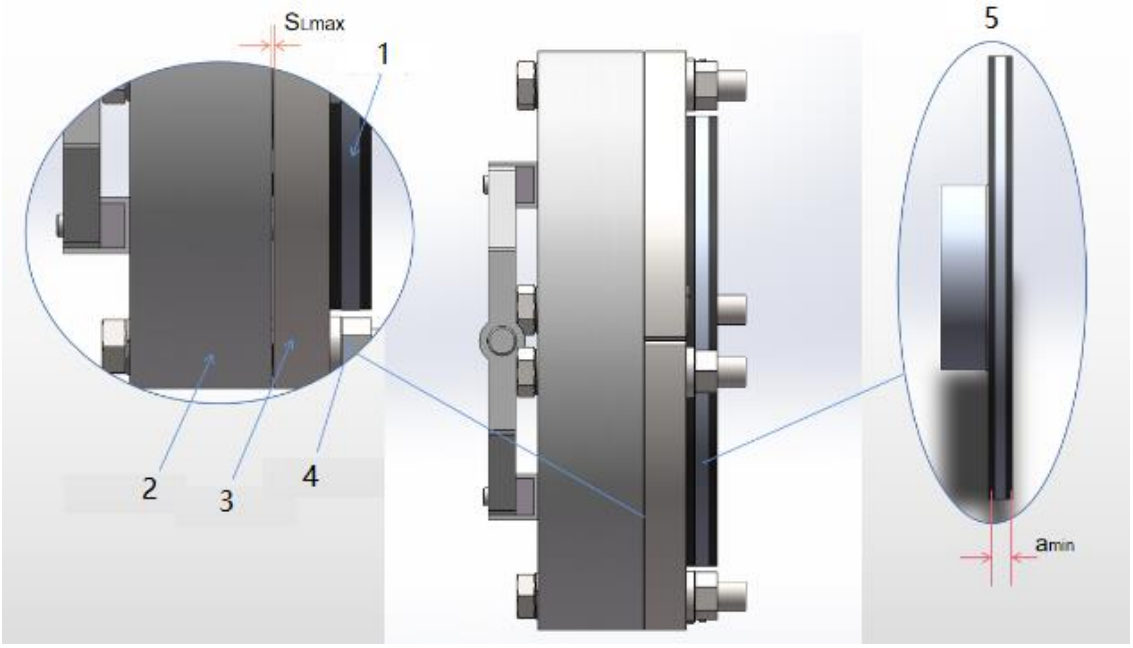
Material loss causes the thickness of friction plate to decrease and the gap to increase. Once the gap reaches the maximum allowable value (1.2mm), it must be adjusted. When adjusting the gap, insert a 0.5mm feeler gauge between the static iron core and the moving plate, turn the mounting bolt clockwise to make the feeler gauge just clamped, and then tighten the adjustment screw clockwise to the right to make the 0.5mm feeler gauge can be pulled out, and the 0.55mm feeler gauge can be used to check the gap. If the 0.55mm feeler gauge cannot be inserted, the gap has been adjusted in place. Adjust all the gaps in turn to make the gap uniform.



(1) Bolt
(2) Static iron core
(3) Service gap 0.5mm
(4) Dynamic iron core
(5) Screw
(6) Mate plate

Fig. 6-3 Adjust the service gap

The degree of wear on brakes varies from use to use. Material loss causes the thickness of friction plate to decrease and the gap to increase. Once the thickness value of friction plate less than 15.8mm, it must be replaced, shows in Fig. 6-4.



(1) Friction plate
(2) Static iron core
(3) Dynamic iron core
(4) Bolt
(5) Friction plate

Fig. 6-4 Replace friction plate

6.4.2.4 Replace friction plate

1) Unscrew the mounting bolts and remove the brake (see Fig. 6-5)
2) Loosen the brake connection cable

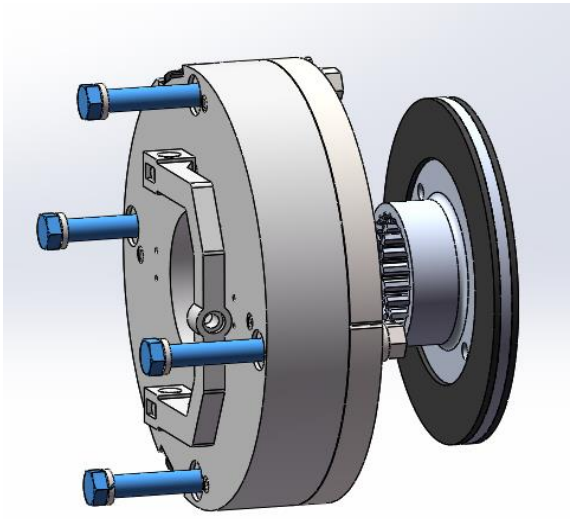
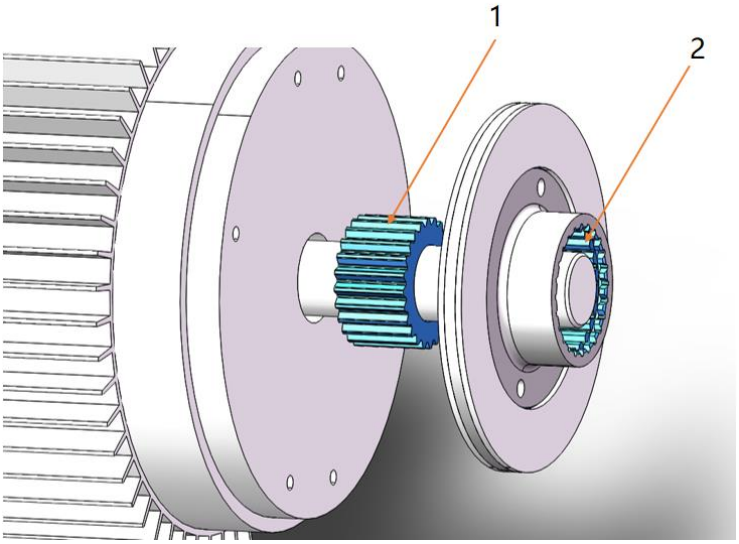


Fig. 6-5 Dismantle the brake

3) Pull the friction plate assembly completely out of the spline sleeve.
4) Check the spline engagement. Replace if necessary (see Fig. 6-6),



(1) Splines meshing (2) Splines meshing

Fig. 6-6 Check the splines meshing

5) Check the friction plate mating surface. Replace the friction plate or the mating surface when the scratches are serious. Rework the friction surface when the friction of the bearing cap 1 is severe (as shown Fig. 6-7)
6) Install a new friction plate. Adjust the brake air gap, please refer to the brake adjustment section.
7) Connect the cable.
8) Install the encoder

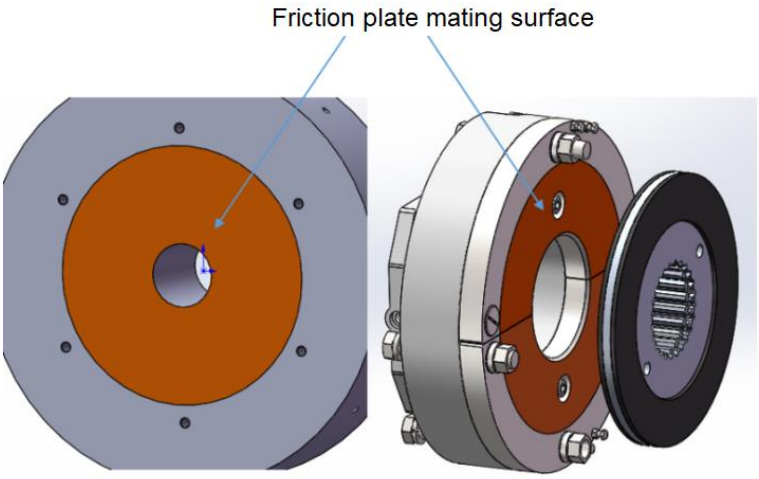
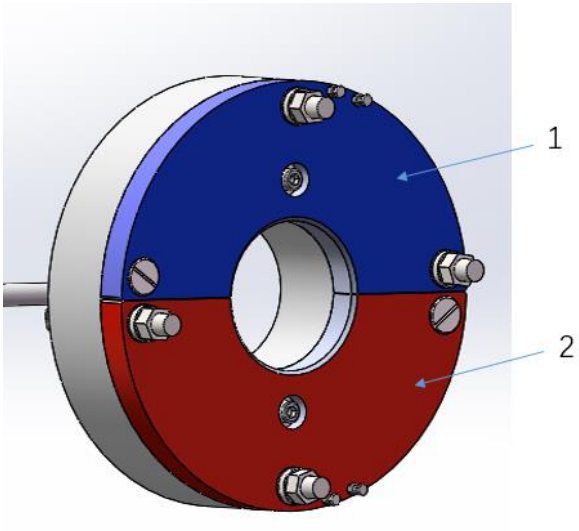


Fig. 6-7 Check the Friction plate mating surface

6.4.2.5 Debug synchronization

The SPZ brake consist of dynamic iron core 1 and dynamic iron core 2. Adjusting synchronicity is aimed at the need to configure dynamic iron core have the same pull-in and release synchronization (see Fig. 6-8). This step is specific for the double-plate brakes, the single-plate do not need to debug.



Dynamic iron core 1 Dynamic iron core 2

Fig. 6-8 Dynamic iron core

If the operation is not synchronized, first unscrew the brake release, and appropriately adjust the depth of the 4 set screws on the brake surface to achieve synchronization. Listen whether pull-in and release are consistent, and the confirm the dynamic plate synchrony.

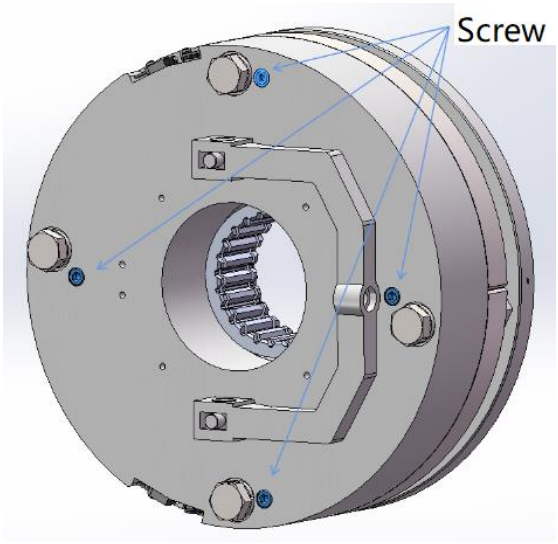


Fig. 6-9 Lock screw

6.4.2.6 Install the brake

■ General description

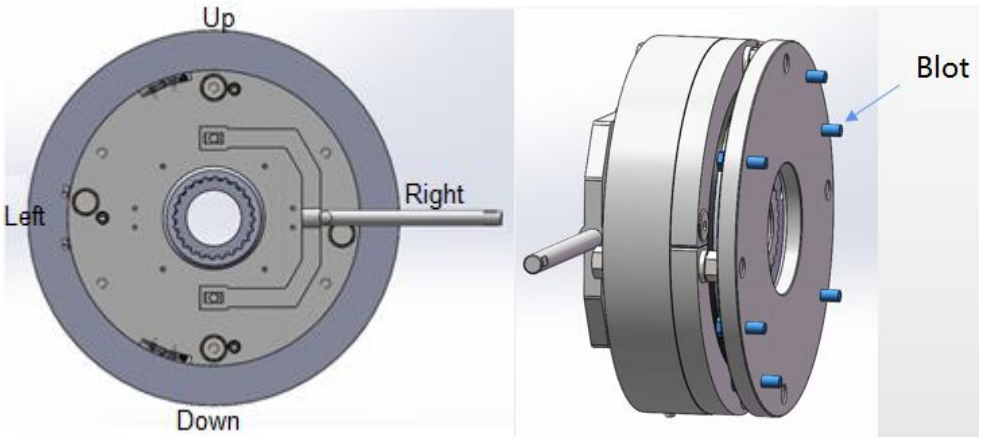
1) The installation of the brake must be completed by trained and qualified technicians, and care must be taken when working
2) During the installation planning stage, there should be enough working space around the equipment for equipment installation and future maintenance and repairs
3) Before the start of assembly and installation, sufficient hoisting equipment should be prepared in advance
4) The installation and connection process of the equipment should prevent the brake from being clamped

■ Installation basis

1) The installation surface must be horizontal or vertical and flat
2) The rigidity of the mounting surface is sufficient to bear the force acting on it
3) The installation direction of the brake should be completed carefully to avoid the wrong installation direction to affect the actual operation

■ Installation instructions

1) First, confirm whether the motor installation surface is flat and free of oil;
2) Then determine whether the brake is installed in the correct direction, and the position of the release lever of the brake release is directly on the right side (see
3) When installing the spline sleeve, make sure that the shaft Retainer ring can clamp the spline sleeve, and there is no looseness in the axial direction;
4) Ensure that the friction component and the spline sleeve can achieve axial relative sliding, avoiding the friction plate from being stuck in the axial direction due to too tight fit;
5) Install the SPZ400(350) and SPZ400(400) brake on the motor by six M10 bolts through 30N·m moment. Install the SPZ600A (500) and SPZ600A (600) brake on the motor by eight M12 bolts through 60N·m moment. The layout of single-plate brake bolts is slightly different from that shown, installing according actual object.



(a) (b)

Fig. 6-10 Install condition for brake

6.4.2.7 Debug micro switch

The micro switch includes: action signal switch, wear monitoring micro switch, see Fig. 6-11. Micro switch has been adjusted before leaving the factory. Only when switch go wrong do you need to adjust.

1) Adjust the action signal switch

When adjusting the action signal, the brake is energized to pull on S_L=0, and the jack screw is turned to the micro switch signal trigger critical point d to the action signal trigger. 0t this time, the jack screw is gently turned to travel 90° to overpressure 0.2mm, Finally, apply thread glue on the nut and tighten the nut to ensure that the signal feedback is not lost.

2) Adjust the micro switch for wear monitoring

When adjusting the wear monitoring signal, the brake is energized to pull in S_L=0, and the jack screw is turned to the micro switch signal trigger critical point d to the activation signal trigger. At this time, the jack screw is slightly turned and screwed into 3/4 turns to 0.6mm overpressure, finally apply thread glue on the nut and tighten the nut to ensure that the signal feedback is not lost.

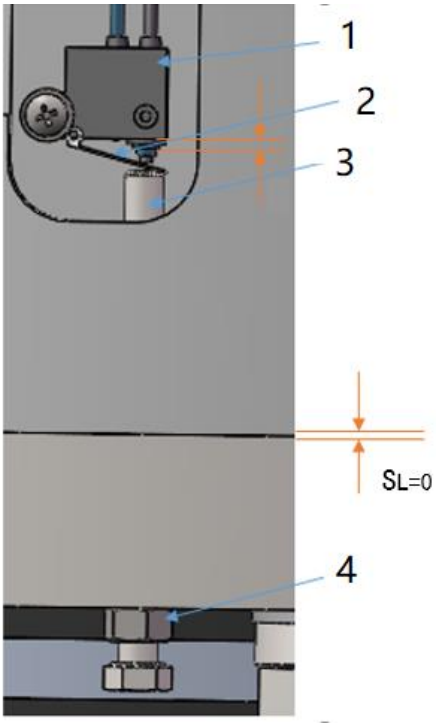


Fig. 6-11a Action signal switch

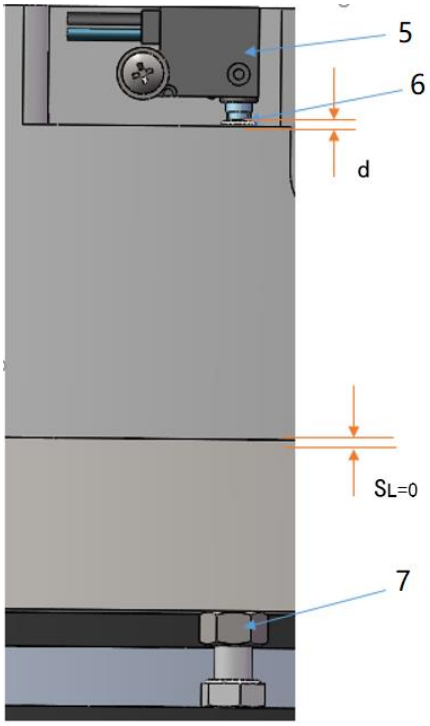


Fig. 6-11b Wear monitoring micro switch

(1) Action signal switch (2) Switch lever

(3) Screw (4) Nut

(5) Wear monitoring micro switch (6) Screw

(7) Nut

Fig. 6-11 Adjust action signal switch and micro switch for wear monitoring

6.4.3 Maintenance of the motor

6.4.3.1 Storing the motor

The motor should be stored in the dry and ventilated place and be covered by rain cloth. Keep the motor clean, avoid any water, oil, dust, or corrosive gas get into the motor, and clean the dust inside or outside the motor regularly.

For the motor stored over one year, clean the impurity inside and dry, apply a coat of clean anti-rust oil to the bearing, all the fasteners (except the earthing bolts) and fitting surfaces.

The cover plate, junction box cover and unused outlet should be covered well, for avoiding things as water, dust, oil, or emulsion get into the motor, and caution the mouse destroying the coil.

6.4.3.2 Maintenance before use the motor again

1) Observe the motor and transmission after starting, if any abnormal situation occurs, stop the motor immediately, find out the cause and solve it, then the motor can restart;
2) The increase heat of the working motor is prohibited to exceed the permission value. Using the temperature gauge to measure the heat increase of the iron core or shell, generally the increase can't exceed 60°C, the increase of bearing can't exceed 95°C, always monitor the heat increase of the parts in the working;
3) Notice the smell, vibration, and noise of the motor. The winding will scorch with smell because overheat. Some problems, especially the mechanism problem, will show as vibration or noise, so the motor should be stopped immediately when the abnormal smell, vibration, and noise occur;
4) Check if the bearing is overheating or oil-leaking constantly, and pay attention to supplement or replace grease regularly. The grease is generally made of No,2 lithium grease. Use the same grease as possible, the grease in the bearing room should not exceed 70%;
5) Keep the motor clean, no water, oil and impurities can fall into the motor. The air inlet and outlet must always be unobstructed;
6) If the motor leaves unused for a long time, mind to deal with the exposed parts of the motor by dustproof and waterproof treatment. When use again, take a mechanism check before installing, check if the assembly is complete, if the fasteners are loose. The dust or impurities inside should be cleaned if there are, use dry compressed air to clean if necessary. Must use 500V megohmmeter to measure the insulation resistance between the stator winding and the shell. If it's lower than 0.5 MΩ, the motor must be dried, charging in low-voltage electric is a suggested way. The temperature of the winding is not allowed to exceed 125°C. To avoid the motor rusting, when assembling after the excreting and checking, all the fasteners (except the earthing bolts) and fitting surfaces should be applied with a coat of clean anti-rust oil. All the fasteners should be attached with spring washer to avoid loose. After the assembling, rotate the rotor by hands, the rotor should roll flexibly and have no friction.

Avoid to crash, knock the brake and rotary encoder in the tail of the motor. Check if the brake and rotary encoder are assembled completely and installed right, and if the fasteners are loose.

6.4.4 Maintenance of the reducer

6.4.4.1 Period of the maintenance

Users should maintain the reducer regularly according to the items in the following table:

Table 6-6 The period of the reducer maintenance

Check items	Period	Remarks
Check the oil temperature	Everyday	
Check the abnormal noise of the reducer	Everyday	
Check the oil leaking of the reducer	Everyday	
Clean the vent cover	Every three months	
Check the wear of the spline shaft of the reducer	Once every six months or after changing site, check the spline shaft extension and the spline lateral clearance of the coupling spline sleeve to prevent wear or deformation, and apply grease	Check together with coupling
Replacing oil after starting the reducer for the first time	One year	
Oil replacing afterwards	Every year for oil quality, maximum oil replacing period no exceeding five years	

- *If the mechanism leaves unused for a long time, mind to deal with the exposed parts of the reducer by dustproof and waterproof treatment. When use again, take a mechanism check before installing, check if the assembly is complete, if the fasteners are loose. The dust or impurities inside should be cleaned if there are, use dry compressed air to clean if necessary.*
- *Paint thread locker to the reducer connecting bolt to avoid loose; paint the thread locker again when reinstalling the bolt after taken down.*
- *The bolts connecting of the reducer refer to **Table 6-3**.*
- *Check the wear of spline regularly, if the wear is over 0.5mm, please contact our after-sales service for avoiding danger.*
- *Matters need attention following **Table 6-7**:*

Table 6-7 Matters need attention of reducer

The matter	Possible reason	Solution
Leaking	Invalid sealing	Clean surroundings, rotate the sealing for several circle, check again.
	Broken sealing	Contact our after-sales service.
Overheat	Lack of grease	Add specified gear lubricating grease.

Strong vibration or loud noise	Problem inside.	Contact our after-sales service.
lubricating grease becomes milky white	Too much water in the grease	Replace the lubricating grease

6.4.4.2 Oil adding of the reducer

The structure arranging types of hoisting and trolley reducers are the same, see the figure below.

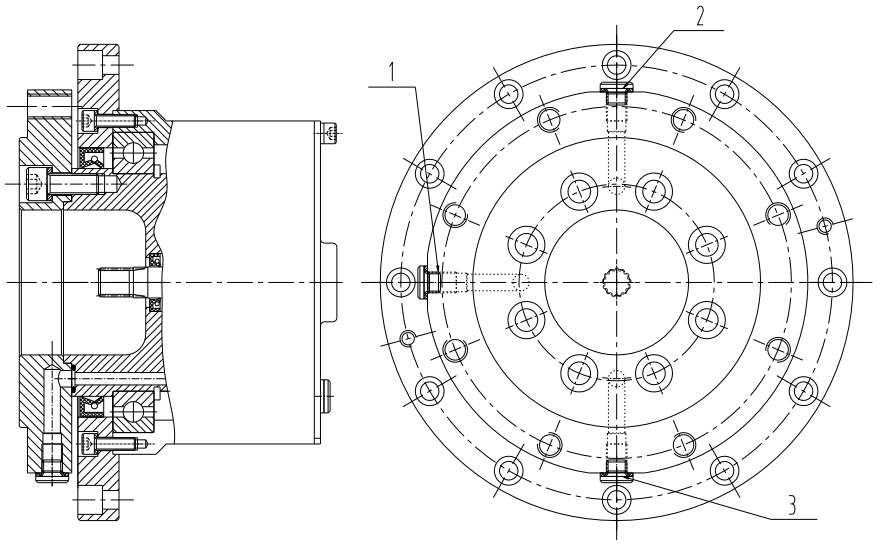


Fig. 6-12 The structure arranging type of reducer

(1) Oil inlet (2) Oil inlet

(3) Oil outlet

■ The oil adding steps are:

1) Replace plug of the part 2 oil inlet to a vent cap, open the part 3 oil outlet and put in a tube, clear the waste oil inside, install the plug back;
2) Open the plugs of the part 1 and 2, add the gear oil conforms to the Table 6-1 to the reducer;
3) Add oil until the oil almost spill out from the part 1 (refer to the Table 6-8);
4) Install the plug of part 1 and vent cap of part 2 back, ensure the vent cap is water-repellent to avoid going bad of oil.

■ Check the oil level:

After mechanism running two years or change construction site, the motor shall dismantle and inspect as follow:

(1) Check the spline shaft, side gap about the coupling spline housing, eliminate over-wear or deformation, and the grease spline housing and spline shaft;

(2) Check wear condition about the elastomer, if there is obvious indentation and deformation, the elastomer recommend replace.;

(3) Check whether reducer is leaking oil, if the oil plug is leaking oil, apply moment to tighten oil plug according to Table 6-3. and then adding the required gear grease. If the seal components damage, please contact our after-sales service.

Table 6-8 Reference of oil adding amount of the reducer

Reducer model	Oil model	Reference fuel
P250T240-2W(BLZ)	Synthetic heavy duty industrial closed gear oil 4408(320#)	2L (1.8kg)

Too much oil may cause planetary reducer severe fever, swell and overflows when running. So please fill the reducer with required model and oil value. Because reference fuel in the reducer cannot reach oil mirror position, at static status cannot observe lubricating grease face through oil mirror, only in the operation process whether there is lubricating grease can be observed.

(1) Ensure the gear oil has cool down to the surrounding temperature before adding or replacing oil, otherwise the operator can be scalded.

*(2) The lock plug of hoisting reducer refers **Table 6-3**.*

(3) The rubber slice in the reducer vent cap shall be remove after install mechanism.

6.4.5 Coupling

➢ Check the mechanism weekly and listen operation situation of motor output shaft end. Such as coupling and other parts of the abnormal sound issued, stop operating and contact our after-sales service for replacement.

➢ Check the coupling elastomers and half- coupling regularly. If there is obvious indentation and deformation, please replace or contact our after-sales service. Check the spline shaft, side gap about the coupling spline housing, eliminate over-wear or deformation.

6.4.6 Method of rope arrangement problem of hoisting mechanism

Rope of tower crane hoisting mechanism is multilayer coiling. The drum is Lebus drum which is fit for multilayer rope coiling. The characteristic is most of the rope race is straight line rope race. The under-layer rope arrangement has obvious guide effect to the upper rope arrangement. It is not easy to lead to rope climbing and rope disordering phenomena and is helpful to arranging multilayer rope coiling orderly. Rope arrangement of hoisting mechanism is shown in Fig. 6-13.

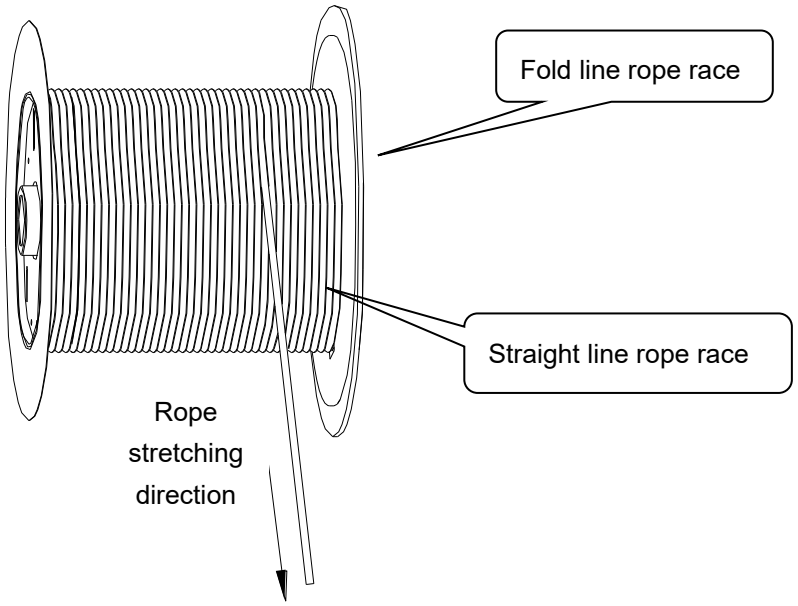


Fig. 6-13 Drum structure

Table 6-9 Rope arrangement problem summary of hoisting mechanism

Rope arrangement problem summary		
Problems description	**Reason analysis**	**Handling Method**
Bad rope arrangement and rope jumping of drum	Bad lubrication of A-frame guide pulley leads to clamped pulley cannot guide well.	Check the lubrication condition, if dry lubricating grease is found, wipe it off and paint new lubricating grease. If the environment temperature is too low and viscidity of lubricating grease is too high, add thin grease to the pulley (Check before starting the machine and paint thin grease if necessary).
	Hoisting mechanism is installed aslant	Check whether the bracket is installed aslant, if yes, adjust it.
	Center lines of hoisting mechanism drum and counter jib are not aligned	Adjust mechanism installation seat to let the center lines of hoisting mechanism drum and counter jib be aligned.
	Bracket of hoisting mechanism is not installed flatly	Check the flatness of the bracket. If it is not flat, adjust it.
	Upper layer rope is pressed under the lower layer rope of the drum	Check if the first layer rope is arranged tightly, if not, arrange it tightly with some load (2% of the minimum broken tension of the rope or 10% of rated hoisting load)

CAUTIONS:

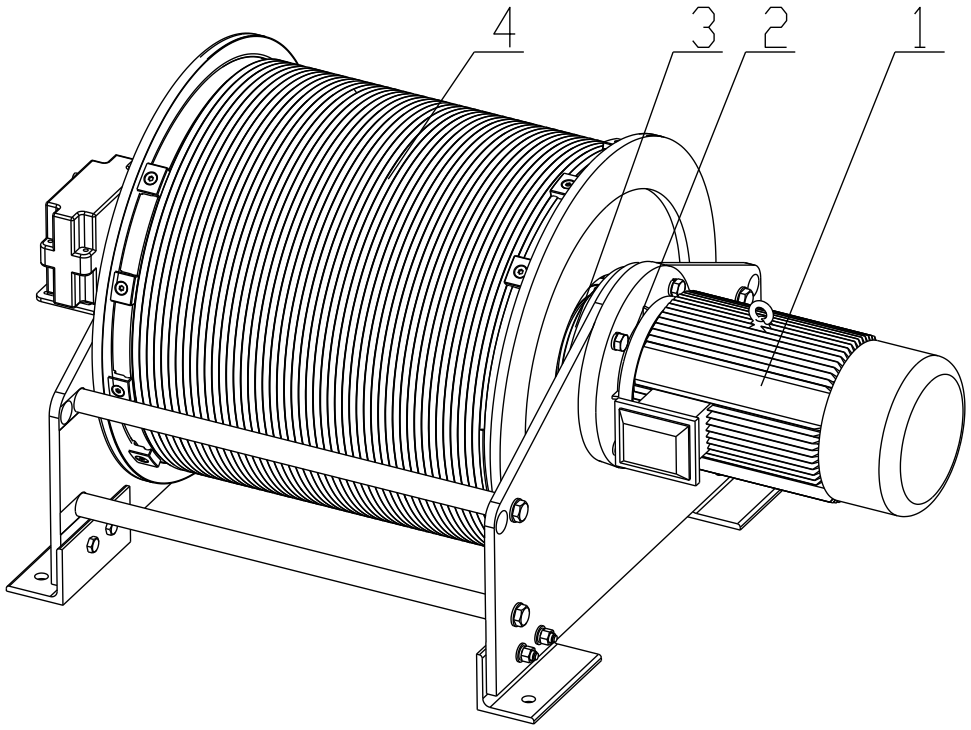
- The lubricating condition has some effects to the rope arrangement. Check the lubricating condition of the rope. If dry lubricating grease is found, wipe it off and paint new lubricating grease.
- If rope disordering occurs, arrange the first layer rope tightly and well with some load (2% of the minimum broken tension of the rope or 10% of rated hoisting load)
- When the tower crane is at the height and below free-standing height, the 6×29 non-rotate hoisting rope can be used; The height of the tower crane greater than free-standing height, the 35W×7 rotate rope suggest to be used.
- Disorderly rope during the service is related to diameter and pre-tightening force of the rope. The rope was pre-tensioned when leave factory. The first layer rope must keep-in, lined up and as much load as possible (2% of minimum breaking load rope or 10% of rated load).
- In order to reduce the probability of mutual extrusion and random rope caused by more layers around the rope, according to the construction progress, use cycle, final height, fall change, life expectancy and other comprehensive conditions, consider the configuration of multiple rope of different lengths, to ensure that the first layer of the drum rope has pre-tightening force. By using short rope in the early stage, the service life of rope can be effectively extended and the service cost of rope can be reduced.

- When the height of the tower crane is low, the length of the rope is suggested to use adopt 4-fall, and the pre-tightening force of the whole length can be satisfied through the load, to prevent the phenomenon of rope sinking and chaos caused by the partial rope not being preloaded.
- After the maximum length of rope is released, the rope on the drum should be retained for at least 3 laps.
- When the height of tower crane reaches 180~200m, rope easy twist slip, it is recommended to use the compacted rope, the detailed scheme please contact our after-sales service;
- The lubrication of the rope also has a certain influence on the arrangement of the rope. The rope should be checked regularly. If the rope is found to have dry grease, it should be removed manually and then smeared with new grease, see Table 6-1.

6.5 Trolley mechanism

6.5.1 Overview

The structure of the trolley mechanism is shown in the figure below which layout as "—" type. The three-phase asynchronous frequency motor with axial flow fan. The electromagnetic brake installed at the empennage of the motor. Planetary reducer which motor output torque to reducer through coupling. The reducer output end flange connected to drum by bolt.



(1) Motor (2) Coupling

(3) Reducer (4) Drum

Fig. 6-14 Structure of the trolley mechanism

6.5.2 Trolley brake

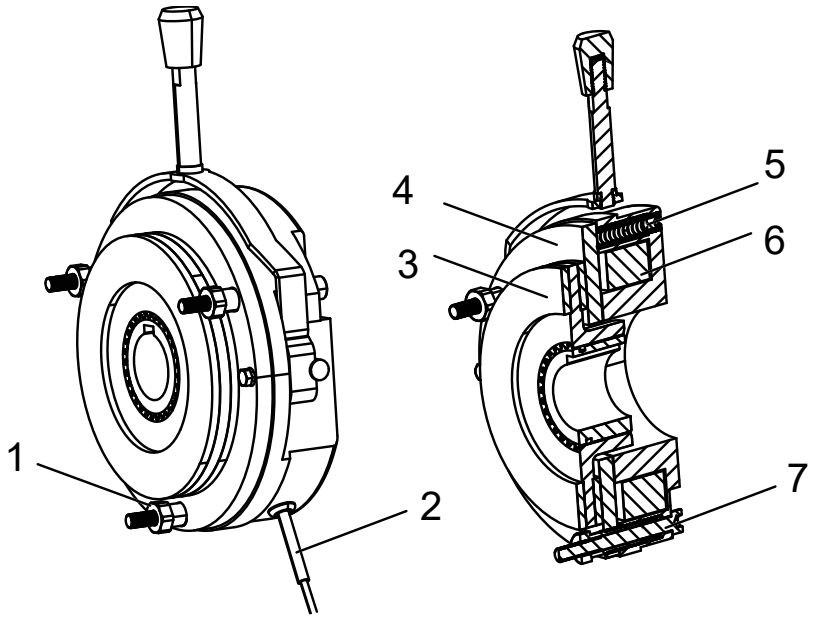


Fig. 6-15 Trolley brake

(1) Brake disk
(2) Hollow bolt
(3) Armature iron
(4) Mounting screw
(5) Magnetic yoke assembly
(6) Spring
(7) Fixture wire

6.5.2.1 The apply and release of brake

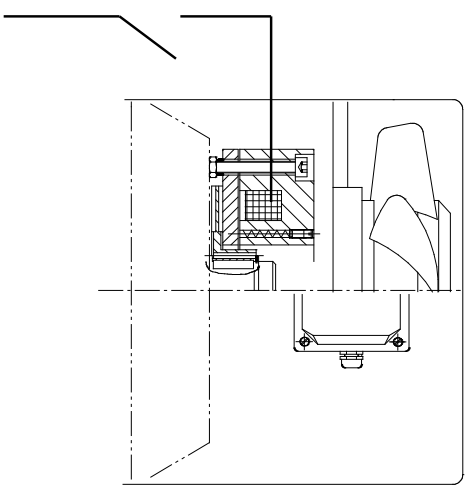


Fig. 6-16a Apply the electromagnetic brake

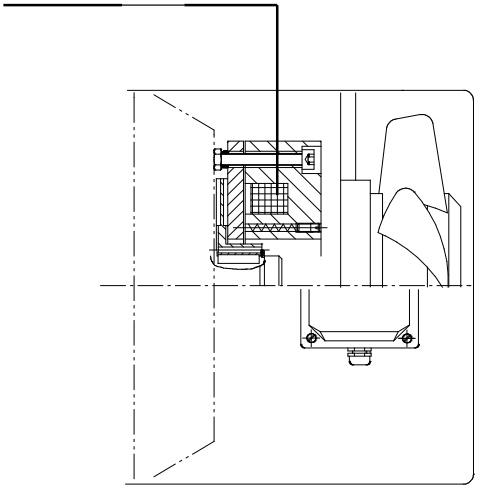


Fig. 6-16 b Release the electromagnetic brake

Fig. 6-16 Apply and release state

6.5.2.2 Maintenance

- Maintain once for every 450 hours or three months.
- Adjust the air gap: the standard air gap value δ=0.6mm for the electromagnetic (2) brake of three-phase asynchronous motor. See Fig. 6-17.

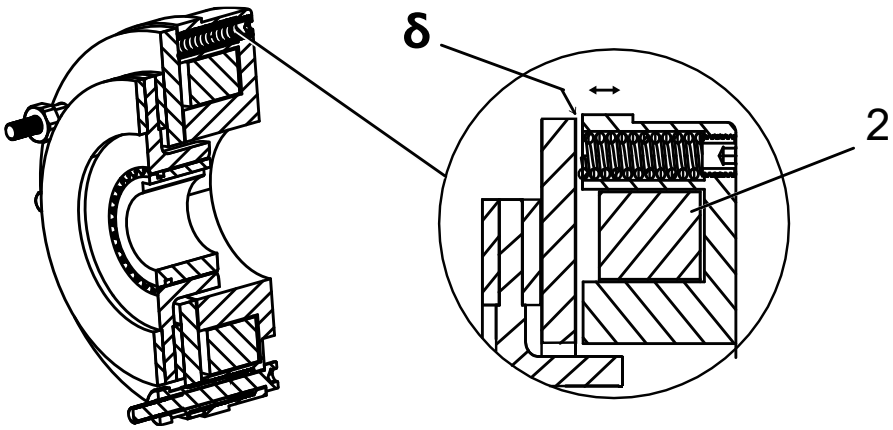


Fig. 6-17 Adjust the air gap

Ensure that there are no sundries (for example: concrete, sand, or grease) in the electromagnetism brake.

6.5.2.3 Adjust the air gap of the trolley travel gear brake

Ensure the main motor and brake are power-off!

The normal working air gap of the brake is 0.6mm, maximum gap is 1.2mm. If check out the brake is not working or the air gap over the maximum gap value the brake need to adjust.

1) See Fig. 6-18 loosen the retaining bolts ① and remove the fan cover ②;
2) See Fig. 6-18 loosen the installing screw ③ and then adjust the hollow nut ④ to the proper position until the gap value is 0.6mm, and then tighten screw ③.

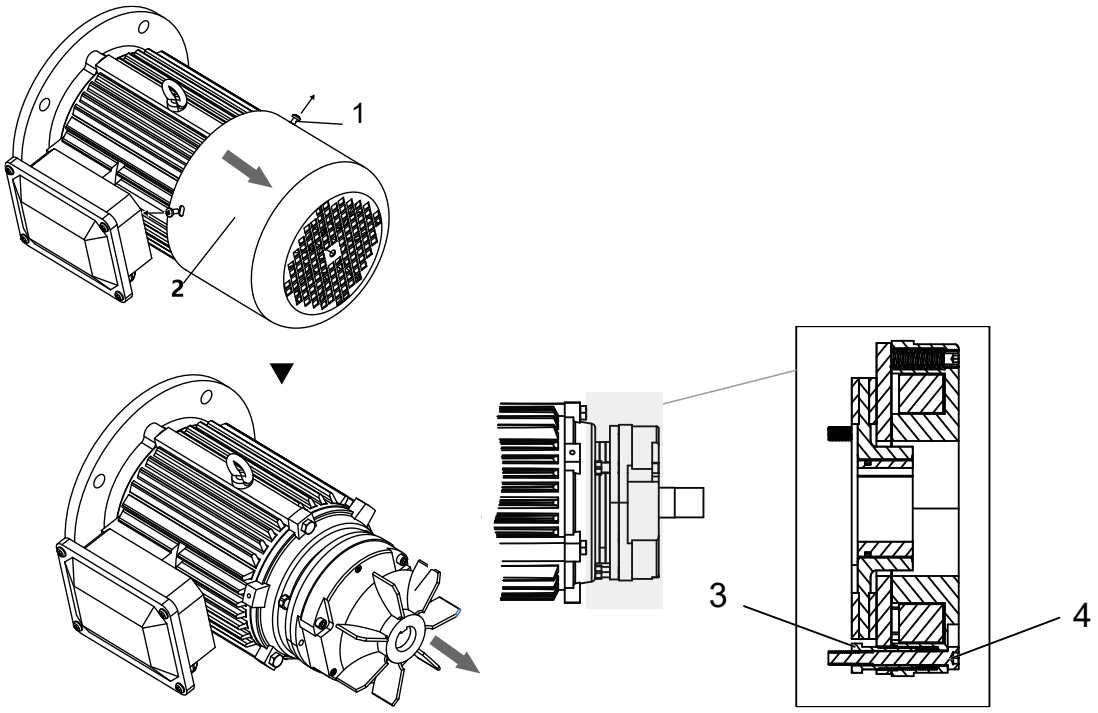


Fig. 6-18

3) See Fig. 6-19, install the fan cover ② and tighten the retaining bolts ①.

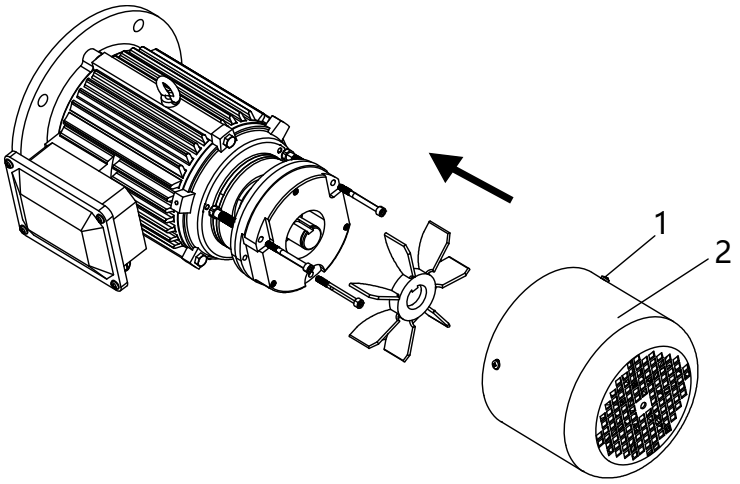


Fig. 6-19

If the air gap is not appropriate, repeat the step 2 and adjust it to 0.6 mm, it should be consistent in all directions.

6.5.2.4 Replace the brake friction plate

When single side of friction plate wear close to the metal end brake disk about 2mm, must replace friction plate. Make sure the motor and brake at the blackout state, step as following:

- See Fig. 6-20a, loosen the retaining bolts ① and remove the fan cover ②;
- See Fig. 6-20b, loosen the fixing screws ⑤, and remove the brake ⑥.
- See Fig. 6-20c, Remove the Retainer ring⑦, pull out of the brake disk and the splinted sleeve⑧

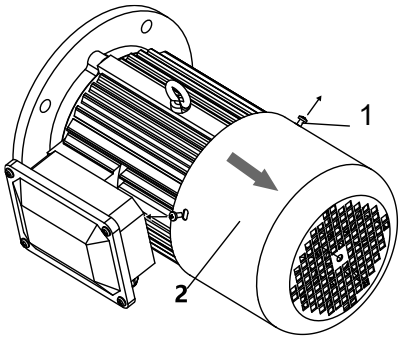


Fig. 6-20a

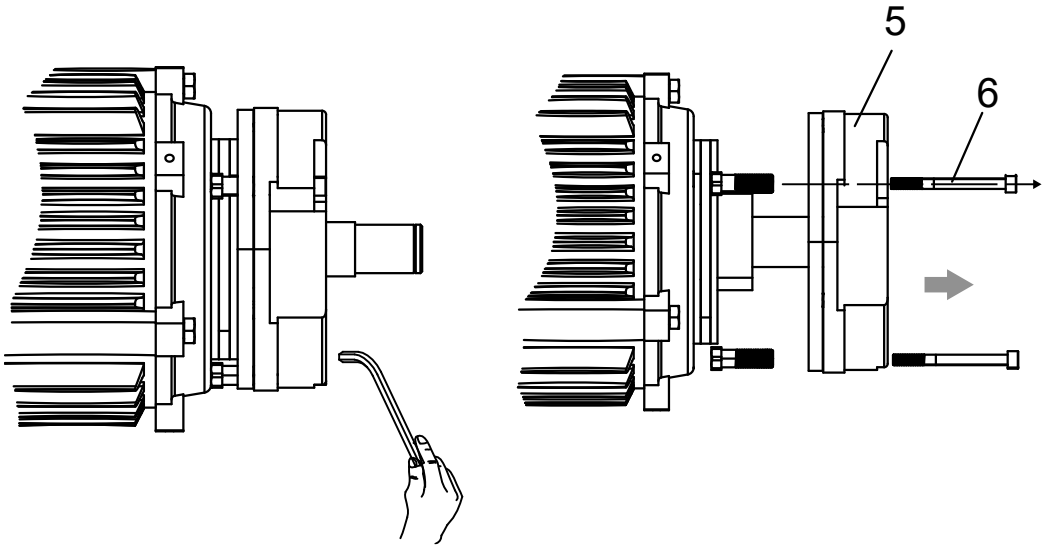


Fig. 6-20b

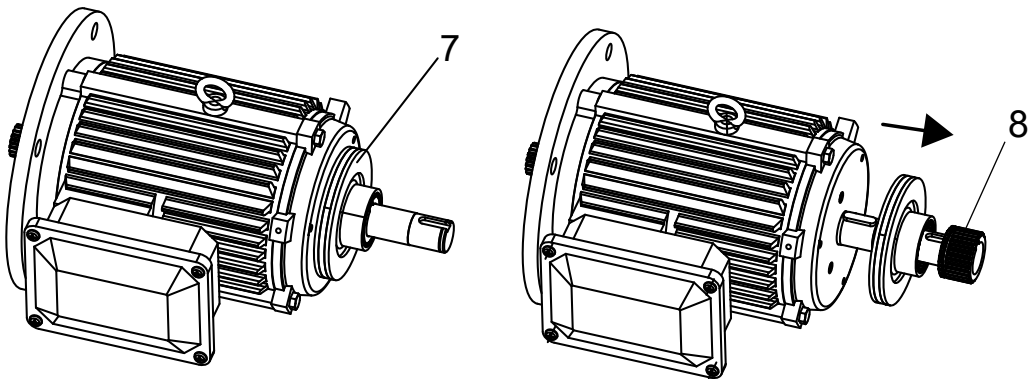


Fig. 6-20c

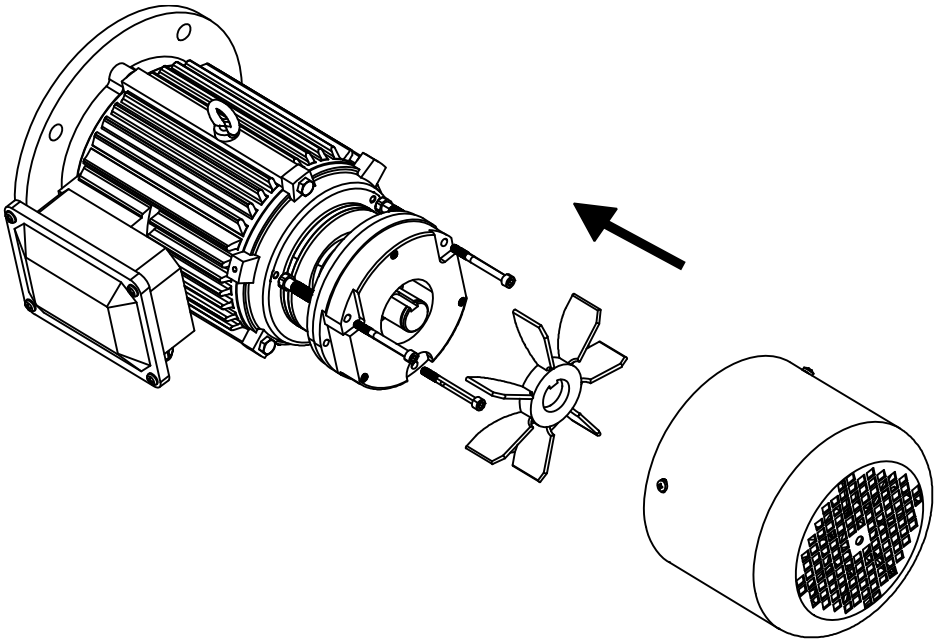


Fig. 6-20 Replace friction plate

- install new brake disk and splinted sleeve and fit the Retainer ring;
- install the brake and the mounting bolts (adjust the air gap according to *Section 6.5.2.3*)
- install the fan cover and tighten the retaining bolts.

6.5.3 Maintenance of trolley reducer

6.5.3.1 Maintenance period

Refer to the ***Section 6.4.4***.

6.5.3.2 Adding oil

The structure of the reducer is shown in the figure below.

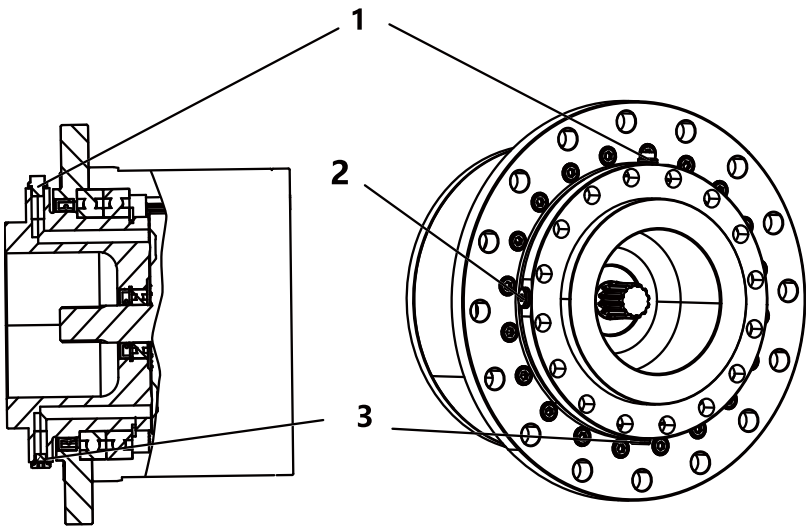


Fig. 6-21 Structure of the trolley mechanism reducer

(1) Oil hole (2) Oil hole

(3) Oil hole (connecting to oil output tube)

Oil adding steps:

a) Change the oil plug of hole (2) to a vent cap, prepare the specified oil (it is forbidden to mix different lubricants with each other)

b) Open the vent cap of the oil plug first, and then the oil plug of hole, expel all the waste oil inside, then insert the oil plug;

c) Open the oil plugs of hole (1) and (2), add oil to the reducer according to Table 6-1;

d) Tighten the oil plugs of hole and vent cap, ensure water can't get in the holes.

Table 6-10 Reducer fuel reference value

Reducer model	Oil model	Reference fuel
XX2-15.43	Fully synthetic gear lubrication oil 4408 (IOS viscosity 320)	0.28L(0.25kg)

(1) Ensure the gear oil has cool down to the surrounding temperature before adding or replacing oil, otherwise the operator can be scalded.

*(2) The lock plug of trolley reducer refers **Table 6-3**.*

(3) The rubber slice in the reducer vent cap shall be remove after install mechanism.

6.5.4 Maintenance of trolley motor

6.5.4.1 The storage of motor

- The motor should be stored in dry and ventilative places and covered by waterproof cloth. Keep the motor clean, and no droplet, greasy dirt, dust or erosion gas could be get into it. Clean the inside and outside of the motor regularly.
- As for motors that have been stored for more than one year, clean the inside of it and dry the inner water. Daub clean antirust oil on the bearings, all the matching surfaces and fasteners with thread(except for grounded bolt).
- The covers, covers of connecting box and unused outlets on the end cover should be covered soundly to avoid water, dust, oil or grease getting into the motor. Watch out for mouse.

6.5.4.2 Maintenance for motor before reusing

- As for motors that have been stored for more than one year, check whether there is rust in bearings and the location of bearings. If rust exist, exchange bearings immediately. Clean and refuel the bearings before restarting to avoid damages or noise caused by dried grease.
- Check whether the assemble is integrated, or whether the fasteners are tight. If there are dust or foreign materials inside, please clean up and use dry compressed air when necessary.
- If the mechanism is left unused for a long time, the exposed parts of the motor should be kept dust-free and dry. When it is to use again, perform mechanical check before installation. Check whether the assemble is integrated, or whether the fasteners are tight. If there are dust or foreign materials inside, please clean up and use dry compressed air when necessary. Measuring the insulation resistance between stator winding and shell with 500V Megohmmeter before using. When the figure is less than 0.5 megohm, the motor should be withered and the drying treatment could be performed by bubbling low pressure air into the winding (the temperature should not be more than 125℃). To avoid motor rusty, it is recommended to daub anticorrosive oil on the matching surface and fasteners with thread(except for grounding bolts) during installing. Also, all the fasteners should be with spring washer to avoid automatic relaxation. After installation, turn the rotor manually and it could rotate freely with no friction.
- After installation, check whether the brake could close firmly or release. After energizing, the rotor of the motor could be rotated elastically by hand.
- When install gear or coupling, clear the rust on the shaft first. Heavy strike should be forbidden to avoid damages to the bearings
- The connection box is equipped with grounding bolts which should be grounded reliably after installation.
- The method of connection of motor should be exactly the same with the requirements offered in this technical file, or abnormal operation or even overburn will occur.
- After installation of motor, it should run 30~40 minutes without load. If the condition is well, then add load and watch out for the stability of power. When deviation between the voltage of power(the frequency is rated) and rated voltage is no more than ± 5%; or positive deviation occurs both for voltage and frequency and the sum total of them is no more than

6%; or negative deviation occurs both for voltage and frequency or one is positive and the other is negative, and the total sum of them of absolute value is no more than 5%, the motor is allowed to operate in rated condition.

6.6 Slewing mechanism

6.6.1 Overview

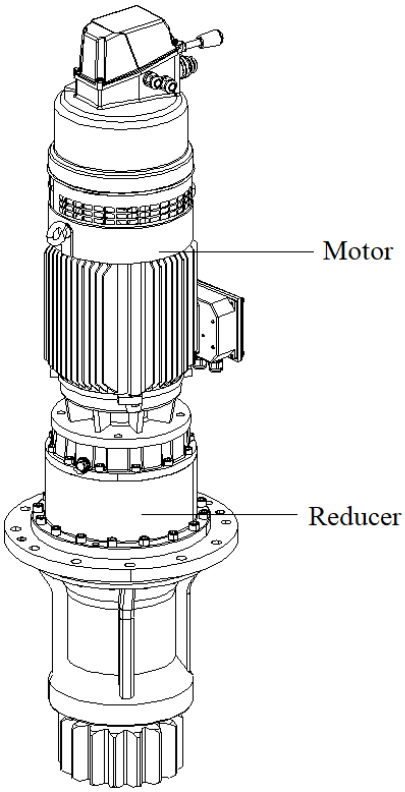


Fig. 6-22 Sketch of slewing mechanism structure

Motor connects to reducer spline. Reducer flange install on the turntable, reducer output gear driven the slewing ring. The layout of slewing mechanism depends on the model, with single or double slewing, etc.

The braking model of the slewing mechanism is normally closed braking with weathervane. The motor and reducer of slewing mechanism should be checked and lubricated regularly according to the requirements of the ***Section 6.1*** and the ***Section 6.3***.

6.6.2 Slewing brake

Slewing motor brake configure with weathervane which consist of brake and electrical weathervane; The brake can be released electrically or manual by electric weathervane. The moment of brake is **40**N·m.

Slewing brake can be divided into two type of structural arrangement. The follow-up will respectively describe the clearance adjustment and maintenance of the two kinds of brakes.

6.6.2.1 Working principle

The slewing brake is an electromagnetic brake, which will be applied once the power supply is cut off. See Fig. 6-23

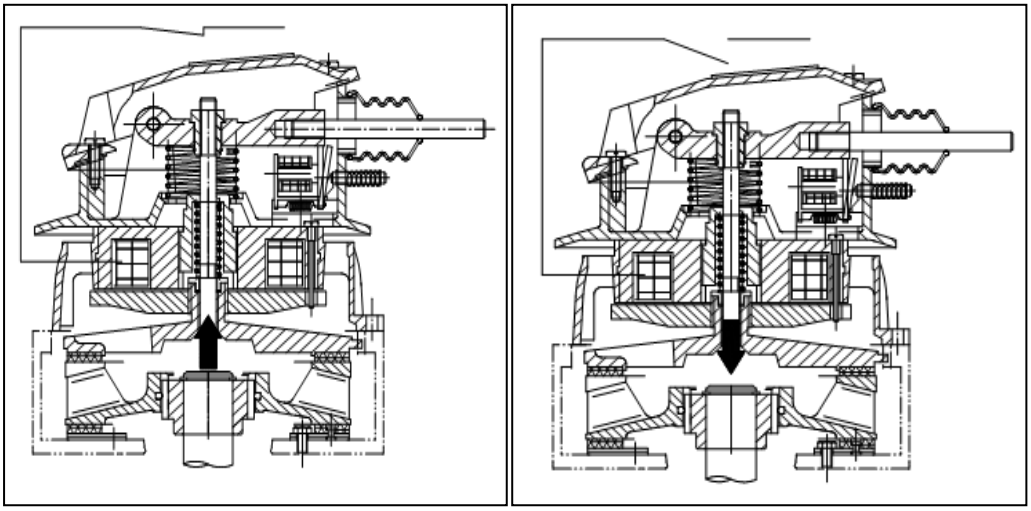


Fig. 6-23a Brake released Fig. 6-23b Brake applied

Fig. 6-23 Working state of brake

6.6.2.2 Electric release and Manual release

- Electric release:

First, the brake excitation iron core is fed with specified DC current, and then the weathervane electromagnet is fed with specified DC current, and then the weathervane armature is close., and then the DC current of the brake electromagnet should be disconnected. At this time, the armature of the weathervane supports the weathervane release rod, so that the friction disc connected by the release screw and the weathervane release rod cannot move towards the brake disc, the brake disc is in the release state. Finally, the DC current of the weathervane electromagnet should be disconnected in time. At this point, the electric release of the brake is completed.

- Manual release of vane Brake:

First move the electric weathervane release handle to the tail of the motor, then push the weathervane push handle inward to make the armature hold the weathervane release lever, and finally release the weathervane push handle, to achieve the manual release function of the weathervane brake

6.6.2.3 Clearance adjustment and maintenance (1)

For conventional brake structure see Fig. 6-24, brake friction plate (13) after long-term use of friction losses, armature (10) and field core (9) increase the air gap δ, brake spring (16) length increases, reduce the braking moment, because the air gap δ may increase at the same time, the armature (10) have difficult in actuation, serious will not be able to actuation, result the motor in braking state, and then the motor burnout. There before, it is necessary to check the air gap δ value frequently. When the static braking moment is less than the stipulate value or greater than 1.2mm, the δ should be adjusted in time. And if the friction plate (13) is worn to close to its steel mail, the friction plate (13) should be replaced in time.

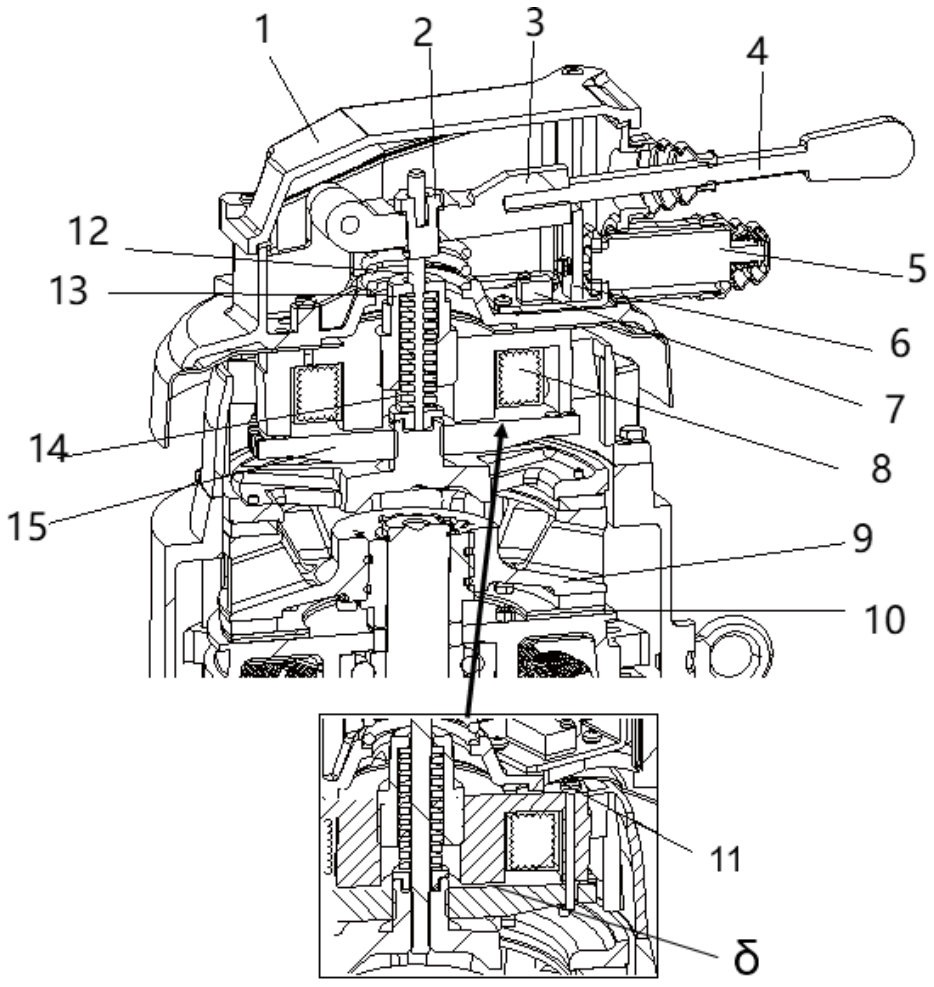


Fig. 6-24 Brake structure

(1)	Cover	(2)	Adjust nut
(3)	Release rod	(4)	Release handle
(5)	Push handle	(6)	Armature
(7)	Electromagnet	(8)	Field core
(9)	Friction disk	(10)	Friction piece
(11)	Locating screw	(12)	Release screw
(13)	Spring chamber	(14)	Braking spring
(15)	Armature		

■ Regular inspection

Regular inspection once a month, do not remove any parts, the braking opening, braking should be metal impact sound; When the motor is running, the brake should have no abnormal sound (friction, metal impact) and vibration.

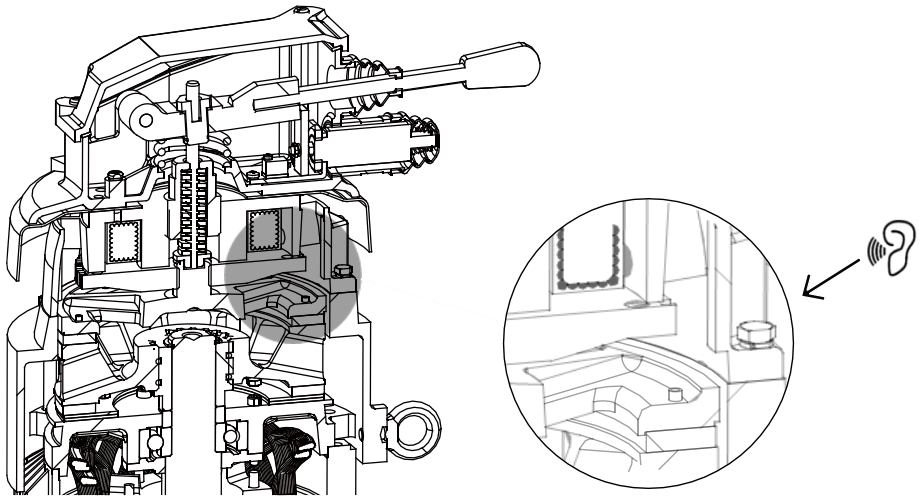


Fig. 6-25

■ Regular adjust

Once every 3 months, remove the weathervane cover. Flat mouth screwdriver loosens the positioning screw and counterclockwise moving armature pull cylindrical gear, let the armature against field core, to promote the positioning screw, make its end stick close with armature ends, at the same time with a flat mouth screwdriver clockwise slowly moving armature pull cylindrical gear, when the end of the armature fifth hole through the end of the positioning screw, insert and tighten the set screw on moving (the clearance values δ: 0. 75-~1.0m). When the brake is opened and braking, the action should be sensitive and there should be obvious metal impact. When the motor is running, the brake has no abnormal sound (rubbing sound, metal impact sound) and action. See Fig. behind.

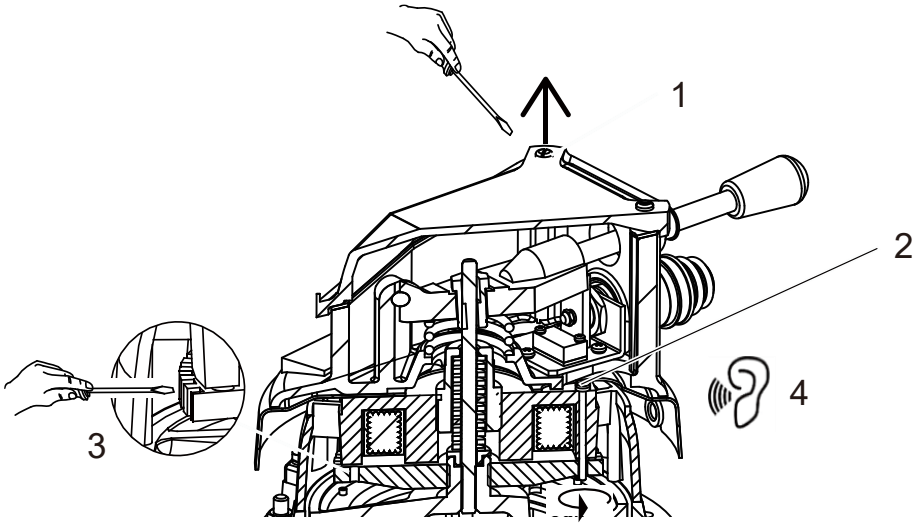


Fig. 6-26

■ Regular dismantling and check

Once every 6 months, remove the whole lower vane brake and check the friction plate (13). When its thickness (a) is less than 3mm, the friction plate must be replaced. Install the whole windward marker brake, and adjust the clearance δ value according to the regular debugging requirements. See Fig. behind.

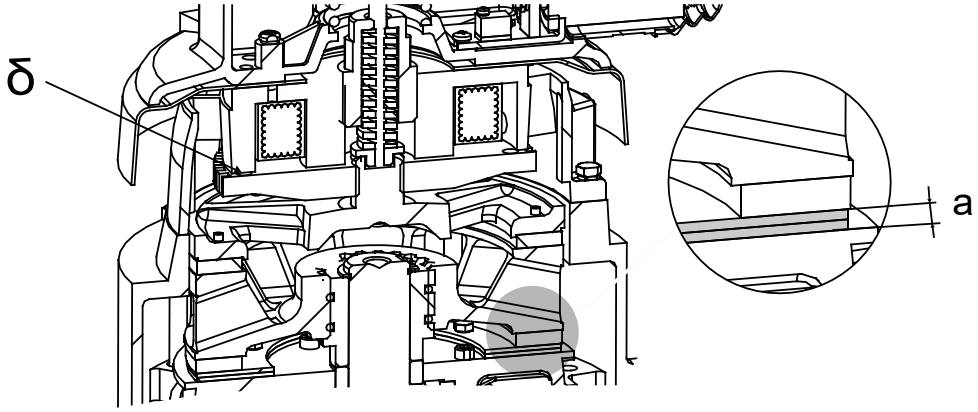


Fig. 6-27

■ Replace Steps of brake friction disk

1) Put the tower crane in the safe state, ensure will not happen any accident when Dismantling motor operation, otherwise the following operations were prohibit!
2) Cut off all power;
3) Dismantling electrical weather vane;
4) Unscrew locating screw (8);
5) Unscrew the spring chamber (15), take out the brake spring (16), unscrew the mounting screw of the exciting iron core (9), carefully remove the exciting iron core (pay attention to protecting the exciting iron core lead), remove the friction disc (11) and brake disc (12), and check the friction disk mounted on the cover frame (14) and the friction disk respectively. The friction plate on (11) if the friction plate is seriously worn, it should be replaced immediately (13), remove the worn friction plate (13) and install a new;
6) Remove the worn friction plate and install a new one;
7) Reinstall the removed parts in the reverse order, and adjust the brake gap δ according to the second (regular debugging), and adjust the electric weathervane according to the fifth (adjustment steps of the electric weathervane).

■ Adjustment steps of electric weathervane

1) Disconnect all power supplies, and adjust the brake gap δ according to the second (regular debugging);
2) Put the motor under braking state (weathervane release lever (3) can move downwards freely);
3) Hold down the weathervane release handle (4), and slightly loosen the adjusting nut (2) in a counterclockwise direction, so that the weathervane armature (5) emerges about 1mm below the weathervane release lever (3);

4) Release the electric weathervane by sounding to see if the action is normal. If the weathervane armature (5) is blocked from free movement under the weathervane release lever (3), the adjusting nut (2) should be loosened again at this time, if the weathervane armature (5) If the weathervane release lever (3) cannot be supported, the adjusting nut (2) should be properly tightened;
5) Manual and electric release several times, and then close the weathervane cover after the action is normal.

- *Check whether the weathervane is working properly, and readjust if necessary. When the gap value is greater than 1.2mm, the gap value should be adjusted in time, and the recommended gap value is about 0.8mm;*
- *When the thickness of the friction plate is less than 3mm, the friction plate should be replaced in time;*
- *The adjusted electromagnetic brake and electric weathervane should be checked if the manual release function, electric release function and braking function are normal, and they can be put into use after being normal.*
- *The electromagnet of the electric weathervane cannot be energized for a long time, otherwise it will burn the electric weathervane electromagnet.*
- *When the motor is working normally. The electric release action of the electric weathervane cannot be used, otherwise it will cause the motor brake to work abnormally, which will affect the safety of the tower crane in severe cases.*

6.6.2.4 Clearance adjustment and maintenance (2)

Lay out of new designed slewing motor as shown the following Fig. 6-28.

Adjustment steps of electromagnetic brake

After long-term use and wear of the brake friction plate, the gap between the armature and the excitation magnet core increases, the length of the brake spring increases, and the braking torque is reduced. At the same time, due to the enlarged gap, it is difficult for the armature to pull in. In severe cases, it cannot be pulled in, causing the motor to be in a braking state, and even the motor is burned out. When the static braking torque is less than the specified value or the gap is greater than 1.5mm, it should be adjusted in time. When the thickness of one side of the integral friction disc is less than 1.5mm, it should be replaced in time.

The adjustment steps of electromagnetic brake gap can be divided into: adjust the gap between static core and moving plate; adjust the gap between bottom plate of loose brake and contact plate.

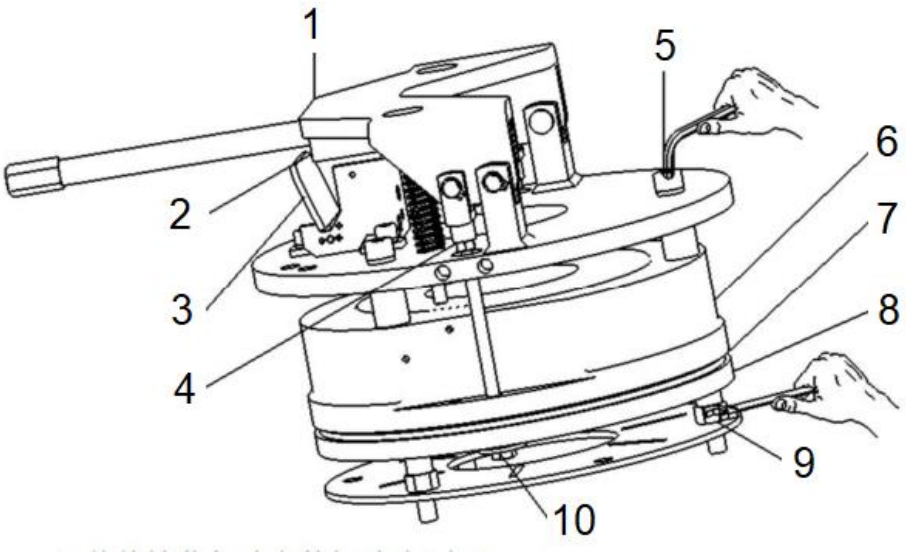


Fig. 6-28 Adjust electromagnetic brake gap

(1)	Release brake bottom plate	(2)	Gap 2
(3)	Contact plate	(4)	Nut
(5)	Screw 1	(6)	Static core
(7)	Gap 1	(8)	Moving plate
(9)	Adjusting bolt	(10)	Screw 2

■ Adjust the gap between the static core and the moving plate

- Put the tower crane in a safe state to ensure that the motor is operated on the premise that no safety accident occurs during disassembly. Otherwise, the following operations are prohibited;
- Disconnect all power supplies;
- Insert the 0.7mm feeler gauge (4) into gap 1, tighten the screw 1. When the feeler gauge is clamped, stop screwing the screw 1; See Fig. behind.

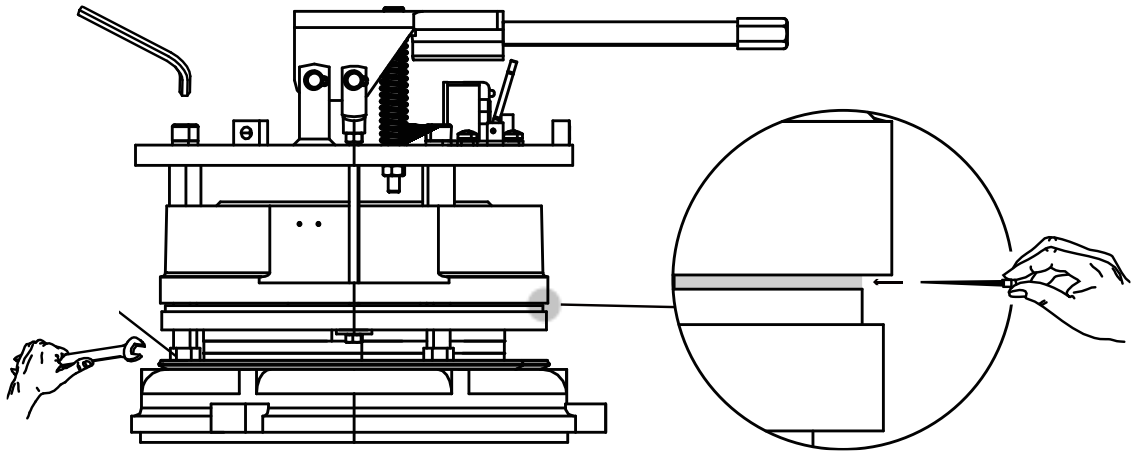


Fig. 6-29

- Turn the adjusting bolt to the left, stop turning the adjusting bolt when the feeler gauge can be easily taken out, and then tighten the screw 1 completely;
- When the feeler gauge is pulled out, there is a sense of blockage and the gap meets the requirements. If the gap is too large, loosen the screw and adjust the bolt. Fine-tune to the right, and then fully tighten the screw 1. On the contrary, if the gap is too small, fine-tune the adjusting bolt to the right;
- Repeat the above steps to adjust the front of the remaining 2 screws.

■ Adjust the gap between the brake release bottom plate and the contact plate

After power on, the contact plate is attracted and the contact plate is in a vertical state. The gap (1) between the upper surface of the contact plate and the lower surface of the loose gate is 0.3~0.5mm. When adjusting the gap, first screw down the nut on the screw 2. When the gap is too large, screw the screw 2 upwards, and when the gap is too small, screw the screw 2 downwards until the gap meets the requirements, and then tighten the nut. See Fig. behind.

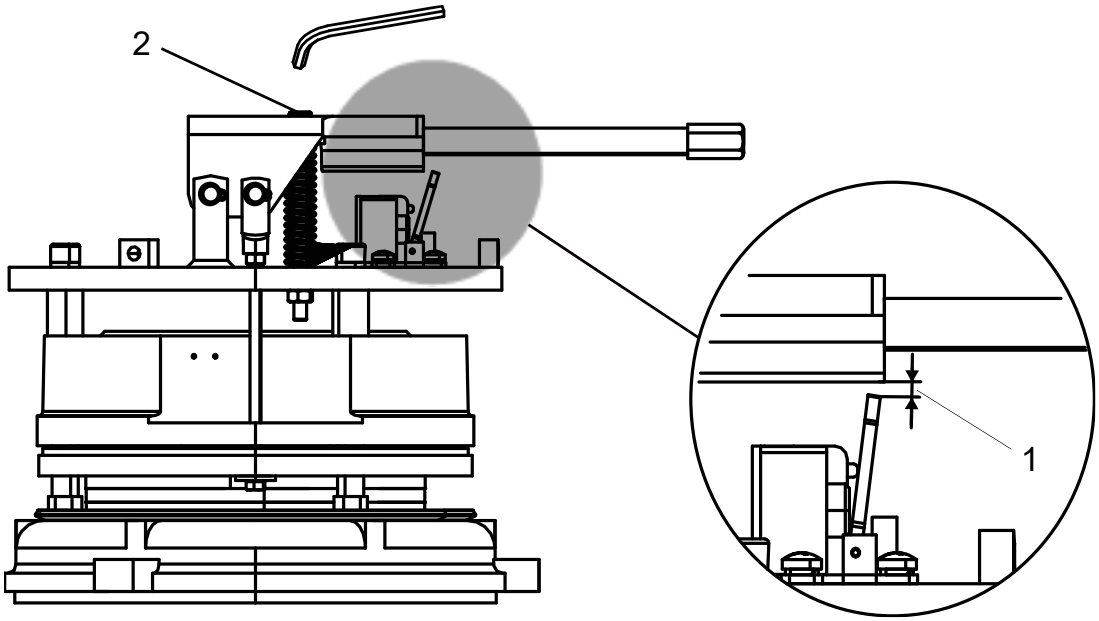


Fig. 6-30

- Replacement of the integral friction disc

➢ The overall friction disc should be replaced by a professionally trained person, otherwise it is easy to cause other damage;

➢ Put the tower crane in a safe state to ensure that the motor is disassembled without any safety accidents. One step operation, otherwise, the next operation is prohibited;

➢ Disconnect all power;

➢ Remove the weathervane and brake connecting wire;

➢ Remove the parts at the rear end of the integral friction disc one by one (the entire weathervane brake);

➢ Replace with a new integral friction disc of the same specification;

➢ Install the disassembled parts one by one, and adjust the brake according to the same clearance adjustment procedure of the electromagnetic brake.

After adjusting the brake and electric weathervane, check whether their braking, manual release and electric release functions are normal. After everything is normal, the motor can be put into use.

6.6.3 Maintenance for slewing ring

- The rolling groove of the slewing ring has been filled with 2# extreme pressure lithium base grease when leaves the factory. Add the grease once every 100 hours of operation, Addition of lithium base grease, should make the slewing mechanism rotated slowly, while rotation, while the oil, the grease filling evenly, until the seal a grease extrusion, said the old fat has been replaced by. Special working environment, such as rain, humidity, dust, temperature variation and continuous operation, it should shorten the lubrication cycle;
- After long time idle, enough new grease must be added to slewing ring;
- Exposure of tooth surface and tooth surface, often should clean the rubbish, and coated with grease corresponding;
- Slewing bearing the first 100 hours of operation, should check the retightening force of bolt. After examining every 500 hours of operation time, must keep enough preload force;
- The use of the process, if found, the impact of noise, power increases suddenly, should immediately stop check, troubleshooting, remove check when necessary;
- Never use water directly scour slewing bearing the use of the process, to water entering the race;
- To prevent the hard foreign body close to or into the meshing area;
- Always check the seal intact, if it is found that the sealing strip damaged should be replaced promptly, if found off should be timely reset.

6.7 Maintenance climbing mechanism

6.7.1 Working principle

The climbing hydraulic system consists of pump station, climbing cylinder and high-pressure hose. It can jack or lower the upper parts of the telescopic cage, and stop at any position for mounting or dismounting tower mast sand tower sections. Refer to the figure below:

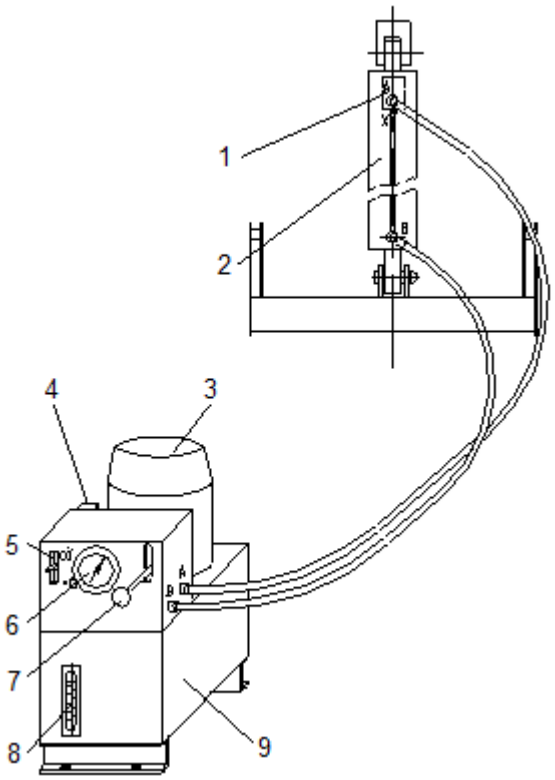


Fig. 6-31 Schematic diagram of tubes connecting of the Hydraulic system

(1) Balance valve
(2) Climbing cylinder
(3) Motor
(4) Terminal box
(5) Air switch
(6) Pressure gage
(7) Control handle
(8) Liquid level meter
(9) Pump station

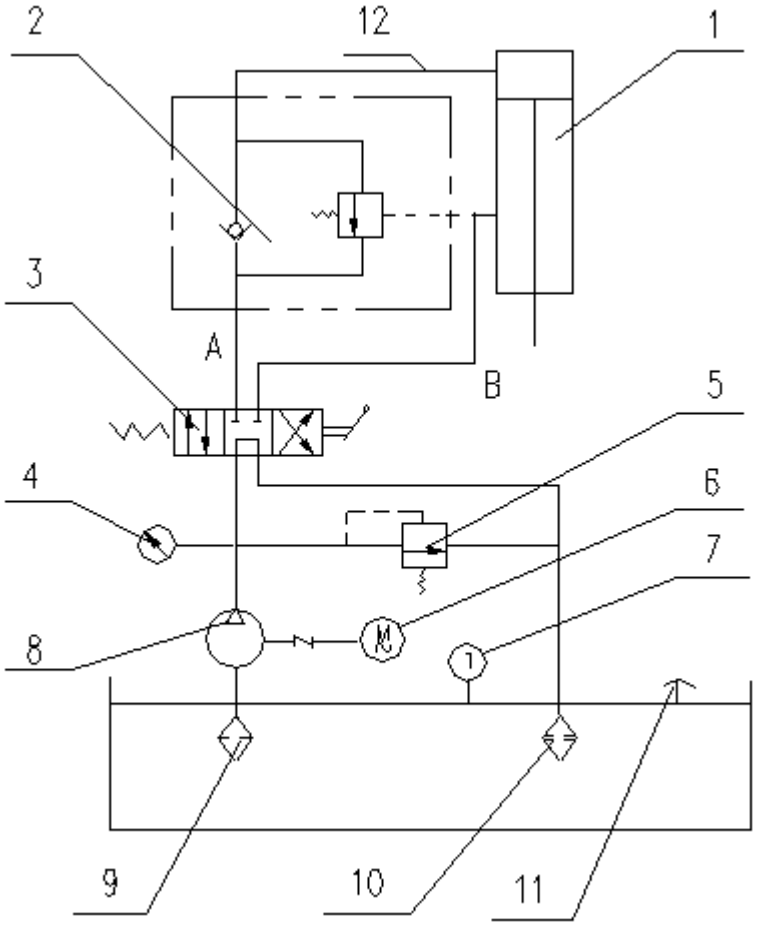


Fig. 6-32 Schematic diagram of hydraulic system

(1)	Pump station	(2)	Balance valve
(3)	Manual control valve	(4)	Pressure gauge
(5)	High pressure overflow valve	(6)	Motor
(7)	Level meter	(8)	Level meter
(9)	Oil filter	(10)	Fine oil filter
(11)	Air filter	(12)	Tube

6.7.2 Erection, operation, and maintenance of the hydraulic pressure system

6.7.2.1 Erection, operation of the hydraulic pressure system

- Oil cleaning

Screw open oil suction screen 11, fill 10μ hydraulic oil filtered by hand-held oil filter into the oil tank up to the upper limit mark. After that, start the oil pump motor (look down at the motor blades to see if the rotation direction is the same as that marked at the motor tail)

Pay attention to the fact that the pump may be rotated either left or right. Wrong wiring will cause no system working and pump burn-down.

- Connect high-pressure hose openings for clean status

Connect ports A.B of the hydraulic pump station to the hydraulic cylinders through high-pressure hose. Screw down the connectors.

- Air exhausting of the system

Unscrew the handle of overflow valve, and then the high-pressure hose-to-port A connector. Move the handle of hand-operated valve 3 to its up position. Start the motor to drive the air out of Port A until the pump noise has become normal and no foam formation from oil liquid. Make the cylinder into no-load status. Push the operating handle to let upper cylinder or piston rod move up and down at full strokes for several times to completely exhaust the air from cylinder into oil tank through oil hose.

When the piston rod has moved to its extreme position, pull back the handle immediately to its middle position and keep this position for several minutes until air bubbles in oil tank have disappeared, and then carry out another action.

- System operation

Before system operation, check if the oil cylinder is well connected to the crane frame, including the check of relevant portions of the tower crane for meeting relevant technical requirements:

1) Maximum working pressure setting: Unscrew the locking nuts, in front of the control handle, of overflow valve 5 at non-climbing operation status. Start motor 6. Move the operating handle to upper position and extend the cylinder piston rod to its extreme position. At this time, pressure gauge 4 readings rise. Keep on screwing down the handle of the overflow valve until the readings on pressure gauge 4 have become stable at 31.5 Mpa. Screw down the locking nut in front of the regulating handle of the high-pressure overflow valve (The overflow valve shall not be adjusted by unauthorized or untrained person). Operate the handle in a reverse direction to retract the piston rod. Finally move the handle back to its middle position.
2) Start motor, and move operating handle to its up position. Extrude the cylinder piston rod to hang the hanging plate connected to the piston rod into the lugs slot of the tower mast section. Carry out the climbing operation for new section adding (or tower section dismantling).

6.7.2.2 Maintenance and precautions for hydraulic system

The hydraulic system is super high-pressure or high-pressure equipment. The whole process from oil filling to adjustment shall be accomplished strictly according to the stipulations in its operating instructions.

- Hydraulic oil for the system
  - Anti-wear hydraulic oil L-HM 46 shall be used in the hydraulic system according to the regulations. Mixture other hydraulic oils or fill directly without filtering the oil are prohibited. When oil foaming or emulsification, should be timely cleaning mailbox replacement of new oil;
  - Filling oil: Fully fill the tank with oil for the first time. After start-up, extrude the cylinder rod, and then retract the cylinder rod. At this time, fill the tank with make-up oil up to the tank upper limit mark;
  - At this time, it is a high-pressure hydraulic system with strict requirements of highly cleaned oil, which should be filtered for 4~6 hours by hand-hold filter. The oil cleanness should reach 7~8 levels (NAS1638) before starting the system;
  - The oil should be completely changed after the system working for 2400h and add part of clean oil after working for 1 month;
- Shut the system when it is out of service because of the poor condition of ventilation;
- To avoid damage the components, the pump station should be protected well by rainproof shield when raining;
- Be careful when lifting and transporting. No charge and discharge rudely. Don’t put it in environment that can corrode metal and rubber.

6.7.2.3 Common troubles and troubleshooting

Table 6-11 The common troubles and methods of troubleshooting

No.	Trouble	Reason	Troubleshooting
1	Pump station outputs no pressure / Pressure can't be adjusted to rated value / Pressure is not stable	Motor rotates in wrong direction	Commutate the motor line
		Oil relief valve get stuck by impurity in unclean oil	Dismantle main valve and clean it
		Hose had ruptured and spill oil	Dismantle the hose, weld the crack or replace it
		Hose joint is loose	Tighten the joint
		Seal of joint is broken	Replace the broken seal
		Coarse oil filter is blocked	Clean it
		Pump is broken for overloading	Replace the pump
2	Motor don't revolve after power source is connected	Joint at line terminal and circuit breaker has loosened	Check the line, connect it according to the schematic circuit diagram
		Circuit breaker automatically tripped or burned because of overloading or short circuit	Check the contact and breaker, repair or replace it

- *Never let the cylinder's balance valve and the pipeline be crashed, check that if the clamping screw of the balance valve is loose when change place and set up the tower, to avoid the danger!*
- *The O-ring between the balance valve and cylinder should be change once two year!*
- *Don't adjust the pressure of the pump station when the cylinder on the work, only in the condition that the piston rod of the cylinder retract or extend!*
- *When the piston rod retracts completely, the pressure lever of the oil tank should reach the max lever position!*
- *To avoid safety accident, the climbing pumping station should not be used when natural wind over fourth lever!*
- *When power off and the pump out of work, adjust the balance valve clockwise to make the piston rod retract.*
- *If the pump station out of work for a long time, it must run for more than 30-minutes before use.*

6.8 Rope

6.8.1 Basic Knowledge of Rope

1) The structure of rope

Wire rope is a spiral structure, which made up of a certain number of a layer or layers of wire strands, see the figure below.

2) The lay of rope as the following figure

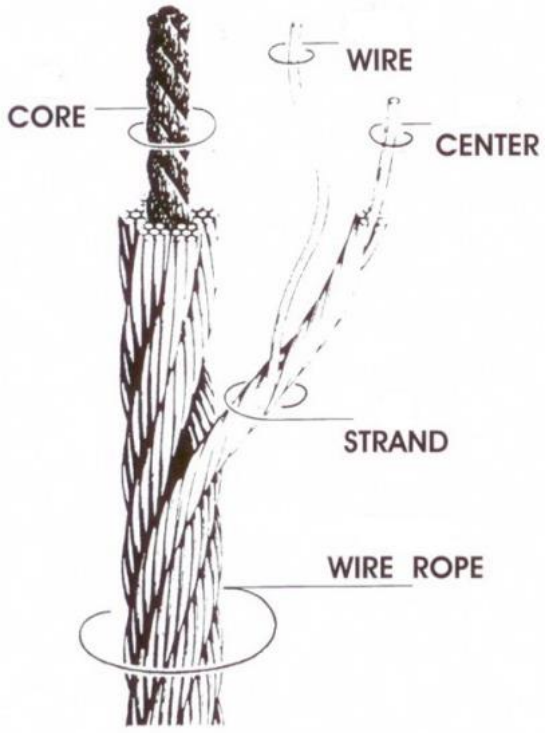


Fig. 6-33 The structure of Rope

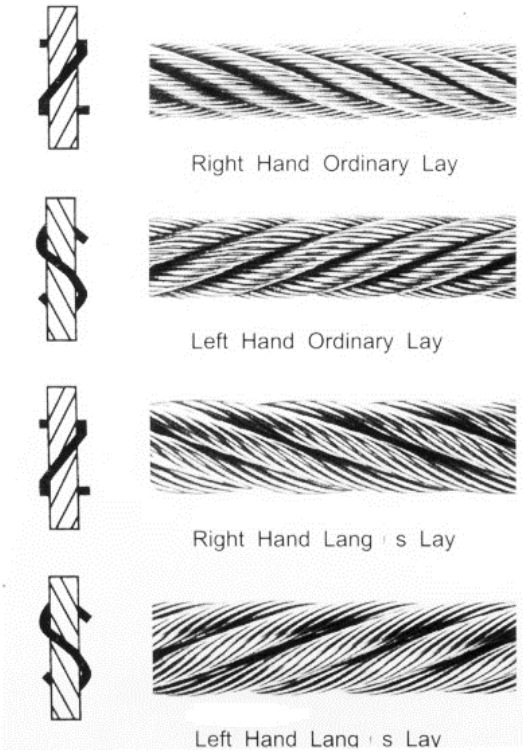


Fig. 6-34 The twist of Rope

3) Measuring the Diameter of Rope

Measure the diameter of the rope through correct method, see the figure below.

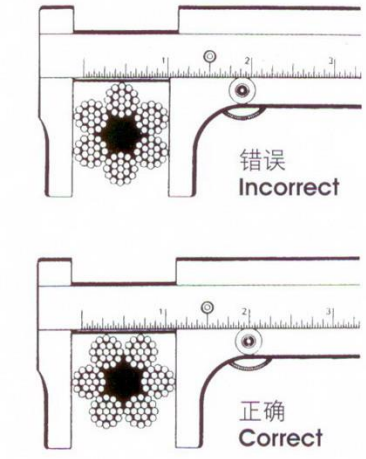


Fig. 6-35 Measuring the diameter of the rope

4) Discharge and Storage

To avoid the contingency, be careful when discharging the ropes. The wind should not go down. It is not allowable to insert the rope by metal hook or lifter fork, see the figure below.

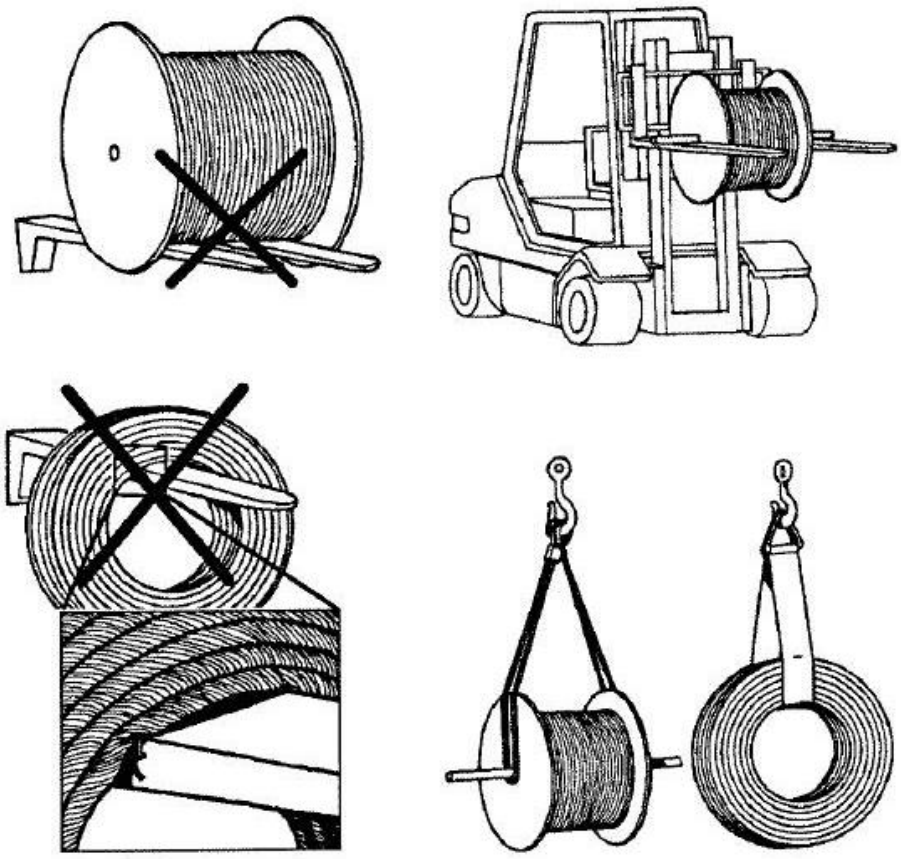


Fig. 6-36 Discharging the ropes

Ropes should be stored in the cool and dry warehouse and cannot be in contact with the ground. Ropes must not be stored in the location which is easy to be affected by chemistry fog, steam, or other corrosives. Check the stored ropes regularly, and if necessary, bind the ropes up. If outdoors storage cannot be avoided, cover the ropes to avoid the damp corroding the ropes, see the figure below.

Thoroughly clean the discharged from the crane. Bind every rope up before storing them. The ropes whose lengths exceed 30m should be stored on the wind.

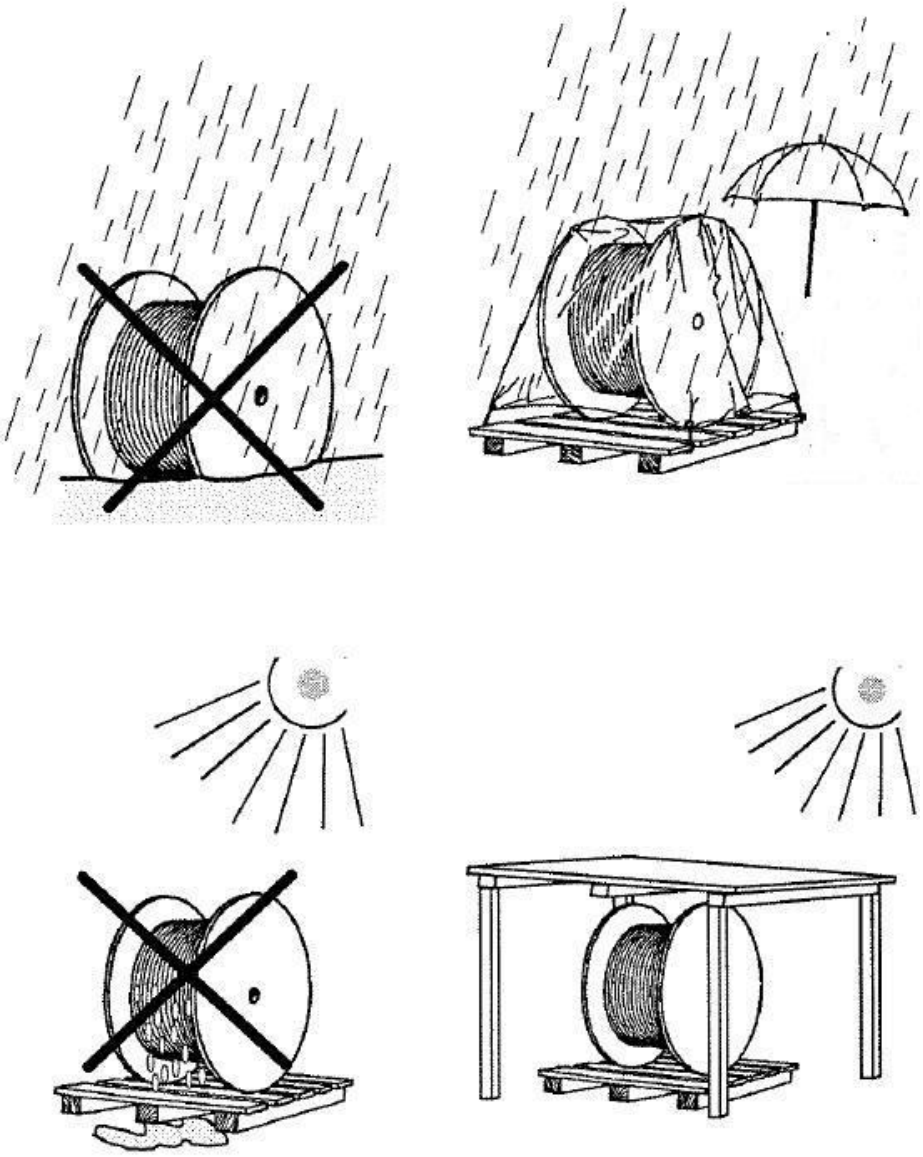


Fig. 6-37 The storage of the rope

5) Uniting the Rope

When uniting the rope, put the rope on specified bracket or reeve a steel tube through rope wind hole, hoist the two ends after being put rope sleeves and rotate the rope wind slowly, refer to the figure below.

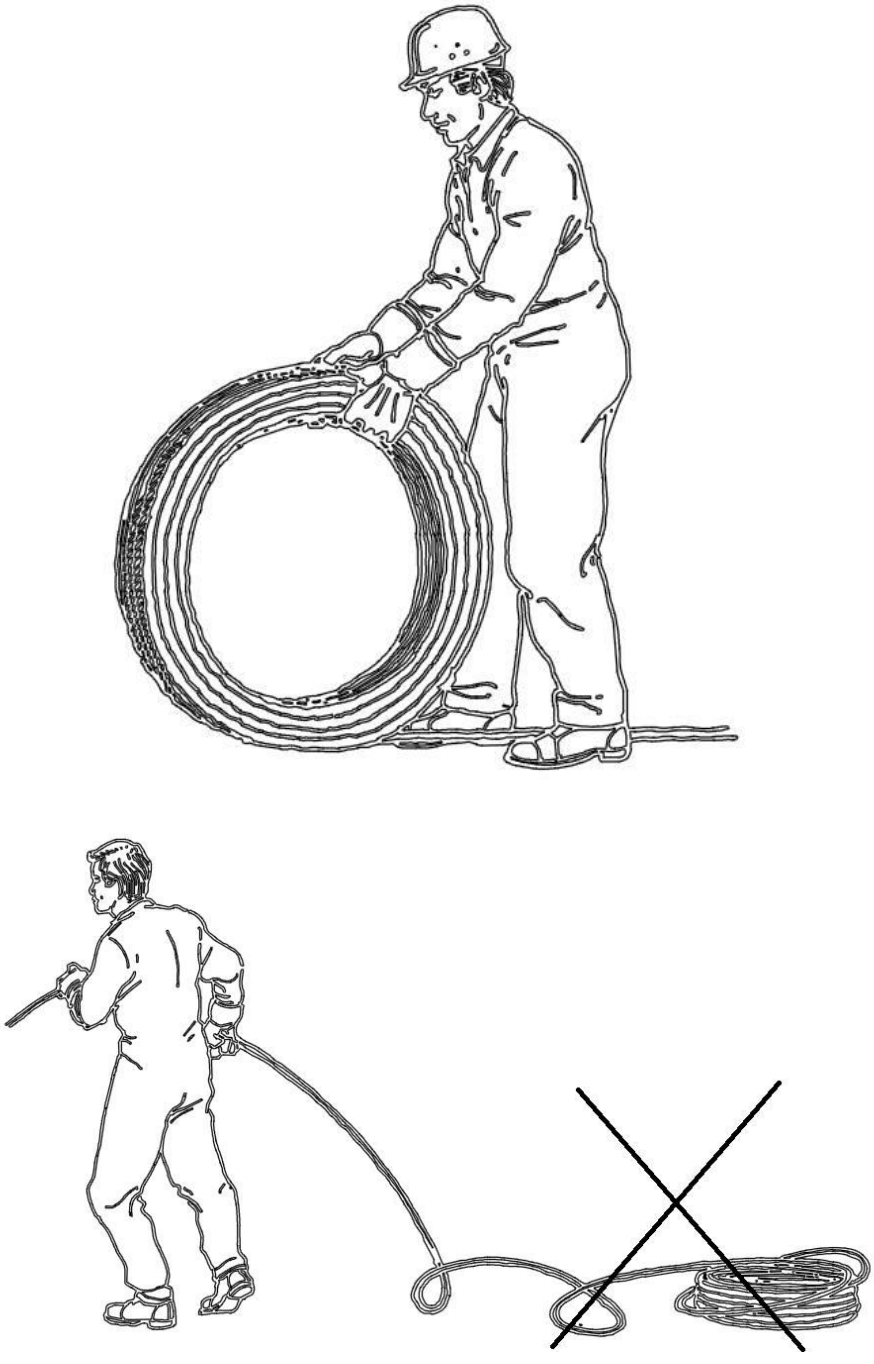
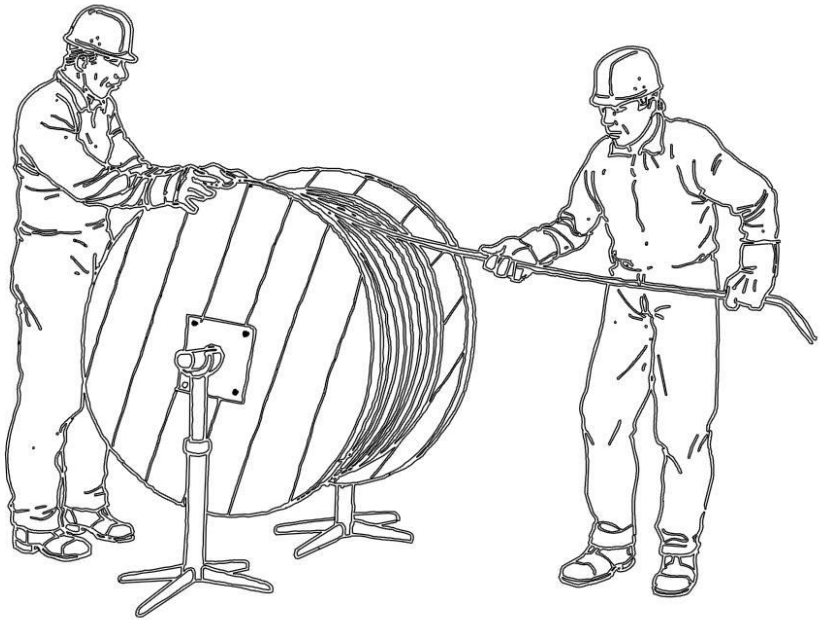
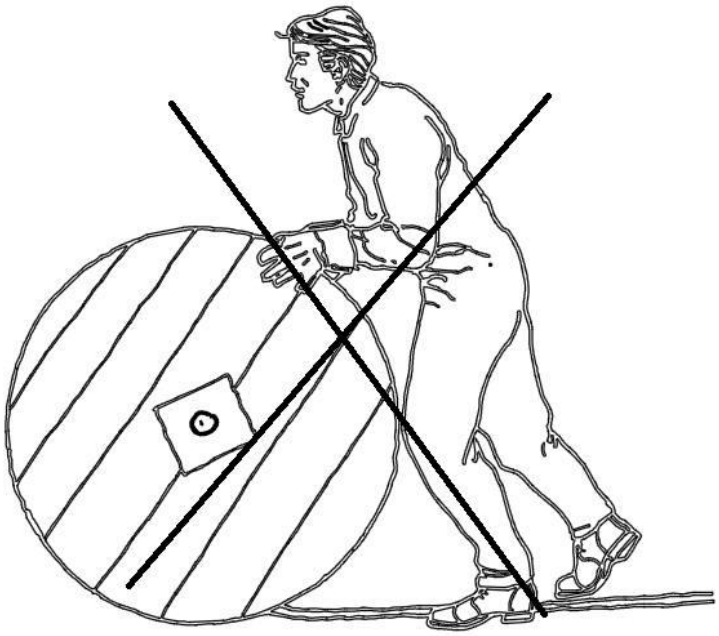


Fig. 6-38 Untiring rope from rope sheaf





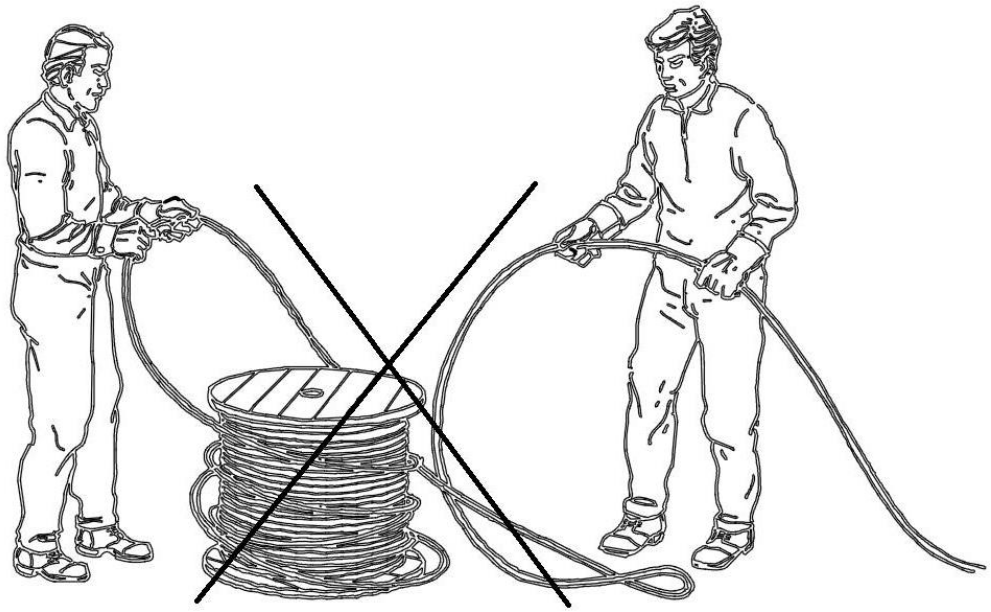


Fig. 6-39 Uniting rope from rope wind

6) Rope clamp

■ Arrangement of the rope clamps

The rope clamp must be buckled on the working rope line in such a way as is see the following figure. Buckle the U-shape rope clamp on the end of the rope.

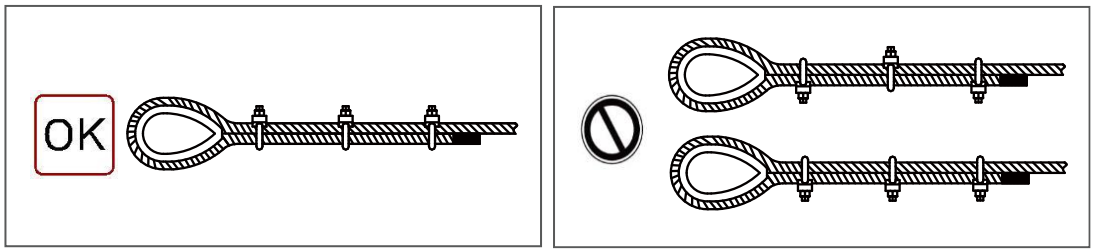


Fig. 6-40 Correct method to arrange the rope clamps

■ Number of rope clamps

For the situation according with the requirement of this standard, the minimum number of rope clamps needed by every connecting section is as indicated in the next table.

Table 6-12 The minimum number of rope clamps needed

Nominal dimension of rope clamp mm (nominal diameter of rope d)	≤19	>19~32	>32~38	>38~44	>44~60
The minimum number of the rope clamp (suit)	3	4	5	6	7

■ Interval between two rope clamps

As the figure below, the distance A between two rope clamps is about 6~7 times of the rope diameter.

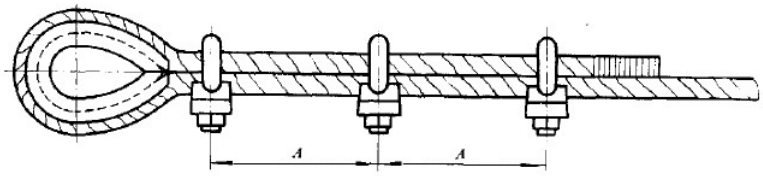


Fig. 6-41 Interval between two rope clamps

■ The fastening method of rope clamps

Considering every rope clamp can be forced reasonably when you fasten and fix the clamps, the farthest clamp should not be fastened and fixed firstly. The rope clamp abutting the rope ring (the first rope clamp) should be as close to the rope ring as possible, and the rope clamp shall be correctly tightened without damaging the outside layer of wires.

6.8.2 Rope List

Ropes for WA7025-10E are see the table below:

Table 6-13 Ropes for WA7025-10E

Designation	Specification	Diameter (mm)	Nominal length mass kg/m	Minimum braking force (kN)	Fixing method	Remark
Hoisting rope	35W×7-14-1870	Φ14	0.902	132	Pressing plate, wedge sleeve	The diameters of the selected ropes must meet the requirement listed in the table
Trolley rope	6×19-9.3-1700-Ⅱ-ZS	Φ9.3	0.3045	46.495	Rope clip	The minimum breaking force of the rope shall not be less than the value listed in the table

6.8.3 The length of the rope

The length of the selected rope must meet the use requirement of this tower crane. There must be three rounds of rope on the terminal location of the drum at least. According to the use condition, if it is needed to cut a section of rope from the long rope, the two ends need special handling or adopt proper method to avoid the rope loose during cutting off the rope, see the figure below.

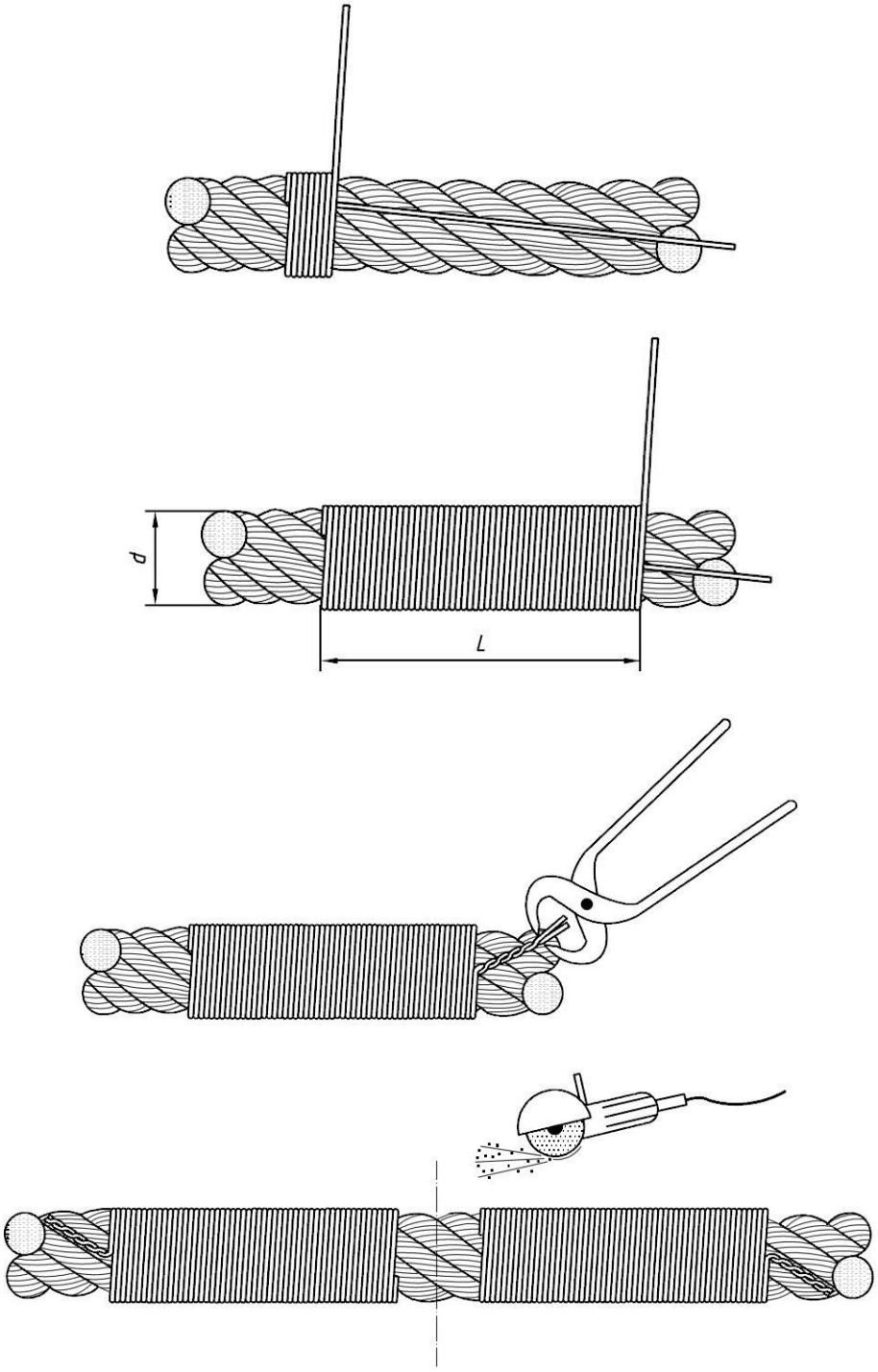


Fig. 6-42 Preparation for cutting off the rope (L≥2d)

6.8.3.1 Calculating the Length of the Hoisting rope

Total length required for hoisting rope

$$L = L0 + f \times H$$

L_0——The sum of the rope lengths of the hook on the max hoisting height, m; see the table below.

f——Falls used;

H——Hoisting height, m.

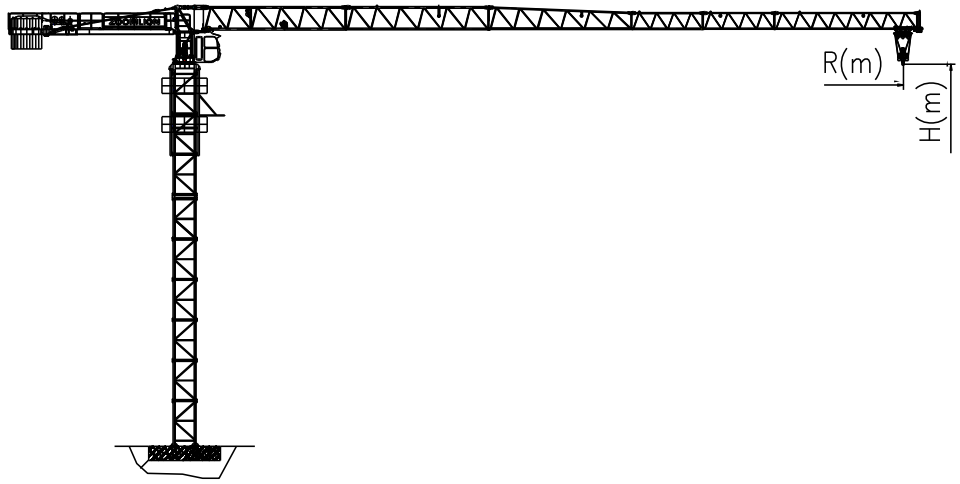


Fig. 6-43 Calculating the Length of the Hoisting rope

Table 6-14 The length of hoisting rope for different length jibs

Jib(m)	30	35	40	45	50	55	60	65	70
L0(m)	80	85	90	95	100	105	110	115	120

6.8.3.2 The Length of the Trolley Rope

The length of trolley rope is fixed as the jib changing, see the table below:

Table 6-15 The length of trolley rope for different length jibs

Jib lengths (m)	30	35	40	45	50	55	60	65	70
Rope Ⅰ Lengths (m)	60	70	80	90	100	110	120	130	140
Rope Ⅱ Lengths (m)	45	50	55	60	65	70	75	80	85

6.8.4 Installation of the Rope

The rope should not be disturbed during installation, when uncoiling the wire rope from a wind or coil, every precaution shall be taken to avoid the Tweaked or tightened kink, bends etc. of the rope.

During installation, the rope shall always bend in the same direction: i.e., pay out from the top of the wind to the top of the drum, or from the bottom of the wind to the bottom of the drum, see the figure below.

Care shall be taken to ensure that termination anchorages are made and secured in accordance with the instructions in the crane manual.

If the rope rubs against any part of the crane during installation, then the points of contact shall be suitably protected.

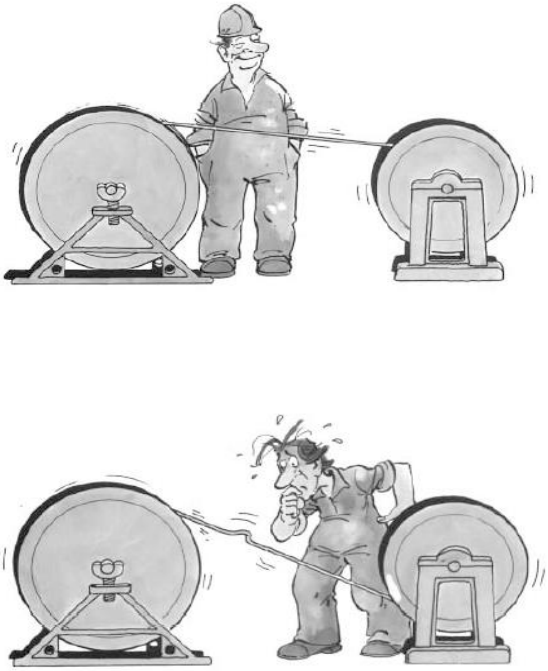


Fig. 6-44 The rope winding

Replacing steel rope of Tower crane should be carried out in accordance with the relevant chapters in the tower crane operation manual to correctly wear around, and make wire rope bend in the same direction as far as possible, otherwise will seriously affect the life of wire rope.

Wire rope should be installed at pre-tightening condition.

Before put into use wire rope on hoisting machinery, the user should ensure that all related to the wire rope work device is installed in place and working properly.

In order to make the steel wire rope stable in place, about 10% of the rated load shall be used to rope wheel system running operation for several times, in order to make wire rope can be accurate and stable in the system, more joint drum steel wire rope, the rope internal release, it is advantageous to the rope neatly, and effectively prevent the wire rope to disturb.

6.8.4.1 Fixing rope head

One end of rope connected drum; another end connected jib end anti-twist device.

- Fixed the rope and drum

The rope is connected to drum through a wedge sleeve. (See Fig 6-29a).

1) The feeding direction should be consistent with the vertical edge of the wedge sleeve and the drum feeding direction;
2) Wedge the wedge with a mallet or a copper rod;
3) The length of the outstretched wedge sleeve of the rope head is 65~78mm, and the length of the tighten rope head is 20~26mm or conical fuse.

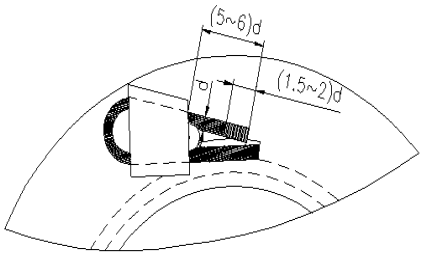


Fig. 6-45a The end of drum wedge connection

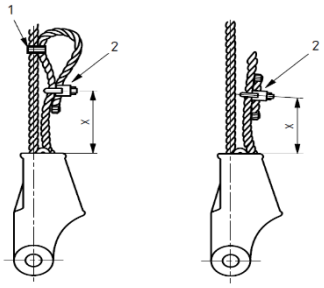


Fig. 6-45b The end of jib end wedge connection

Fig. 6-45 Connected wedge

- Fixed the rope and the jib end

The rope is connected to jib end anti-twist device through a wedge sleeve (see Fig. 6-45b)

1) The extension direction of the force rope should be threaded through the pinhole.
2) The rope clamp specification should match the diameter of the rope.
3) Rope clamp positionis: X=70~85mm.
4) Wedge the wedge with a mallet or a copper rod.

■ Anti-twist device

Adjust the anti-twist device to the state of the release (Can be free rotation) or lock (cannot free rotation) according to the performance of the rope.

1) For the resistence rotary rope with its rotation performance less than 360°(e.g 35(W)×7), the anti-twist device generally be in release state.
2) For the non-resistence rotary rope(e.g 6×29), the anti-twist device generally be in a lock state.

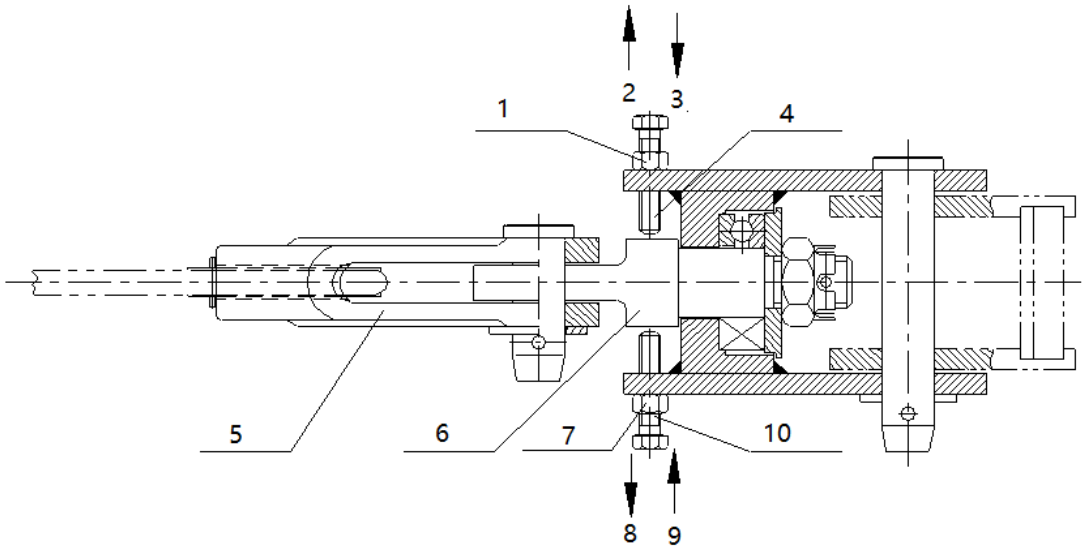


Fig. 6-46 Anti-twist device

(1)	Nut	(2)	Release
(3)	Lock	(4)	Bolt
(5)	Wedge sleeve	(6)	Anti-twist device
(7)	Nut	(8)	Release
(9)	Lock	(10)	Bolt

6.8.5 Discard Criteria of Rope

1) Nature and number of broken wires

The table below take these factors into account when considered in conjunction with the factors given in (2) to (19). So, it can be applied to all structure's ropes.

Table 6-16 The number of visible broken wires that meet or exceed the scrap standard in single strand wire rope and parallel twist compacted wire rope used on steel pulley

Kinds of wires RCN	Number of loads bearing wires of the outer layer of the rope n	The number of visible broken wire rope Concerned with fatigue when lifting machinery must be scrapped					
		A section of wire rope working on a steel pulley and mill or single layer wound on a wind (Random distribution of wire breaks)				Section of multi-layer wire rope wound on the drum	
		Working classification M1~M4 or unknown classification				Off Working classification	
		Interaction of twist		Concurrent twist		Interaction of twist	
		Length arranges				Length arrange	
		>6d[e]	>30d[e]	>6d[e]	>30d[e]	>6d[e]	>30d[e]
01	n≤50	2	4	1	2	4	8
02	51≤n≤75	3	6	2	3	6	12
03	76≤n≤100	4	8	2	4	8	16
04	101≤n≤120	5	10	2	5	10	20
05	121≤n≤140	6	11	3	6	12	22
06	141≤n≤160	6	13	3	6	12	26
07	161≤n≤180	7	14	4	7	14	28
08	181≤n≤200	8	16	4	8	16	32
09	201≤n≤220	9	18	4	9	18	36
10	221≤n≤240	10	19	5	10	20	38
11	241≤n≤260	10	21	5	10	20	42
12	261≤n≤280	11	22	6	11	22	44
13	281≤n≤300	12	24	6	12	24	48
	n>300	0.04n	0.08n	0.02n	0.04n	0.08n	0.16n

Note 1: Silu type wires ropes with outer strands and 519 wires per share (e.g 6×1 silu type) are listed in two rows in the table. The top row represents the number of normally placed outer strands carrying wires.

Note 2: The above values in the multilayer wound wind section may also be applied to other sections of the wire rope working on pulleys made of synthetic materials or having synthetic wheel lining. However, it is not applicable to wire ropes which are specially made of synthetic materials or which are operated on a single winding pulley consisting of a composite wheel lining.

a. Filled steel wire in standard is not regarded as load-bearing steel wire, so it is not included in the n value.

b. A broken wire will have two broken ends (count by one wire)
c. These values apply to sections that are damaged by interference between the jump zone and the overlap layer duo to the effect of the entanglement angle (and not only those section where the pulley is working and where the wire rope is not wound around the drum).
d. Two times of the number of broken wires listed above can be used for mechanisms whose working class is known to be M5~M8. See ISO 4308-1.
e. Nominal diameter of the wire rope.

Table 6-17 Number of visible broken wires of non-rotating wire rope that meet or exceed the scrap standard

Kinds of wires RCN	Number of loads bearing wires of the outer layer of the rope n	The number of visible broken wire rope Concerned with fatigue when lifting machinery must be scrapped			
		A section of wire rope working on a steel pulley and mill or single layer wound on a wind (Random distribution of wire breaks)		Section of multi-layer wire rope wound on the drum	
		Length arranges		Length arranges	
		>6de	>30de	>6de	>30de
21	4 n ≤100	2	4	2	4
	3n or 4 n ≤100	2	4	4	8
	at least 11 outer layers				
23-1	76≤n≤100	2	4	4	8
23-2	101≤n≤120	2	4	5	10
23-3	121≤n≤140	2	4	6	11
24	141≤n≤160	3	6	6	13
25	161≤n≤180	4	7	7	14
26	181≤n≤200	4	8	8	16
27	201≤n≤220	4	9	9	18
28	221≤n≤240	5	10	10	19
29	241≤n≤260	5	10	10	21
30	261≤n≤280	6	11	11	22
31	281≤n≤300	6	12	12	24
	n>300	6	12	12	24

Only use ropes which correspond with the specifications in the ZOOMLION rope list.

2) Broken wires at the termination

Broken wires at, or adjacent to, the termination, even if few, are indicative of high stresses at this position and can be caused by incorrect fitting of the termination. The cause of this deterioration shall be investigated and, where possible, the termination shall be remade, shortening the rope if sufficient length remains for further use, otherwise the rope shall be discarded.

3) Localized grouping of broken wires

Where broken wires are very close together, constituting a localized grouping of such breaks, the rope shall be discarded. If the grouping of such breaks occurs in a length less than 6d or is concentrated in any one strand, it may be necessary to discard the rope even if the number of wire breaks is smaller than the maximum number shown in the table above.

4) Increase rate of the broken wires

In applications where the predominant cause of rope deterioration is fatigue, broken wires will appear after a certain period of usage, and the number of breaks will progressively increase over time. When the time interval becomes shorter and shorter, it is recommended to conduct careful periodic examination and recording of the number of broken wires, with a view to establishing the rate of increase in the number of broken wires. This law may be used to confirm a future date for discarding rope.

5) Fracture of strands

If a complete strand fracture occurs, the rope shall be immediately discarded.

6) Reduction of rope diameter resulting from core deterioration

Reduction of rope diameter results from deterioration of a fiber core or fracture of a steel core. If rope diameters notable reduces, the rope shall be immediately discarded.

Low values of deterioration might not be so apparent from normal examination, particularly if the rope stresses are well balanced throughout the individual strands. However, the condition can result in a high loss of rope strength, so any suggestion of such internal deterioration shall be verified by internal examination procedures, If such deterioration is confirmed, the rope shall be discarded.

7) External abrasion

Abrasion of the crown wires of outer strands in the rope results from rubbing contact, under pressure, with the grooves in the sheaves and drums. The condition is particularly evident on moving ropes at points of sheave contact when the load is being accelerated or decelerated, and is revealed by flat surfaces on the outer wires.

Wear is promoted by lack of lubrication, or incorrect lubrication, and by the presence of dust and grit. Wear reduces the strength of ropes by reducing the cross-sectional area of the steel strands. If, due to external wear, the actual rope diameter has decreased by 7% or more of the nominal rope diameter, the rope shall be discarded even if no wire breaks are visible.

8) Elasticity decreases

Under certain circumstances usually associated with the working environment, a rope can sustain a distinct decrease in elasticity and is thus unsafe for further use. Decreased elasticity is difficult to detect. If the examiner has any doubt, advice shall be obtained from a specialist in wire ropes.

While no wire breaks may be visible, the wire rope will be noticeably stiffer to handle and will certainly have a reduction in diameter greater than that related purely to wear of individual wires. This condition can lead to abrupt failure under dynamic loading and is sufficient justification for immediate discard.

9) External and internal corrosion

- Corrosion of the outer wires can often be detected visually. When the pits appear on the wires and the wires are quite loose, the rope should be discarded.
- If there is any indication of internal corrosion, the rope should be carried out internal examination as indicated by governors. The ropes with serious internal corrosion are sufficient to be discarded immediately.

10) Waviness distortion

As the figure below, when the waviness distortion occurs, when the rope length is no more than 25d, d1>4d/3, the rope shall be discarded. In the formula d is the nominal diameter of the rope and d1 is the diameter corresponding to the envelope of the distorted rope.

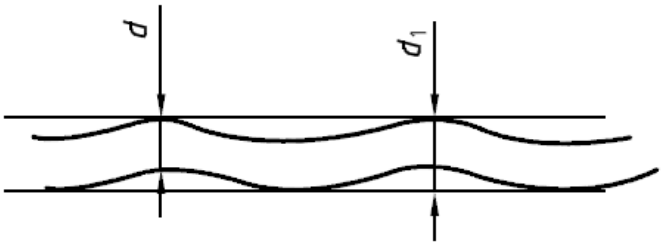


Fig. 6-47 Waviness distortion

11) Basket or lantern deformation

Basket or lantern deformation is a result of a difference in length between the rope core and the outer layer of strands. Ropes with a basket or lantern deformation shall be immediately discarded as the figure below.

Fig. 6-48 Basket or lantern deformation

12) Strand protrusion

Strand protrusion usually happens with basket or lantern deformation. It shows the rope misbalanced. Rope with strand protrusion shall be immediately discarded as the figure below.

Fig. 6-49 Strand protrusion

13) Wire protrusion

In wire protrusion, certain wires or groups of wires rise, on the side of the rope opposite to the sheave groove, in the form of loops. Rope with wire protrusion shall be immediately discarded as the figure below.

Fig. 6-50 Wire protrusion

14) Local increase of diameter of the rope

A local increase in rope diameter can occur and might affect a relatively long length of the rope. This condition usually relates to a deformation of the core (in particular environments, a fiber core can swell up owing to the effect of moisture) and consequently creates imbalance in the outer strands, which become incorrectly oriented. If the local actual rope diameter increases seriously, the rope shall be immediately discarded as the figure below.

Fig. 6-51 Local increase of diameter of the rope

15) Flattened portions

Flattened portions of rope results from machine accidences as the figure below. If flattened portions of rope is serious, the rope shall be discarded immediately.

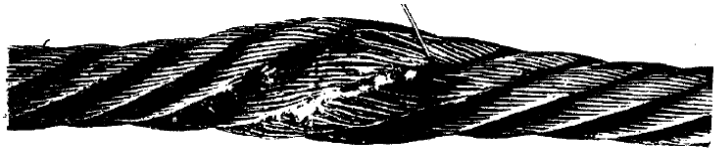


Fig. 6-52 Flattened portions

16) Kinks or tightened loops

A kink or tightened loop is a deformation created by a loop in the rope which has been tightened without allowing for rotation about its axis. Imbalance of lay length occurs, which will cause excessive wear, and in severe cases the rope will be so distorted that it will have only a small proportion of its strength remaining. As the figure below showing, rope with serious kinks tightened loop shall be immediately discarded.

Fig. 6-53 Tweaked or tightened kink

17) Bends

Bends are angular deformations of the rope caused by external influence. Rope with a severe bend should be immediately discarded as the figure below.

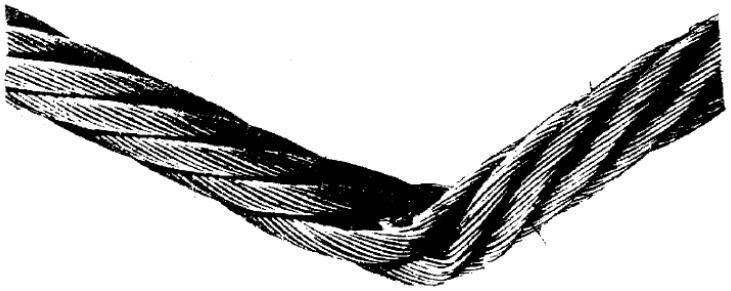


Fig. 6-54 Bends

18) Local decrease of diameter of the rope

A local decrease in rope diameter usually relates to a fracture of the core. As the figure below showing, local decrease of diameter of the rope shall be immediately discarded.

Fig. 6-55 Local decrease of diameter of the rope

19) Damage due to heat or electric arcing

Ropes that have been subjected to exceptional thermal effects, externally recognized by the colors produced in the rope, shall be immediately discarded.

6.8.6 Replace the rope

When the length of rope cannot meet the use requirements or reach the scrap standard, it should be replaced in time.

■ Procurement

1) To ensure the quality of the rope, it is recommended to purchase from the original factory of the main engine.
2) Rope tube should be used for storage and transport.
3) Correct handling of rope head.

➢ Truncation should be done by cone-open fusing.

➢ When conical fuse breaking is not possible due to limited conditions, it can be handled by tying steel wire and then cutting it off, but attention should be paid to:

1) It is recommended to use medium 1mm steel wire binding, and as tight as possible.
2) Binding length l should be (2~4) d, multiply rope should be large value.
3) The distance between the two sides of the binding place should be 10~20mm.
4) It is advisable to use gas cutting or electric welding to weld the end firmly after grinding.

■ Loading, unloading and storage

1) Loading and unloading

Loading and unloading should be done in the correct way, see Fig. 6-56, Operation see Fig. 6-57 should be rejected.

➢ The correct handing and unloading method

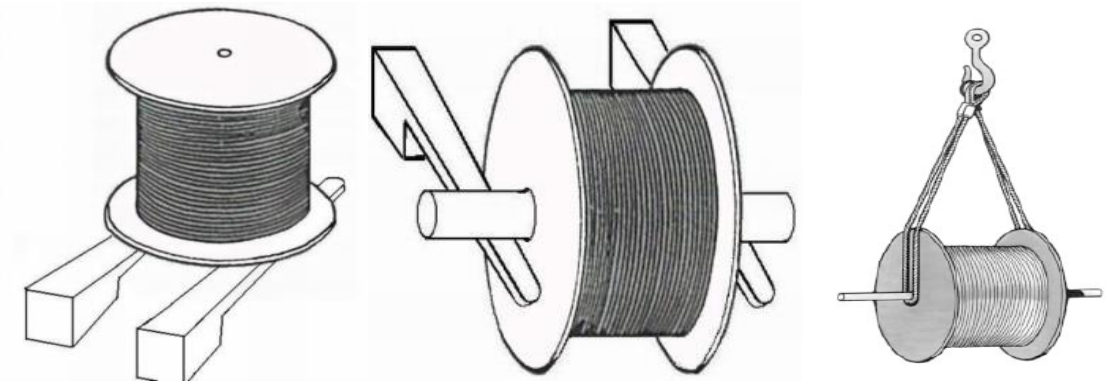


Fig. 6-56 The correct handing and unloading

- The wrong handing and unloading method

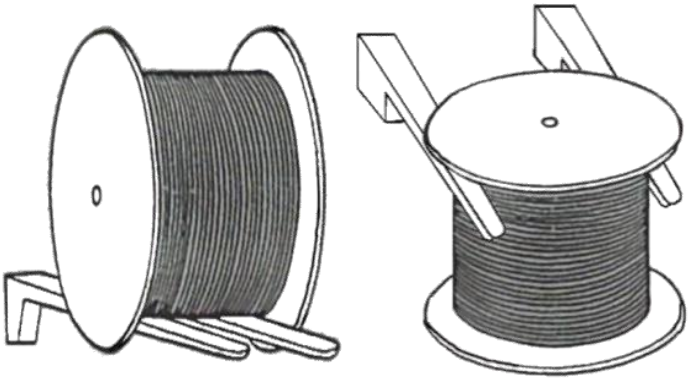


Fig. 6-57 The wrong handing and unloading

2) Storage

The rope should be properly kept to prevent rust or damage caused by damp. the requirements are as follows:

- The rope should be stored in a well-ventilated room, isolated from the damp ground, to prevent direct sunlight, hot air baking and grease dripping.
- Avoid contact with acid, alkali and other invasive materials.
- Avoid the rope from being squeezed and hit.
- It should not be stacked in the open air. If it must be stored outdoors, it should be placed on the dry ground with higher ground, and the air floor at the bottom is isolated and covered with a tarpaulin.
- The original information of each wind of wire rope must be kept completely.
- For the storage of rope for a long time, generally a yearly appearance inspection, rust, oiling, and then re-winding, to prevent improper storage of rope serious deterioration.
- The rope stored for more than one year can be used only after passing the qualification test before use.

■ Winding the rope

1) The out and in directions of rope drum and drum should be the same. (Fig. 6-58)

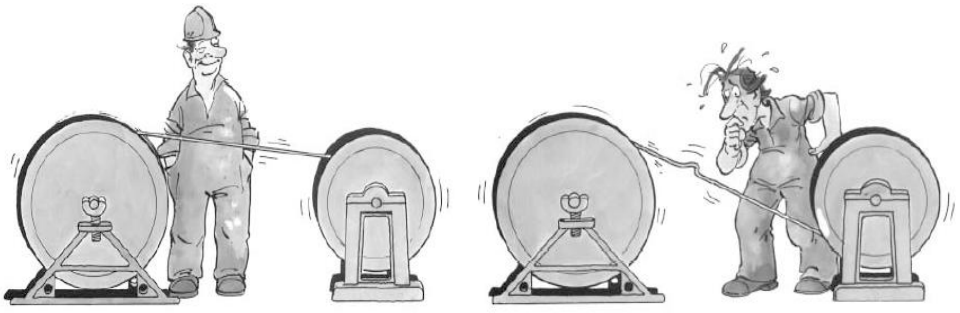


Fig. 6-58a Correct (Along the winding) Fig. 6-58b Wrong (rewind the winding)

Fig. 6-58 Winding the rope

2) Rope pre-tightening

When the rope is wound out of the drum, resistance should be applied to the rope drum according to the site conditions and the principle see Fig. 6-59 to prevent excess rope from being released.

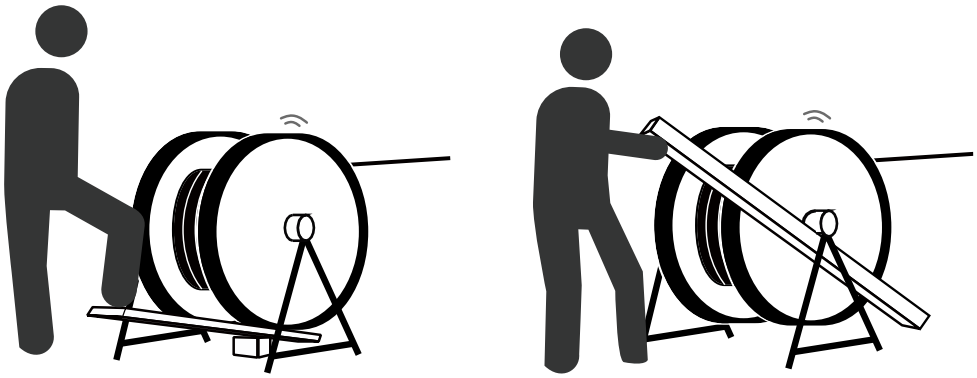
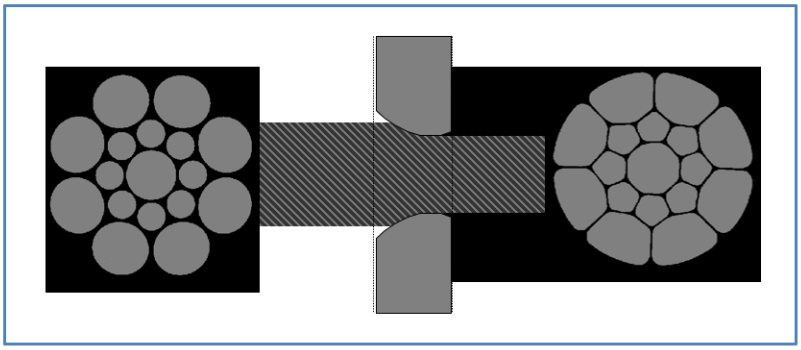


Fig. 6-59 Principle of rope pre-tightening

During rope wound into the drum, ensure that the tension of rope is not less than 10% of wire rope tension. If the site condition does not be met, the length of the rope should be controlled. At the maximum fall, the hook is in the lower limit, the rope allowance on the drum is generally not more than 2 layers.

When replacing the hoisting rope, user must configure the compactable rope in strict accordance with the specifications required by this manual. The wrong use of common (non- compactable) rope will cause rope fracture, resulting in serious consequences of crane destruction and death.



Non- compacting rope **Compacting rope**

There is huge difference between compacting rope and ordinary non- compacting rope. The same diameter of compacting rope than non- compacting rope breaking pull is much larger, the service life is longer, please be sure to configure the compacting rope according to the requirements.

To guaranteed the quality of rope, please choose the original rope in the purchase of rope.

*Trolley rope must comply with relevant provisions of **GB 8918-2006 <Important Purpose Wire Rope>***
*Hoisting rope must comply with relevant provisions of **T/CCMA 0086-2020 <Tower Crane Hoisting rope>** and **YB/T5359** compacting rope*

In addition, the following requirements must be met; (d is the theory diameter of rope)

- The minimum breaking tension of the hoisting rope and trolley rope shall be complied with requirements:
- The diameter allowable deviation of trolley rope is d (+1%~+5%), unevenness ≦2% and out-of-roundness ≦3%
- The diameter allowable deviation of hoisting rope is d (+2%~+4%), unevenness ≦2% and out-of-roundness ≦3%
- Anti-torsion performance of hoisting rope: torque coefficient KQ≦0.021, rotation degree≦1.5r/1000d;
- The lateral pressure stability of the hoisting rope :ΔV≦8%;
- The diameter shrinkage of the hoisting rope: ≦3%.

6.8.7 Maintenance of Rope

Maintenance of the rope should be relative to the crane usage environment and involved rope type. Paint lubricating grease and lubricating oil when installing the rope. The rope shall be cleaned where necessary, and the rope being reused in regular time interval, especially before the section of rope passing round the pulley shows signs of dryness or corrosion should be kept in good lubricating condition.

The rope lubricating oil (grease) should be Graphite calcium base grease ZG-SSY1405-65, it has strong penetration. A shorter working life of rope will result from lack of maintenance.

If wire rope grease on the surface dry, it should be cleaned in time, and apply new accord with the prescribed grease.

Wire rope surface should avoid applying too much grease. Surface blotted out too much grease may produce the following question

1) Aggravated deterioration of the rope rupture
2) Environmental pollution
3) Easy adhesion of the dust or other substances, make the wire rope from corrosion

6.9 Maintenance of pulley assembly

6.9.1 Examination of pulley assembly

Hoist pulley, trolley pulley, trolley and hook pulley are non-lubricating bearings. The pulley shaft has no oil nozzles and does not need to be lubricating,

- Daily inspection of bearings:
  - whether there is oil leakage
  - Shaft end seals
  - Elastic ring
  - Operation noise and resistance
  - Bearing clearance.
- Table of pulley parameters, Table 6-18

Table 6-18 Pulley parameters

Designation	Specification	Diameter (mm)	Rope groove depth (h)	Rope groove radius (R)
Hoisting pulley	000209906A0040051	450	35	7.5
Trolley pulley	214-178-B41-80-R6	214	18	6

6.9.2 Pulley scrap

The main forms of pulley damage are worn and extrusion of the pulley groove caused by the steel rope. Generally, the surface condition of the pulley groove (Fig. 6-60 and Fig 6-51), wear depth and arc radius are the basis for judging whether the pulley is normal or not.

- Surface condition of rope groove

The surface of the pulley groove should be worn evenly and smoothly. When there is obvious indentation, the pulley should be replaced.

Fig. 6-60 Example pulley indentation

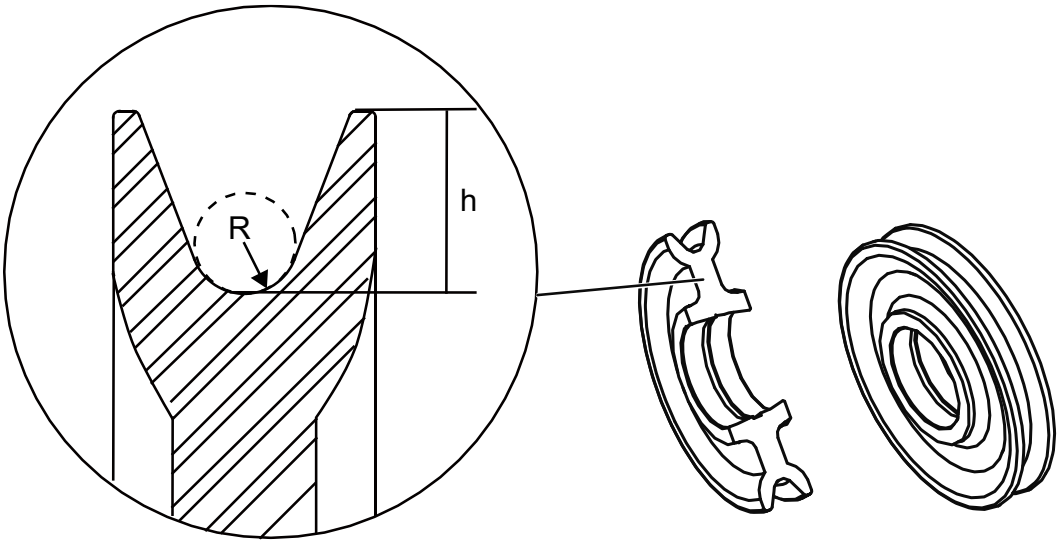


Fig. 6-61 Depth detection of rope groove

■ Depth of rope groove

Due to wear, the h value of rope groove depth increases gradually. For the hoist pulley, the pulley should be replaced when the value increases by 30%d over the theoretical value. For the trolley pulley, the pulley should be replaced when the h value increases by 30%d over the theoretical value.

■ Rope groove radius

➢ Due to wear, the radius R of the rope groove will change. when the value of R exceeds 0.525d~0.6d, the pulley should be replaced.

➢ The rope groove radius detection method see Fig. 6-62

➢ The radius of the pulley grooves is detected by the pulley gauge or radius gauge (R gauge). From the beginning of the large diameter measuring tool to the arc of the measuring tool basically coincides with the arc of the normal section of the pulley groove.

Fig. 6-62 Examples of radius detection of pulley groove arc

■ When the pulley is found to have flange, crack and other phenomena, the pulley should also be replaced.

6.10 Maintenance of travelling chassis parts

6.10.1 Maintenance of driving/driven dollies

- Check each connection parts every day, the connection should be tightened and reliable.
- Check reliability of rail clamps and pin shaft, and settle it if abnormality occurs.
- Check each traveling limit switch every day, they should be sensitive and reliable.
- Add lubricating oil into each lubricating point every two months. The lubricating of each bogie is see

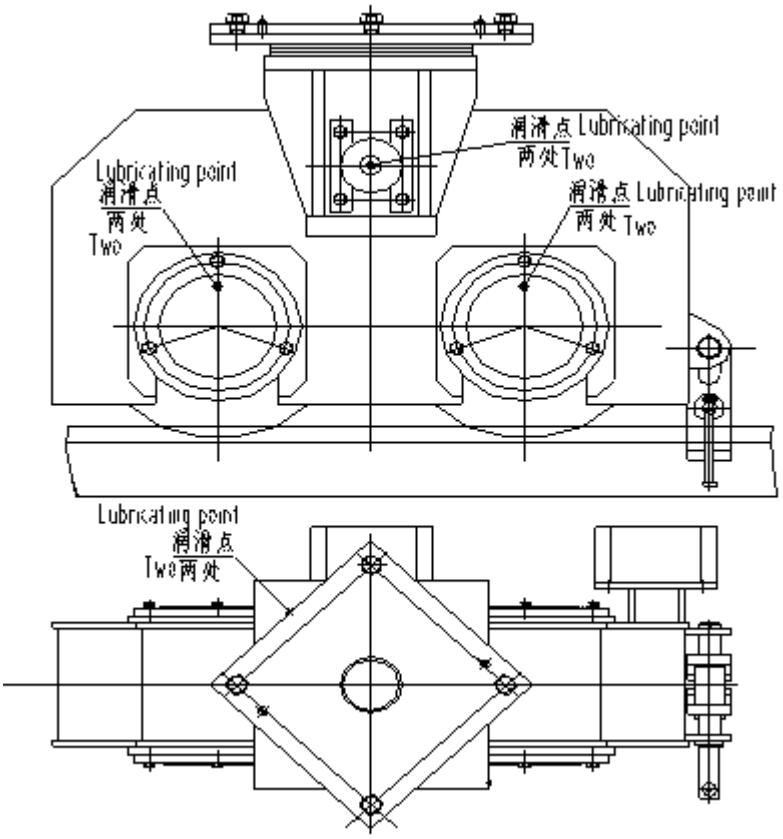
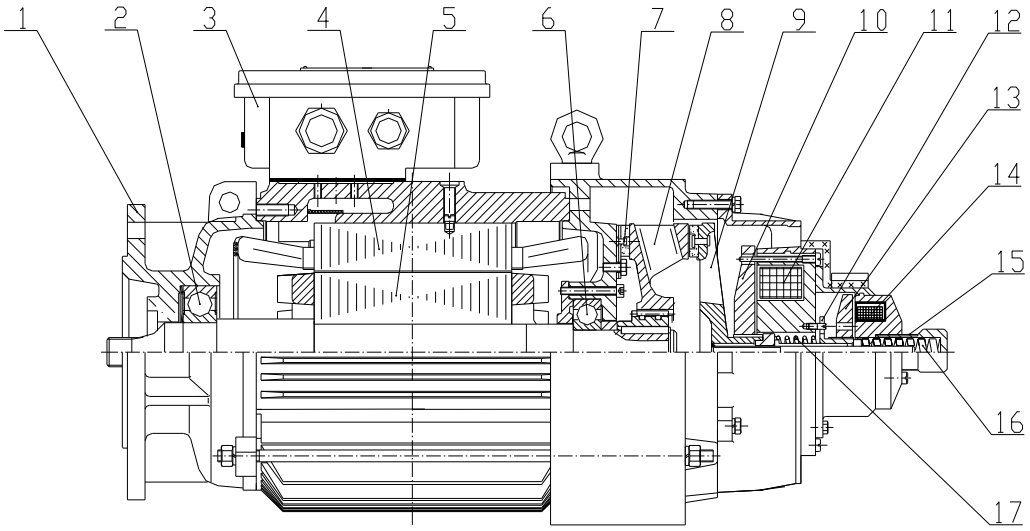


Fig. 6-63 Lubricating points of the bogie

- Check the wheels every 6 working months. It should be scrapped if the following conditions occur:
  - Cracks;
  - The worn value of wheel surface thickness arrives 15% of original thickness;
  - The worn value of wheel rim thickness arrives 50% of original thickness.

6.10.2 Maintenance of traveling motor



1. Front end cover;2. Bearing; 3. Terminal box; 4. Stator; 5. Rotator; 6. Bearing; 7. Friction plate;8. Brake disc (1); 9. Brake disc (2); 10. Armature (1); 11. Iron core with shell (1); 12. Spring block; 13. Armature (2); 14. Iron core with shell (2); 15. Spring Chamber; 16. Spring (1) 17. Spring (2)

Fig. 6-64 Parts of the traveling motor

- **Motor structure diagram is see Fig. 6-64, maintain the motor periodically as following items:**

1. Check each terminal block to see if the contact is well;
2. Check insulating resistance of stator and the rotor winding with a ohmmeter, the value of the resistances should not be below 0.5MΩ;
3. Environment should be kept clean during operation to prevent all kinds of dirt being absorbed;
4. Motor bearing is special sealed bearing, during it using period, should not change lubricating grease. When the life of bearing over, the oscillation and noise of motor will augment obviously, check the radial clearance of bearing, if reaches 0.1mm, should instead of it in time;
5. When motor is started, excitation coil is electrified at one time, brake open; when motor is stop, the control of frequency conversion could let motor from speed of working state to zero or adjacent zero gradually, excitation coil is cut off, it is braking state. So, the brake and release of electromagnetism brake must be sensitive and reliable;
6. Check every part of brake periodically, clear begrime and ordure of braking disc, friction piece, clean the outlet/inlet wind passage;
7. Check the braking moment of brake, value of clearance and friction piece periodically. When static braking moment less than stated value 40Nm or clearance more than 1.2mm, static braking moment and value of clearance should be adjusted in time, if friction piece wear and near to metal surface, friction piece should be changed in time.

■ **The adjustment of static brake moment and clearance is:**

1. Cut off all power; turn the down lag and locknut; take shield;
2. Screw off the orientation bolt; unscrew nut (5mm about);
3. Screw on spring chamber, compress the braking spring, let the static braking moment to the regulate value 40Nm, screw the nut closely;
4. Using tool entering the wind window of excitation iron core poke the teeth circle of armature, until armature keep close to excitation iron core, drill through orientation bolt, withstand armature, poking the armature on the right slowly, find the location of the first hole of orientation bolt drilling armature. At this moment, air clearance is 0.8 mm (armature and orientation bolt of excitation iron core locate on the circle with the same radius, 12 holes distribute equably, the screw pitch of whorl connected with armature and braking disc;
5. Fit on the shield; install and screw locknut closely; install lag and screw closely.

■ **Replace method of friction piece:**

1. Cut off all power; unscrew lag and locknut on the left; take off shield;
2. Unscrew off orientation bolt; unscrew off locknut and release nut;
3. Unscrew the spring chamber and take-out braking spring and spring retaining pad;
4. Unscrew the bolt connecting the excitation coil iron core and shell, remove the excitation iron core carefully (be careful of the lead of protection coil), remove the friction disc and braking disc. (Notice: “3)” , “4)” step should not be upside down, or else attaint the protruding desk on the hole of the bolt;
5. Take off the friction disc of shell and exchange the same standard new friction disc; remove the friction piece on the friction disc, exchange the same standard new friction piece, and felt hard;
6. Install braking disc, friction disc, shell body, excitation coil, spring retaining pad, braking spring and spring chamber according contrary “3)”, ”4)”step;
7. Adjust the static braking moment and air clearance according to the adjustment method of static braking moment and air clearance; install shield, screw the locknut;
8. Screw tow release nut, lock each other off spring chamber 5mm.

After every adjustment of electromagnetism, should check handful releasing equipment and whether snort the armature after electrified, if it is eligible, the motor can be used.

6.10.3 Maintenance of the cable drum

Notice：

a) Cut off the power before open the collector ring;

b) Prohibit inserting stop parts into nut indentation during operation;

c) Lubricating oil level in reducer should be above the center position of the sight hole;

d) When the crane moves toward the direction of power, the motor of cable drum should be started simultaneously with traveling mechanism, while the traveling mechanism stops, the motor of the cable drum should power off after 3 seconds.

1. Must exchange lubricating oil in reducer after the first one-month operation;

2. Check the oil level of reducer every two months, when it is below center of sight hole, and then add HL-30 lubricating oil;

3. **Check the tightness of electric parts of collector ring every two months, to ensure good contact and reliable connection of cable fittings. At same time, measure insulation condition, the insulating resistance should not be below 5 MΩ;**
4. **Change lubricating oil in the reducer every year. Turn out the hexagon plug screw at bottom to drain off dirt oil, and screw out brake parts simultaneously. Screw on the hexagon plug screw and add clean HL-30 lubricating oil, Screw on brake parts after cleaning the dirt oil.**
5. **Keep the surface of collector ring, motor, reducer cleaning;**
6. **Exchange parts in time if the parts are worn greatly and affect performance.**

6.10.4 Bearing model

Wheel bearing model: GB/T288-1994 Bearing 22220C 4 wheels for each bogie.

6.11 The high strength bolts

6.11.1 Basic knowledge of the high strength bolt

- There are many high strength bolts, they are used to connect the components and pass load.
- All the high strength bolts which are used to connect the components of the tower crane are vital for the tower crane and must be installed, maintained, and checked seriously.
- Check the high strength bolts occasionally, to assure the fastness and reliability of the connections. Looseness of the bolt may lead damage and even the stale connection of single component.
- If users choose the bolts by themselves, please ensure the strength grade of the nut can match the bolt.

  For example:

  8.8 grade bolt -> 8 grade nut;

  10.9 grade bolt -> 10 grade nut

  12.9 grade bolt -> 12 grade nut

6.11.2 Checking the bolts and bolt connection sets

Clean and check all the bolt connecting components before the installation. The checking contents include bolts, nuts, thread, the transition part between the bolt head and the screw and so on.

Using the damaged bolts and nuts is strictly prohibited! Don’t use the bolts whose screws are rusty and the bolts or the nuts whose threads are rusty!

6.11.3 Lubricating the high strength bolt assembly

Use molybdenum disulfide to lubricate all the bolt assemblies before installing them. Good lubrication can supply uniform friction and standard preload for the bolt.

As is shown in Fig. 6 53 please lubricate the threads of the bolts and nuts and the contact surfaces. If the preload is exerted on the bolt head, the contact surfaces of the bolt head need to be lubricated as well.

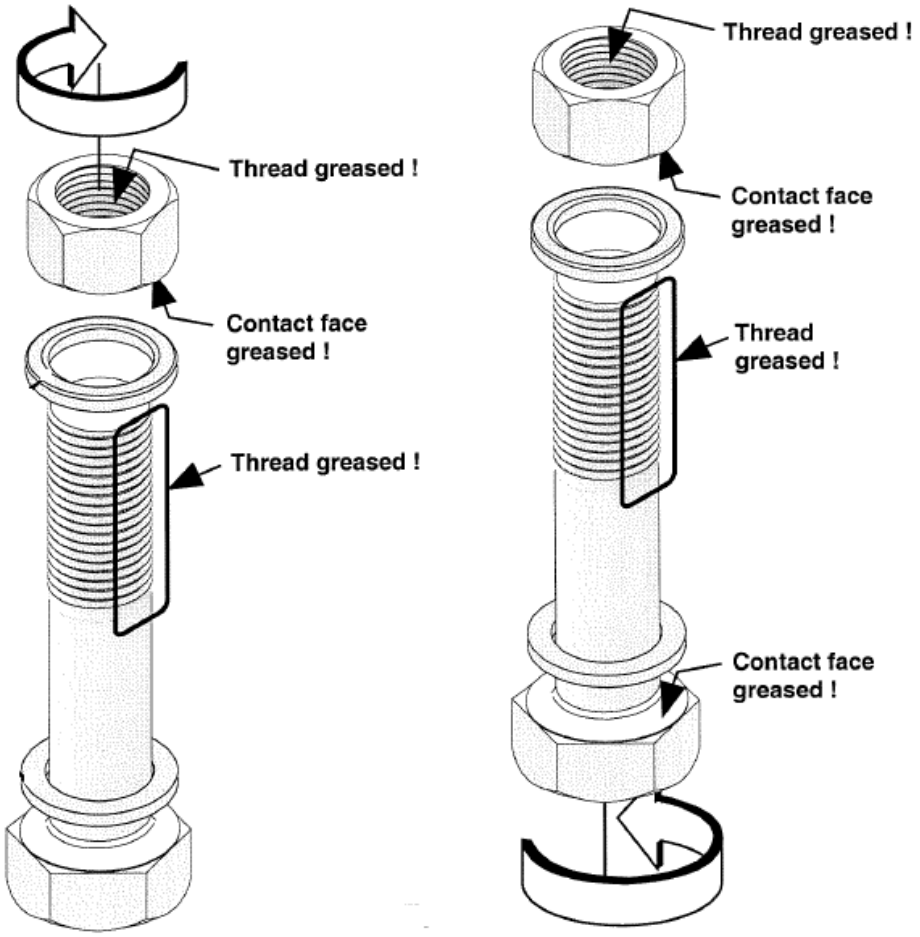


Fig. 6-65 Lubricate the contact surface

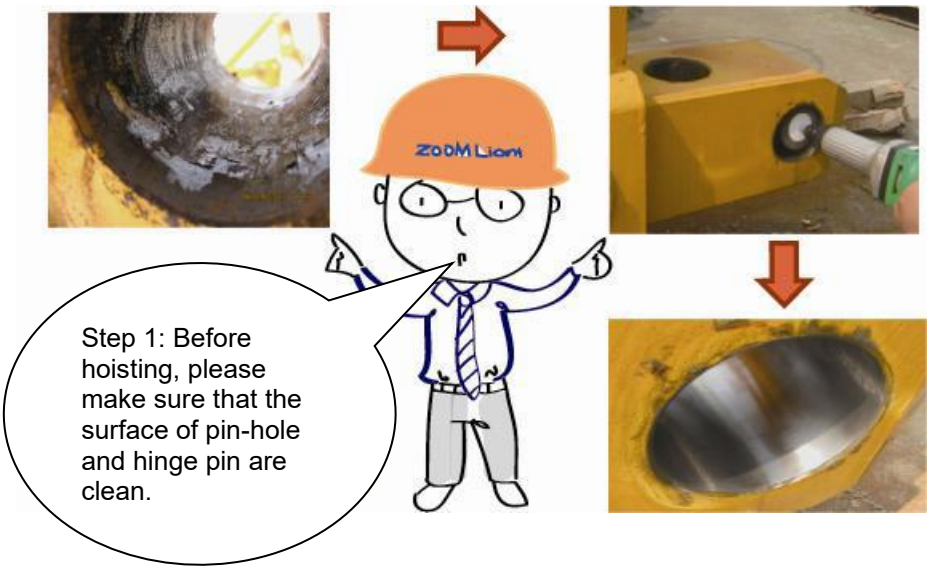
6.11.4 Recycling the high strength bolt

All the bolt assemblies which were exerted preload rightly can be recycled when erecting the tower crane again. However, all the bolt assemblies recycled must have been checked and are not damaged.

6.12 Pins and holes of the tower section

After assembling the tower section, please check the pins and holes as follow the steps.

- Before hoisting the tower section, please make certain that the surface of pin-hole and pin is cleaned. It can use the polisher to clear the pin-hole, but grinding wheel is prohibited which enlarges the pin-hole. After cleaning, the pin-hole should have mental luster.



- When installing the tower section, please check the pin-hole again and make sure there are no sundries, if there are any sundries please clear it.

- After cleaning the surface of pin-hole and pin, uniformly daubing the AG1 rusting preventive grease on the inner surface of the pin-hole and outer surface of hinge pin. Then installing the hinge pin. Strictly prohibit mixing the difference kinds of grease. Strictly prohibit mixing the new AG1 with old AG1.

- After dismantling, the hinge pins must be placed in the clean and waterproof box which should be placed indoors. If the pin-hole of tower section is rusting or the grease consolidation, firstly cleaning the pin-hole, then daubing the AG1 rusting preventive grease. It must have adapting cushion between the tower section and ground.

- Check if the rabbet of the tower section main chord can shake, if it can shake, the shake value cannot exceed 0.7mm, if it exceeds, please contact our company's after-sales staff to handle it before it can be used.

6.13 Hook

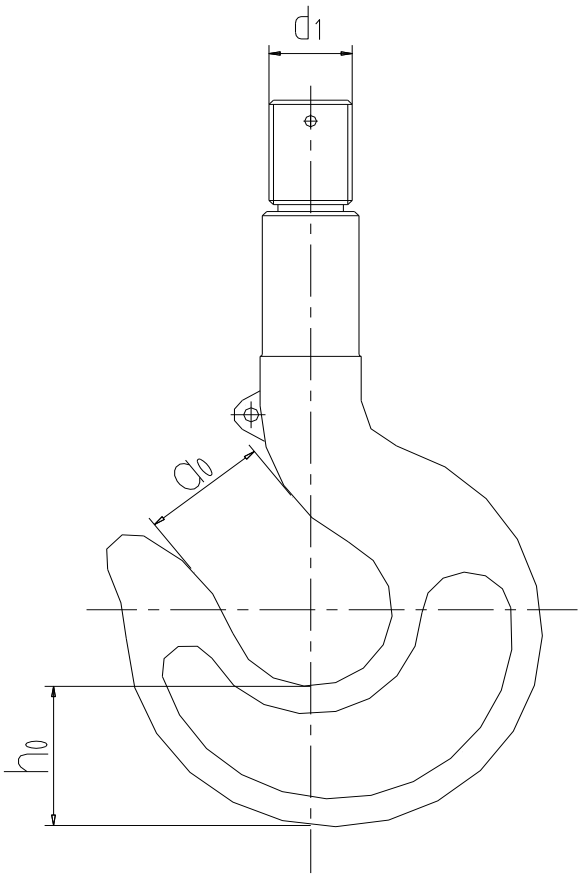
6.13.1 Check the locking of the hook

- All the fasteners of pulley pin and connecting pin are normal;
- The press plate on the hook nut is installed in place, without deformation, and the bolts on the press plate are firmly fixed; The tower crane needs to be checked before use. If the fixing bolt is loose or damaged, please tighten or replace the bolt in time.

6.13.2 Opening Degree of the Hook

Inspect the deformations at least once a month.

- The initial value of hook opening degree $a_0 = 85^{+3}_{-2} mm$. (According to the measuring value before the first time use of the hook)
- If the opening degree has been more than 110% of the initial value a_0, replace the hook.



- Check the torsion deformation of the hook. When the torsion angle of the hook body exceeds 10°, replace the hook.
- The handle of the hook should not be plastic deformation, otherwise it should be replaced

6.13.3 Wear

The initial value: $h_0 = 100^{+5}_{-2}$

The wear on hook may not be greater than 5% of the height “H”. It is not permitted to carry out welding work on hook to repair the wear.

Check hook wear at least once a month.

- Surface cracks

- If there are obvious distortions of the hook, do the surface cracks check to the hook using appropriate method or change the hook.
- Damages and surface cracks can be removed, but no gap can be left. The hook dimension after being removed the cracks and damages should not exceed the permissible tolerance.
- If the installed hook cannot be checked, dismantle it and check it.
- Before making checks, ensure that the surfaces are put into a condition permitting the definite identification of surface cracks!

6.13.4 Corrosion

- The diameter d1 of hook handle cannot be corroded to be less than 95%, if the diameter is less than 95%, change the hook.
- The threads on the hook cannot be corroded.

Hook defects are not allowed to be repaired by welding.

6.13.5 Check hook anti-tripping device

- Hook anti-tripping device, under normal use, anti-rope device and hook can form a closed cavity. If the anti-tripping device and hook cannot form a closed cavity, the anti-tripping device shall be corrected. If it cannot be corrected, shall be replaced.
- If the anti-tripping device or the connecting pin between the anti-tripping device and the hook is deformed, which affects the normal use, please replace the pin.

The anti-tripping device should be check before the tower crane is used.

6.13.6 Oil hook bearing

Thrust ball bearing are used on the hook assembly, which are provided with lubricating oil holes and need to be lubricated regularly.

6.14 Trolley

6.14.1 Routine inspection of trolley rollers

- Check roller bearings;
- The roller rotates normally;
- There is no damage or deformation of roller;
- Roller wear;
- The nut and lock washer of the roller shaft are not loose;
- All the rollers of the trolley are in contact with the jib;
- In the process of running the trolly, he roller, the roller cover and the belly rod of the jib do not interfere

6.14.2 Routine inspection of side rollers of trolley

- Check the side roller bearings;
- The roller rotates normally;
- There is no damage or deformation of roller;
- Check the wear of side rollers (see Table 6-19 Side roller specification table); Replace the side roller when the wear of the side roller reaches 5% of the diameter

Table 6-19 Side roller specification table

No.	Order No.	Specification
1	000209705A0001400	Φ80-30
2	000209710A0600001	Φ120-50
3	000209716A0010019	Φ140-50

- There is no damage to the split pin or clamp plate used for the limit of the side roller shaft, and it is firmly fixed

6.15 Steel structure

6.15.1 Foreword

This description contains the maintenance instructions for the steel structure elements of the crane.

6.15.2 Description

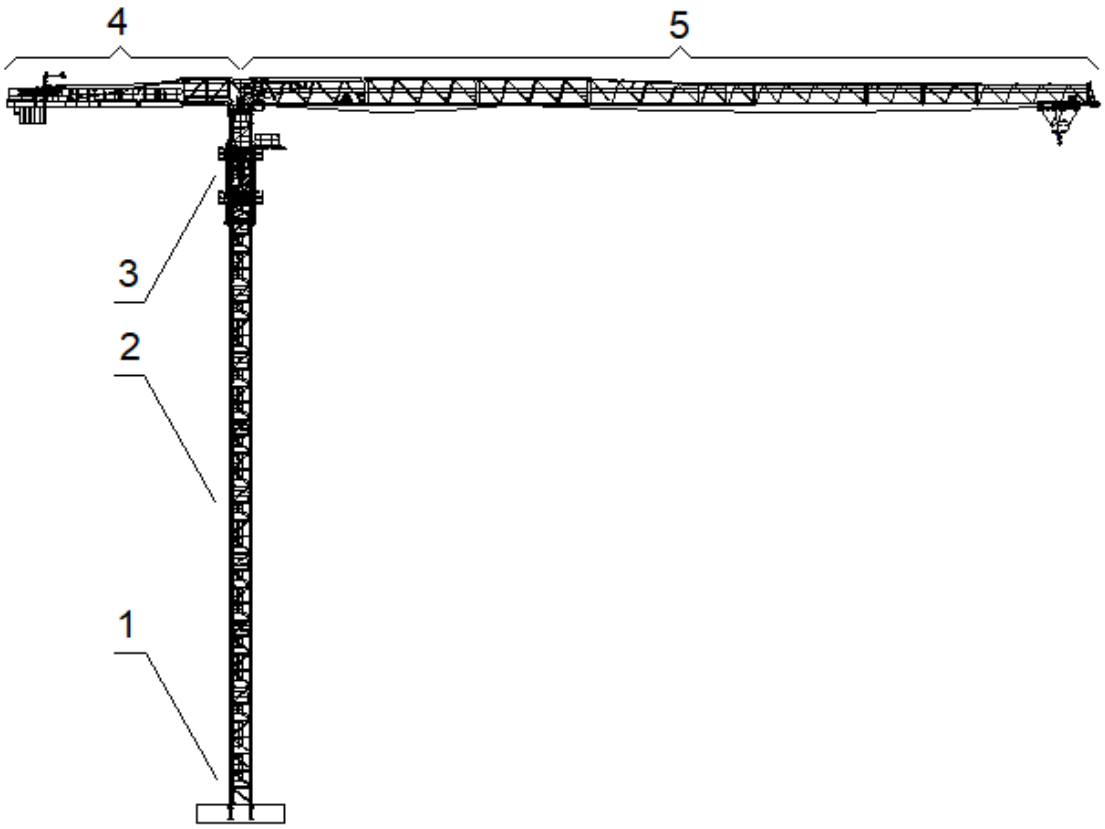


Fig. 6-66 Steel structure of the crane

(1) Outriggers
(2) Mast
(3) Climbing equipment
(4) Counter jib
(5) Jib

6.15.3 Description

The structure defines all the metallic parts constituting the crane steel structure.

General condition / appearance	■ Cleanness / cleaning ■ Paint / corrosion
Steel structure	■ Ballast ■ Derrick / mast / crane tower / jib / counter jib ■ Pins / screw bolts ■ Ladder / platforms / grab rails / catwalks / guard ropes ■ Lifting cab guiding system ■ Greasing

6.15.4 Maintenance

General condition / appearance

Check the general crane aspect: cleanness (concrete, mud, and sand splashes, etc...).

Cleanness and general correct appearance of the crane avoid risks and operating problems.

Cleanness / cleaning

The cleaning must be carried out with fresh water without detergent. Using a high−pressure apparatus is possible if the following instructions are observed:

Never apply the squirt directly on hinges, cables, safety devices and electrical equipment: control panel interior, cables, connectors, terminal strips, etc..

The control panel inside must be freed from dust by means of compressed air. Remove dust from the electrical equipment and the safety devices with a dry cloth.

After each cleaning all the required parts must be lubricated and greased.

Paint / corrosion

Carry out a visual check of the following points:

- In case of a drain line due to an invisible corrosion, carry out a regular check,
- In case of corrosion on a painted part, clean and grind the area, then apply a layer of rust preventing agent and paint,
- In case of wear of the surface treatment, clean and grind the area, then apply a layer of rust preventing agent and paint.

Steel structure

Carry out a visual check of the ballast concerning the following points:

- In case of cracks, fretting, too considerable wear, carry out a weighing in order to make sure that the ballast weight is still within the tolerance.

Tolerance of the ballast weight: 0 to + 4% (base) / −2 to +2% (counter jib).

- In case of corrosion on the metallic ballast, clean and grind the area, then apply a layer of rust preventing agent and paint,
- In case of a drain line due to invisible corrosion carry out a regular check,
- In case of wear of the slinging loops or their fixings to the ballast blocks including the risk of a break, replace the ballast.

Derrick / mast / jib / counter jib

Carry out a visual check on the whole crane steel structure (deformations, cracks, damages, ...).

The crane steel structure is an essential part. As soon as an anomaly is detected: cracks, crackled paint, deformation, anomalous noise, compulsorily stop the crane operation and contact a ZOOMLION expert.

Deformations:

- Deformation of the steel structure

- Deformation of a bracing

- Pressure, sinking

- Friction

Pins / screw bolts

Carry out a visual check on all assembling points of the parts constituting the crane.

Assembling by fish joints, pins and screw bolts is of highest importance. As soon as an anomaly is detected, stop the crane operating and solve the problem.

- Pins

- Screw bolts.

Ladders / platforms / grab rails / catwalks / guard ropes

Carry out a careful visual check of all welding on the whole crane.

All the accesses must compulsorily be present, correctly fastened, and free.

6.16 Maintenance of electronic control system

The electronic control system should be frequently maintained and maintained to eliminate faults, eliminate safety hazards, ensure the normal operation of the whole crane, and extend the service life of the equipment. Maintenance work should be carried out by professionals with relevant qualifications.

6.16.1 Electrical equipment inspection

Table 6-20 Checklist of electrical equipment

Inspection cycle	Inspection item
Daily operate before inspection	Electrical Equipment: Whether the door of the electric control cabinet closes The air switch in the cabinet Circuit breaker Display Electric whistle Sensor Over load display Moment percentage display Trolley position display Hoisting height display Wind speed display Weathervane brake release
	Indicator light/indicator device: Voltmeter Overvoltage indicator light Cab light Beacon light
Check each erection and inspection cycle (suggest cycle is 2-3 weeks)	Main power Main power switch box Phase sequence Service voltage Length and shuck of main cable Every position for reliable earthing
	Cable: Meet a criterion Shuck of main cable in perfect condition, good insulation Plugins in correct location, good contact and reliable Cable stress relief.
	Electrical device: Air switch Circuit breaker Electric relay, contactor

	Display Sensor Over load and moment alarm normal Brake, weathervane brake External equipment connector good contact and reliable
	Indicator light/indicator device: Voltmeter Overvoltage indicator light Cab light Beacon light
	Electrical control cabinet Temperature switch and humidity switch set values correctly Power voltage control set values correctly

- The inspection of electrical equipment must be carried out under no-load conditions:
  - The hook moves up and down slowly;
  - Trolley slowly moves outwards and inwards;
  - The tower crane slowly rotates to the left and right;
  - All control parts run correctly and smoothly,
  - The position of the trolley and the height of the hook on the display screen are displayed accurately and continuously.
  - The wind speed display value on the display is correct and reasonable
  - The mechanism starts quickly and smoothly,
  - Increase and decrease gears, continued, no gears, skipping, and the operating handle can automatically return to the zero position,
  - When running in no-load, there is no obvious special noise or vibration
- Check of component setting value

Temperature sensor (ST) and humidity sensor (SRH) in the main control cabinet, voltage monitoring relay, see the figure below.

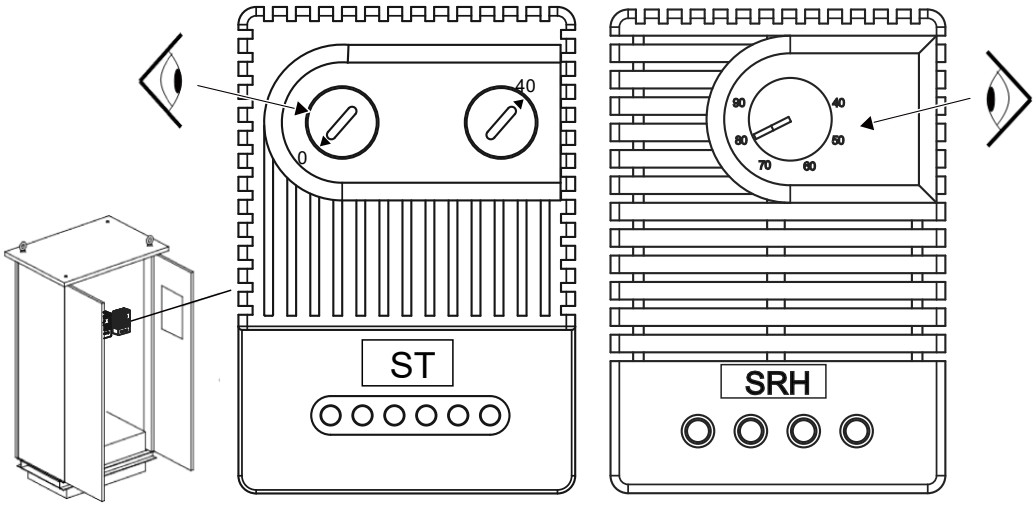


Fig. 6-67 Temperature switch and humidity switch in the main control cabinet

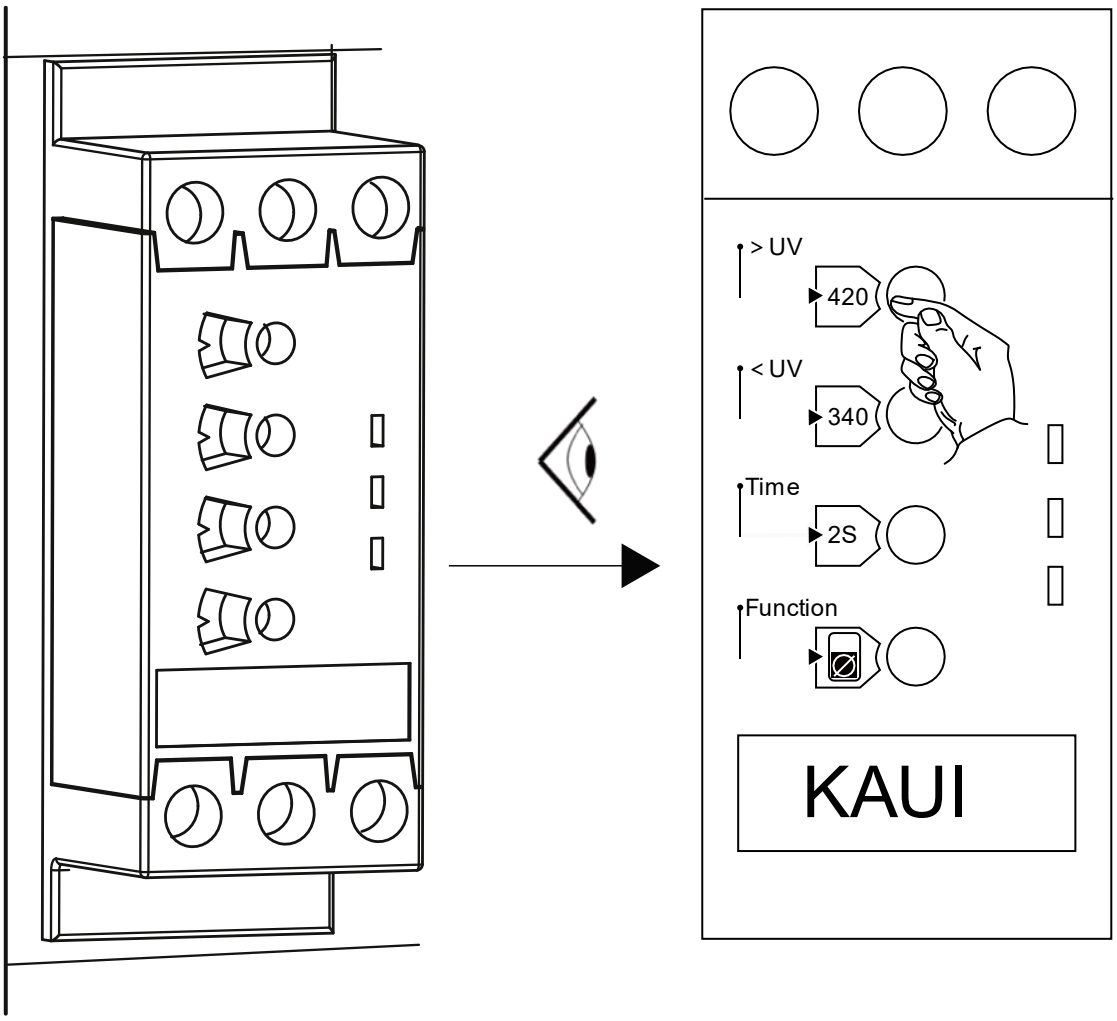


Fig. 6-68 Check set value of main control cabinet monitor electric relay

Table 6-21 Check detailed list for safety device

Code	Definition	Setting value
ST	Coating fan temperature	+40℃
	Heater working temperature	0℃
SRH	Heating humidity RH	+80%
KAU1	Overvoltage protection value(>U)	420V
	Undervoltage protection value(>U)	340V
	Delay time	2S
	Operating mode	Reset delay + no phase sequence monitoring

6.16.2 Maintenance for cabin

- Check if the wiper is well, glass is clean, or the vision is clear;
- Check if there is proper fire extinguisher in the cabin;
- Check if the functions of the operating panel in the cabin are well;
- Check if all the electrical components in the cabin are well connected.

6.16.3 Maintenance for safety device

Every limiter and sensor require to calibrate and recalibrate definite value during every erection.

Table 6-22 Check detailed list for safety device

Inspection cycle	Inspection item
Daily operate before check	Location of limiter: Maximum trolley position for trolley (jib length); Minimum trolley position for trolley; Upper stop position for hook; Hook stop position at bottom according require;
	Load capacity/moment limiter: over load alarm for load limiter, load moment;
Check each erection and inspection cycle (suggest cycle is 2-3 weeks)	Location of limiter: Maximum trolley position for trolley (jib length); Minimum trolley position for trolley; Upper stop position for hook; Bottom stop position for hook;
	Load capacity: Check the accuracy of the load capacity display (Sling the known load); Check the accuracy of mechanism load limiter is triggered Check the accuracy of mechanism moment limiter is triggered (constant load for variable radius, constant radius for variable load); Check the percentage accuracy of mechanism moment limiter display (Take the mechanism moment limiter for refer);
Out of inspection cycle	Every mechanism requires to recheck and recalibrate when change hoisting rope, trolley, hoisting mechanism, trolley mechanism, load sensor and other relevant safety parts.
	Recalibrate if the jib change length
	Recalibrate after climbing operation

6.17 Spare parts list

The spare parts can be selected with price increase. Those adding "*" in the serial number rod are wearing parts.

6.17.1 Spare parts list of mechanism

Spare parts list of hoisting mechanism

No.	Order No.	Designation	Code	Install position	Qty
1	1020005707	Motor	YZPFME225M-4-Z	H37FC25-530B (000209101A6600000)	1
2	1039906067	Brake	SPZ500C		1
3*	1030202793	Friction	P250T240-2W(BLZ)		1
4*	000209944A0 000962	Elastomer	GR48		1
5*	1090101163	Rope	35×7-14-1870		1
6	1021500637	Limiter	DXZ1:360B0×20		
7	1020202010	Encoder	ETF100-H (Nr:851223/0.8)		

Spare parts list of trolley mechanism

No.	Order No.	Designation	Code	Install position	Qty
1	1029805199	Brake	DLTZ3-80	T55FC70-b(D) (000209370A5000000)	1
2*	1029805171	Brake disk	DLTZ3-80-01		1
3*	000209944A0 001022	Elastomer	GR28		1
4*	1090100080	Rope	6×19-9.3-1700-Ⅱ-ZS		-
5	1021500641	Limiter	DXZ1:60B0×22		1

Spare parts list of slewing mechanism

No.	Order No.	Designation	Code	Install position	Qty
1	1021500640	Limiter	DXZ1:46B0×21	S75CA-130LB12/14A (000209289A6700000) S75CN-130LB12/14A (000209289A6800000)	1
2	1029805619 /1029908241 /1039905754	Brake	DDZ-175/DFB /DXM3-80XLY /SPZ100.0		1
3*	1039905750 /1030600057 /1039905756	Friction disk	DDZ-175BM-01 /DXM3-80XLY-02 /SPZ100.2		1
4	1020202364	Encoder	ECK58B (Nr:851249/7.5)		1

Spare parts list of travelling mechanism

No.	Order No.	Designation	Code	Install position	Qty
1	000209401A0000003	Buffer sleeve	000209401A0000003	Travelling mechanism (Only use in travelling crane)	-
2	1050200326	Bearing	22220C (1050200326)		-
3	1030200210	Travelling reducer	TX25(1030200210)		-
4	1020000154	Motor	YTXZ112M2-2B-5.2KW		-
5	000209401A0000034	Bearing seat Ⅰ	000209401A0000034		-
6	000209401A0000040	Bearing seat Ⅱ	000209401A0000040		-
7	000209401D1000036	Travelling wheel	000209401D1000036		-
8	1020500695	Travelling switch	XCR-F17		-
9	1029901693	M822 cable drum collect point ring inner core	K530	M822 cable drum (Only use in travelling crane)	1

6.18 Appendix troubles and troubleshooting

Common troubles and troubleshooting of the crane

(2) Common troubles and troubleshooting of **Huichuan** frequency converter

No.	Trouble	Troubleshooting	Solution
02#	Accelerated overcurrent	a) The input circle of frequency converter exists grounding or short circuit; b) The control mode is parameter identification without vector; c) Accelerated time too short; d) Manual torque lift or V/F curve unsuitable; e) Low voltage; f) Start the point that is being rotated; g) Sudden loading during acceleration; h) Frequency converter selection is small;	a) Troubleshooting peripheral faults b) Click parameter identification; c) Prolong accelerated time; d) Adjust the manual torque lift or V/F curve; e) Adjust the voltage to normal range; f) Start speed tracking up or motor stop; g) Cancel sudden loading; h) Choose a more powerful frequency converter;
03#	Decelerate overcurrent	a) The input circle of frequency converter exists grounding or short circuit; b) The control mode is parameter identification without vector c) Decelerate time too short; d) Low voltage e) Sudden loading during deceleration; f) Frequency converter selection is small;	a) Troubleshooting peripheral faults; b) Click parameter identification; c) Prolong accelerated time; d) Adjust the voltage to normal range; e) Cancel sudden loading; f) Choose a more powerful frequency converter;

No.	Trouble	Troubleshooting	Solution
04#	Constant speed overcurrent	a) The input circle of frequency converter exists grounding or short circuit; b) The control mode is parameter identification without vector c) Decelerate time too short; d) Low voltage d) Sudden loading during operation; e) Frequency converter selection is small;	a) Troubleshooting peripheral faults; b) Click parameter identification; c) Adjust the voltage to normal range; d) Cancel sudden loading; e) Choose a more powerful frequency converter;
05#	Accelerated overvoltage	a) Input voltage high; b) During the acceleration, external forces drag the motor to run; c) Accelerated time too short; d) No brake unit and brake resistance;	a) Adjust the voltage to normal range; b) Cancel the additional force or add brake resistance; c) Prolong accelerated time; d) Add brake unit and resistance;
06#	Decelerate overvoltage	a) Input voltage is high; b) During the deceleration, external forces drag the motor to run; c) Decelerate time too short; d) No brake unit and brake resistance;	a) Adjust the voltage to normal range; b) Cancel the additional force or add brake resistance; c) Prolong decelerate time; d) Add brake unit and resistance;
07#	Constant speed overvoltage	a) Input voltage is high; b) During the deceleration, external forces drag the motor to run;	a) Adjust the voltage to normal range; b) Cancel the additional force or add brake resistance;
08#	Control power damage	a) Input voltage is out of regulation arrange;	a) Adjust the voltage to normal range;

No.	Trouble	Troubleshooting	Solution
09#	Undervoltage damage	a) Instantaneous power failure; b) frequency converter input voltage is out of specified range; c) Bus voltage is abnormal; d) The rectifier bridge and buffer resistance are abnormal; e) Abnormal drive board; f) Abnormal control board;	a) Reset the fault; b) Adjust the voltage to normal range; c) Seeking technical support; d) Seeking technical support; e) Seeking technical support; f) Seeking technical support;
10#	Frequency converter overload	a) Heavy load or motor blocking; b) Frequency converter selection is small;	a) Reduce load and check motor and mechanical condition; b) Choose a more powerful frequency converter;
11#	Motor overload	a) Motor protection parameters bE.01 are incorrectly set; b) Heavy load or motor blocking; c) Frequency converter selection is small;	a) Set this parameter correctly; b) Reduce load and check motor and mechanical condition; c) Choose a more powerful frequency converter;
12#	Input lack phase	a) Three-phase power supply is abnormal; b) Abnormal drive board; c) The surge protection board is abnormal; d) Abnormal main control board;	a) Check and eliminate the problems in peripheral circuits; b) Seeking technical support; c) Seeking technical support; d) Seeking technical support;

No.	Trouble	Troubleshooting	Solution
14#	Module over hot	a) The ambient temperature is too high; b) Air duct blockage; c) Fan damage; d) The module thermistor is damaged; e) Inverter module damage;	a) Lower the ambient temperature; b) Clean duct; c) Replace; d) Replace; e) Replace;
17#	Contactor damage	a) Drive board and power supply fault; b) Contactor fault;	a) Replace; b) Replace;
18#	Current detection damage	a) Hall device anomaly b) Abnormal drive board;	a) Replace; b) Replace;
19#	Motor tuning damage	a) Motor parameter is not set according to the nameplate; b) Parameter identification overtime;	a) Set the correct motor parameter according to nameplate; b) Check the down-lead form frequency converter to motor;
20#	Encoder damage	a) The encoder model does not match; b) Encoder connection error; c) Encoder damage; d) PG card fault;	a) Set the encoder model according to actual situation; b) Remove circle line fault; c) Replace; d) Replace;
23#	Ground damage	The motor shorted to the ground;	Replace cable or motor;
25#	Input lack phase	a) Abnormal down-lead form frequency converter to motor is abnormal; b) The three-phase frequency converter output is abnormal when the is running; c) Abnormal drive board; d) Abnormal module;	a) Troubleshooting peripheral faults; b) Check the three-phase motor winding and remove fault; c) Seeking technical support; d) Seeking technical support;

No.	Trouble	Troubleshooting	Solution
37#	Abnormal frequency direction	If the given operation frequency is opposite direction to the motor feedback the fault will be invalid by factory default;	Check the motor parameter setting are correct; Check whether the load heavy; Adjust the setting of bC.02;
38#	Abnormal frequency follow	The following error between frequency and motor feedback frequency is too large;	Check the motor parameter setting are correct; Check whether the load heavy Adjust the setting of bC.03 and bC.04;
40#	Current limiting fault	a) Heavy load or motor blocking; b) Frequency converter selection is small;	a) Reduce load and check motor and mechanical condition; b) Choose a more powerful frequency converter;
41#	Loose brake fault	The input of the loose brake feedback signal is incorrect;	Check the brake circuit connection; Check the function selection of the feedback input point of the control loose brake;
42#	Closed brake fault	The input of the closed brake feedback signal is incorrect;	Check the brake circuit connection; Check the function selection of the feedback input point of the control closed brake;
43#	Shaft-cooled motor runs overtime at low speed		Adjust the setting of b0.00 and b0.01; Pay attention to protect the motor from overheating;

No.	Trouble	Troubleshooting	Solution
44#	The forward and reverse operation instruction are valid simultaneously	The frequency converter detected forward and reverse operation instructions	Check the peripheral circuits at the forward and reverse operation command input points; Appropriately improve the terminal filtering time;
45#	Control rod is not zero	When the frequency converter is power on, a given frequency signal is detected;	Ensure that the signal from the standby normally on input point is valid during power-on; Wait until the system initialization is complete before entering commands.

7 SPARE PARTS

7.1 Foreword

Dear Users:

If you need maintenance or fittings for your equipment, please check the order number and the designations of the parts you need in the spare parts manual at first, and inform the local after-sales department of ZOOMLION.

7.2 Configuration of the tower crane

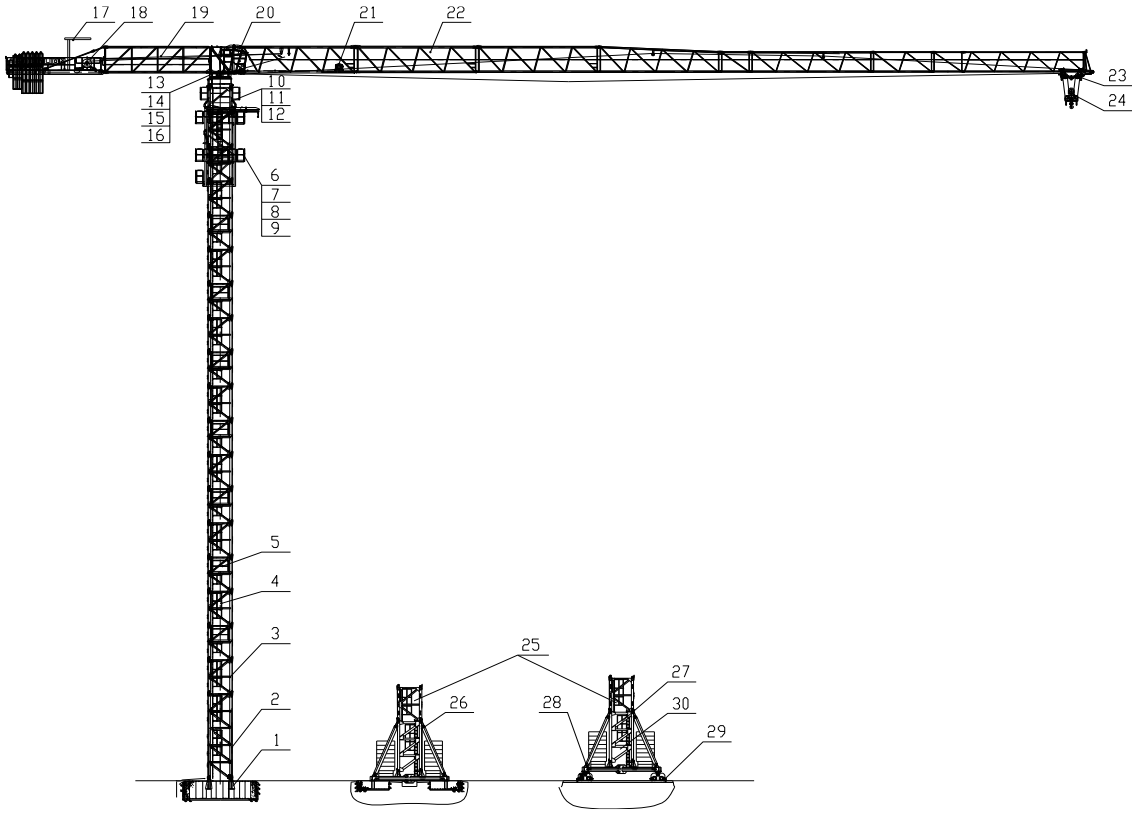


Fig. 7-1 Parts indications of the **WA7025-10E** Tower Crane

Table 7-1 Spare parts list of the WA7025-10E Tower Crane

No.	Designation	Order No.	Code	Notes	Qty
1	Outrigger	000271615DT000000	WA7015-10E.15		1/0
2	Base tower section	000209012A2300000	L68G23	Rung ladder	1/0
		000209012A9200000	L68G23-C	Incline ladder	
3	Tower section	000209012A2600000	L68A4	Rung ladder	17
		000209012A3600000	L68A1A	Incline ladder	17
4	Passageway J	000209014A1300000	L68TDJ	Rung ladder	9
5	Passageway H	000209014A1200000	L68TDH	Rung ladder	8/9
6	Climbing equipment	000261811FT000000	WA7527-20D.11D		1
7	Climbing mechanism	000251812AT000000	WA7527-16D.12		1
8	Climbing hydraulic cylinder	000200429A0100000	YG180/125-2160/1640-31.5		1
9	Pump station	000209501A8700000	BZ11-31.5F		1
10	Erection platform	000281720AT000000	WA7025-12E.20		1
11	Mounting device	000270319AT000000	T6513-8E.19		1
12	Transition section	000209012A1010000	L68C3C		1
13	Slewing support	000281710HT000000	WA7025-12E.10C		1
14	Slewing ring	1031500447	QWA1600.50Z5		1
15	Turntable	000201709CT000000	R275-10RB.09B		1
16	Slewing mechanism	000209289A6700000	S75CA-130LB12/14A		1
		000209289A6800000	S75CN-130LB12/14A		
17	Derrick	000209914B0006000	TCBG1500.1A	Optional	1
18	Counter jib	000281701JT000000	WA7025-12KA.01C		1
19	Hoisting mechanism	000209101A6600000	H37FC25-530B		1
20	Cabin	1130001053	CR6		1
21	Trolley mechanism	000209370A5000000	T55FC70-b(D)		1
22	Jib	000281705JT000000	WA7025-12E.05		1
23	Trolley	000209707L0100000	XC12F		1
24	Hook	000209606A1700000	DG10K		1
25	Tower section (for chassis)	000209012A5800000	L68B7A	Rung ladder	1/0
		000209012A6200000	L68B7A-C	Incline ladder	1/0
26	Stationary	000200614D1000000	TC6517B-10E.14	Rung ladder	1/0

No.	Designation	Order No.	Code	Notes	Qty
	chassis	000281714AT000000	WA7015-10E(Abroad).14	Incline ladder	
27	Travelling chassis	000200623A1000000	TC6517B-10E.23	Rung ladder	1/0
		000281723AT000000	WA7015-10E(Abroad).23	Incline ladder	
28	Powered wheel bogie	000209401D1000000	ZA52-D		2/0
29	Idler wheel bogie	000209402D1000000	B52-D		2/0

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WA7025-10E Spare Parts Book

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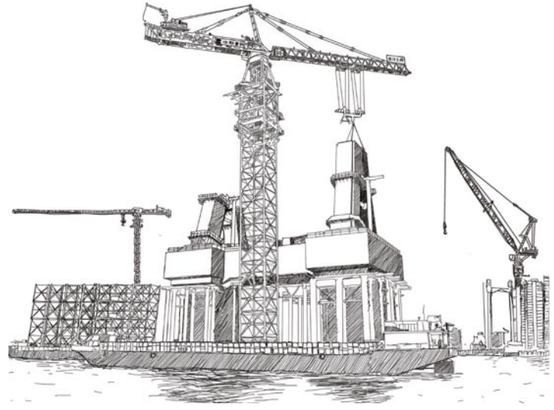
WA7025-10E Tower Crane

Spare Parts Book



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WA7025-10E

Spare Parts Manual

000271700BTE00010

Version 1.0

2024-08-15

To Users

Dear users:

Thank you for choosing ZOOMLION tower crane.

This security prompts are an integral and important part of products. Please read carefully and fully understand it before use tower crane.

Tower crane belongs to special equipment, which has very strict safety requirements. Any illegal operations are likely to result in equipment damage, and more likely to cause death or serious injury, economic loss and social impact of security incidents. To ensure product safety and reliable function, please strict compliance with Tower crane safety tips. The consequences of violating the provisions, our company will Not bear! If in doubt of the equipment operation, please contact our company's service engineers, we will provide you effective technical support in time.

When transfer the tower crane, be sure the security prompts to the recipient.

ZOOMLION

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WA7025-10E

Spare Parts Manual

Chapter 1 Jib

Jib i
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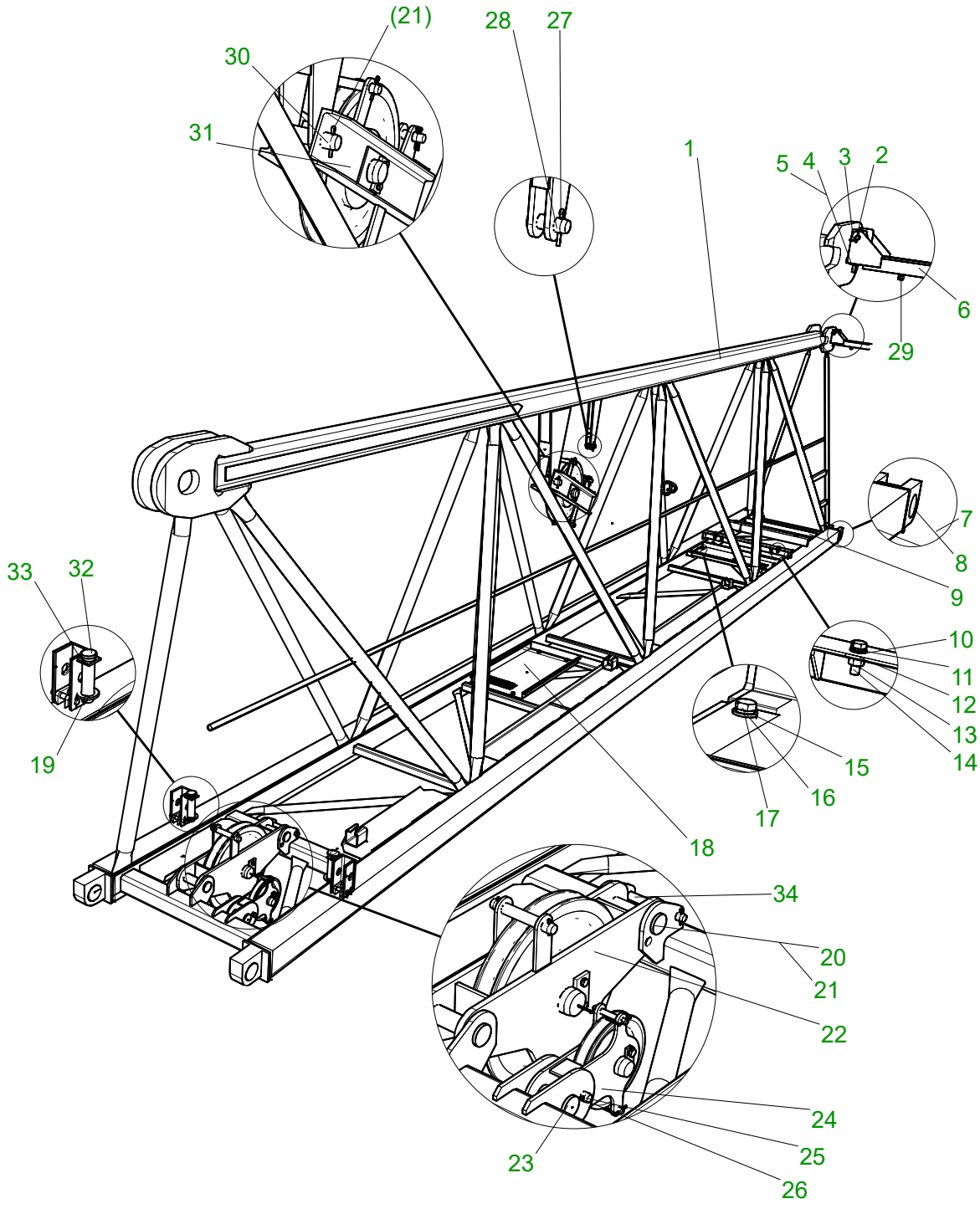
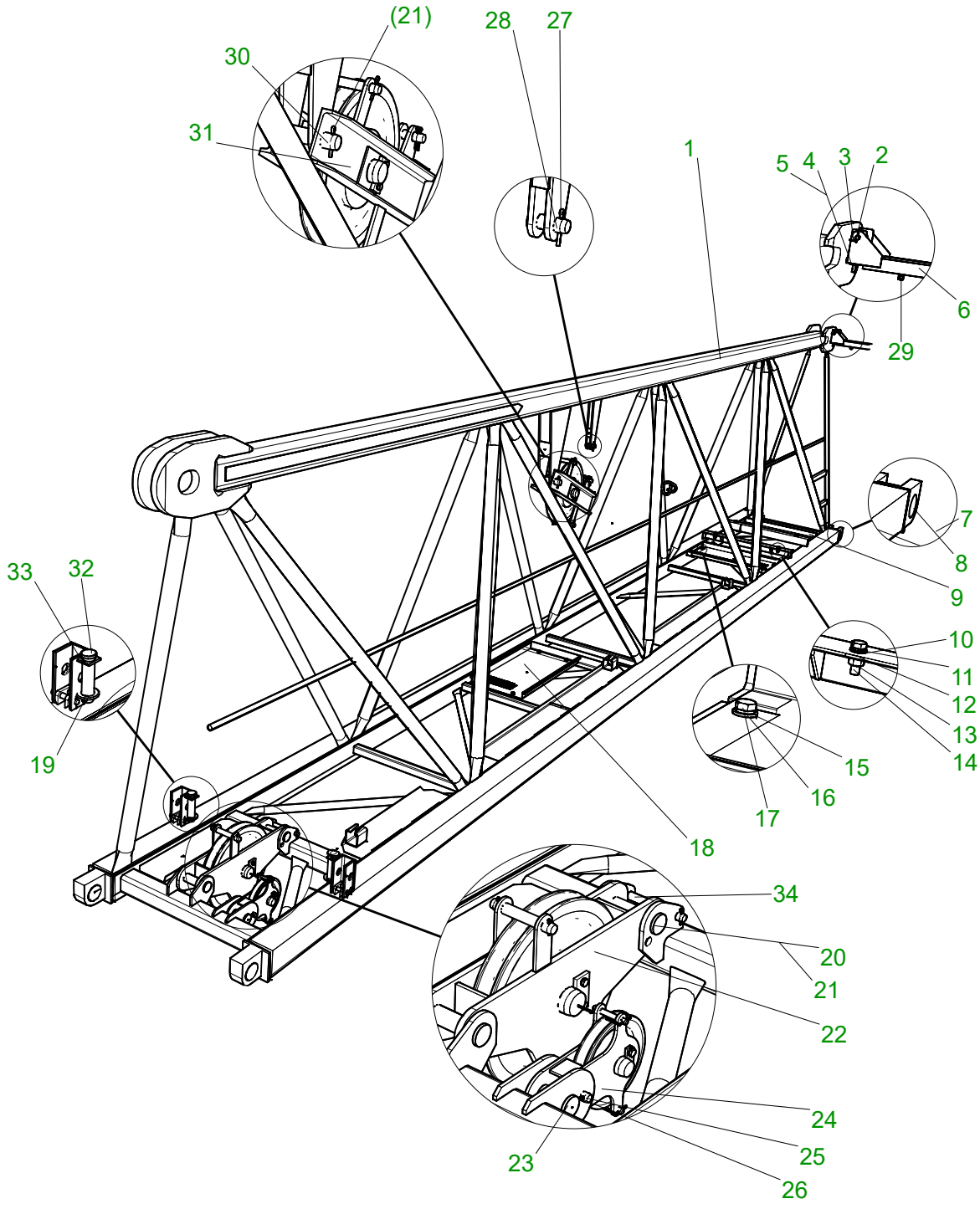


Jib i
(000219705CT001000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib i structure	000219705CT101000			1
2	Pin	000209910A0161601		16×160	1
3	Pin	1040500228	GB/T91-2000	4×32	4
4	Pin	000209910A4182501		90×250	1
5	Pin	1040500646	GB/T91-2000	13×140	2
6	Pin tray	000232805BT002200			1
7	Pin	000231805AT003001		80×180/230	2
8	Pin	000209910A0161102		16×110	2
9	Walkway	000219705CT001001		Tp2	2
10	Washer	1040300052	GB/T97.1-2002	16-200HV	4
11	Washer	1040300065	GB/T93-1987	16	4
12	Washer	1040300309	GB/T853-1988	16	4
13	Nut	1040200110	GB/T6170-2000	M16-8	4
14	Bolt	1040000198	GB/T5783-2016	M16×50-8.8	4
15	Washer	1040300041	GB/T97.1-2002	12-200HV	12
16	Washer	1040300054	GB/T93-1987	12	12
17	Bolt	1040002440	GB/T5783-2016	M12×45-8.8	13

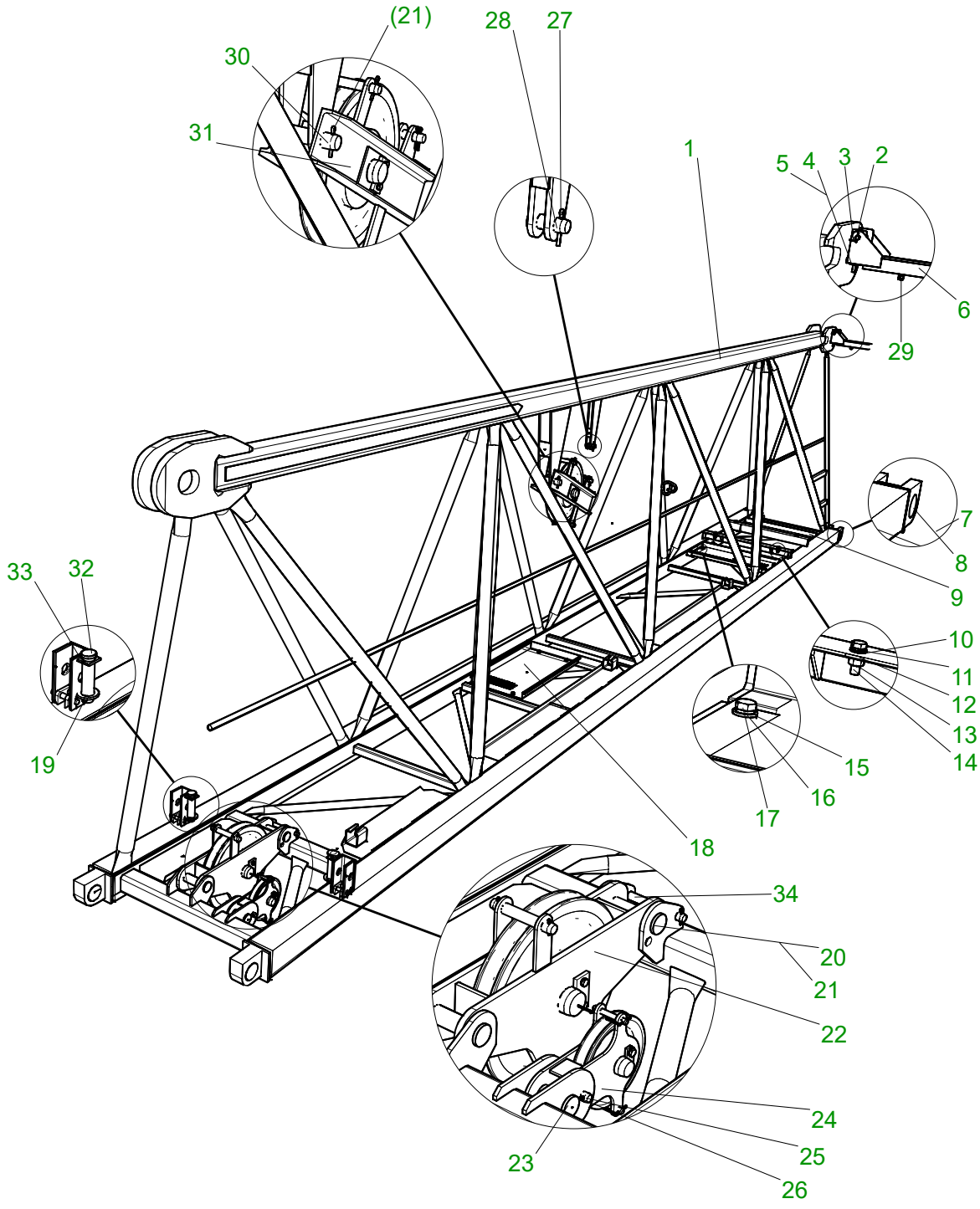
Jib i
(000219705CT001000)



Jib i
(000219705CT001000)

No.	Name	Numbering code	Code	Specification	Quantity
18	Walkway	000290505CT001002		Tp2	1
19	Pin	1040500222	GB/T91-2000	8×80	2
20	Pin	000209910A108171		40×170	2
21	Pin	1040500217	GB/T91-2000	8×63	4
22	Hoisting pulley assembly	000291605ET001500			1
23	Pin	000209910A108101		40×100	1
24	Trolley pulley assembly	000290505CT001400			1
25	Pin	000209910A304111		20×110	1
26	Pin	1040500253	GB/T91-2000	5×32	4
27	Pin	1040500216	GB/T91-2000	6.3×50	2
28	Pin	000209910A105051		25×50	2
29	Nut	1040200096	GB/T6170-2000	M12-8	1
30	Pin	000209910A108131		40×130	1
31	Hoisting limiter rack	000291605ET001600			1

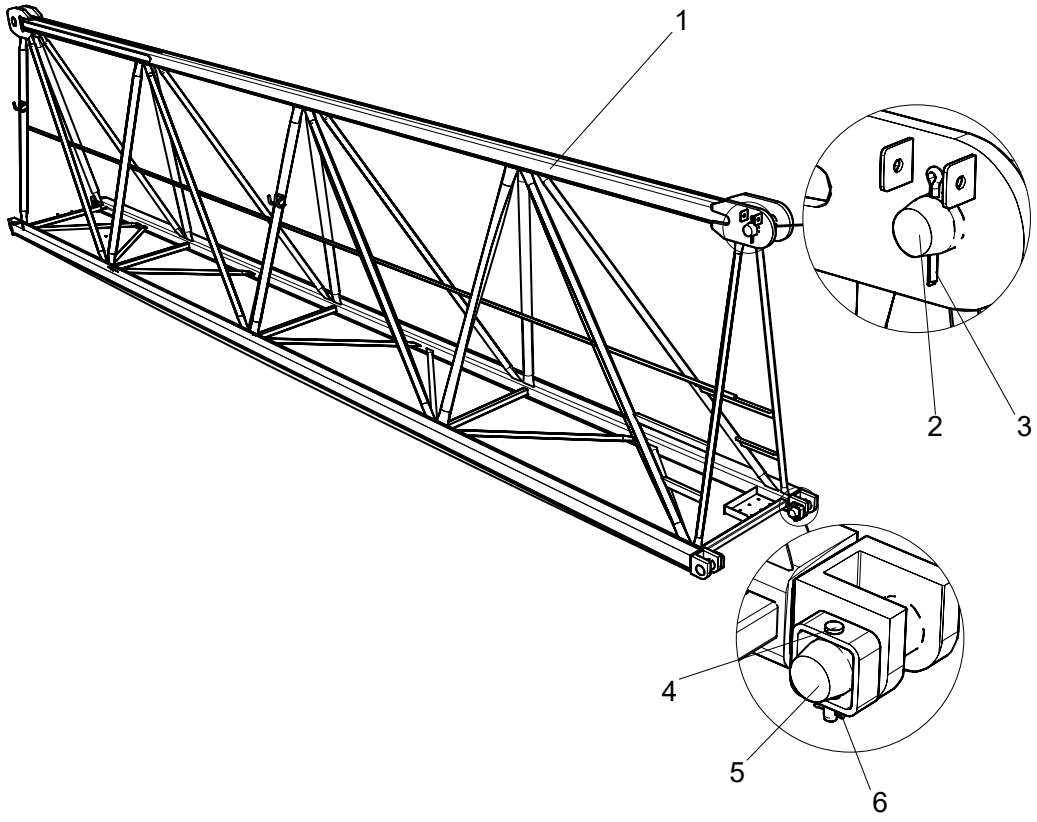
Jib i
(000219705CT001000)



Jib i
(000219705CT001000)

No.	Name	Numbering code	Code	Specification	Quantity
32	Pin	000209910A1071401		35×140	2
33	Washer 36	000290505CT001003		Tp6	2
34	Pin	000209910A3041801		20×180	1

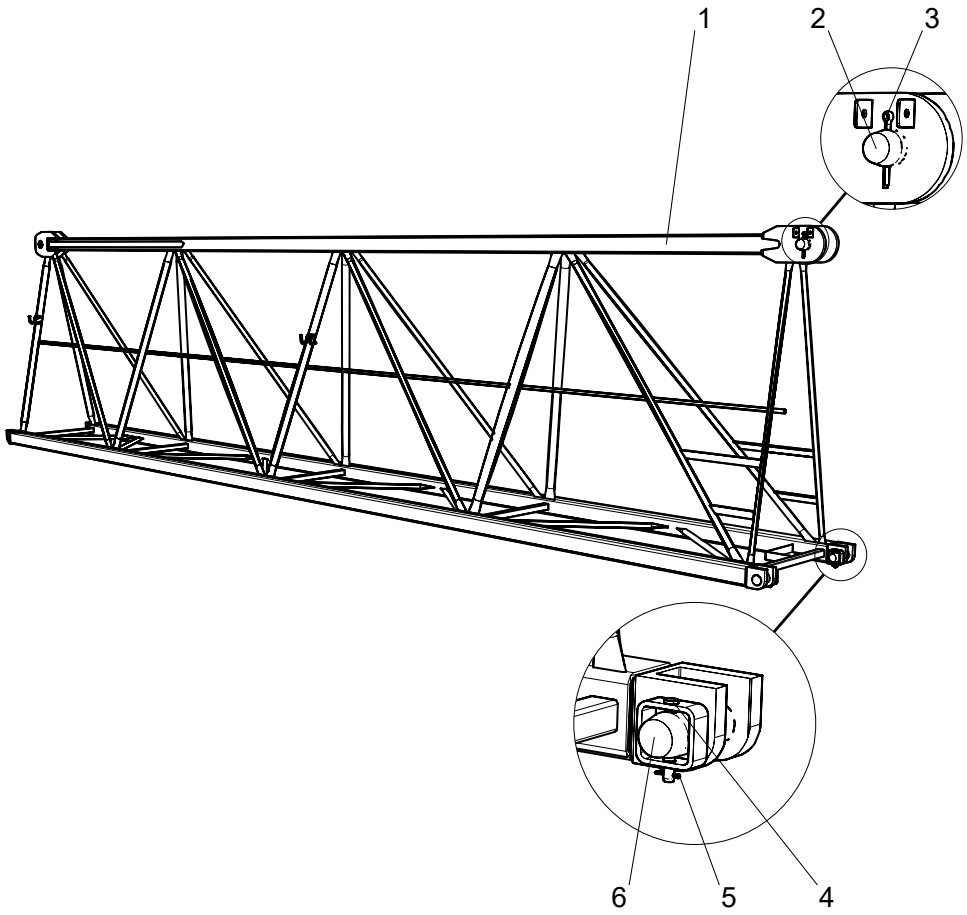
Jib □
(000219705CT002000)



Jib □
(000219705CT002000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib Ⅱ structure	000219705CT002100			1
2	Pin	000209910A4162201		80×220	1
3	Pin	1040500646	GB/T91-2000	13×140	2
4	Pin	000209910A0161102		16×110	2
5	Pin	1040500228	GB/T91-2000	4×32	2
6	Pin	000232805AT003001		70×160/203	2

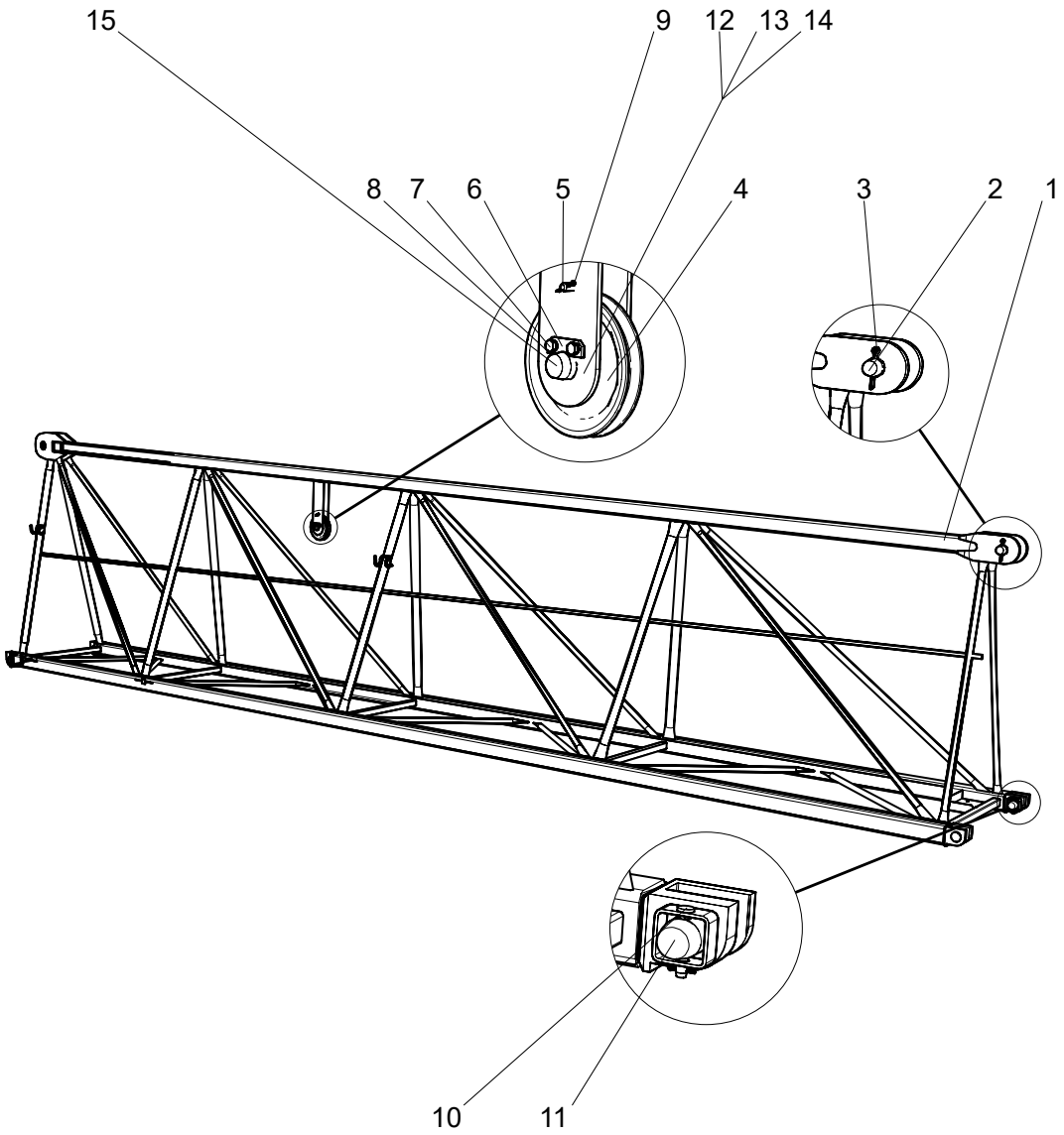
Jib □
(000281705JT003000)



Jib □
(000281705JT003000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib Ⅲ structure	000281705JT003100			1
2	Pin	00020991 0A4162101		80×210	1
3	Pin	1040500646	GB/T91-2000	13×140	2
4	Pin	00020991 0A0161102		16×110	2
5	Pin	1040500228	GB/T91-2000	4×32	2
6	Pin	00023280 5AT003001		70×160/203	2

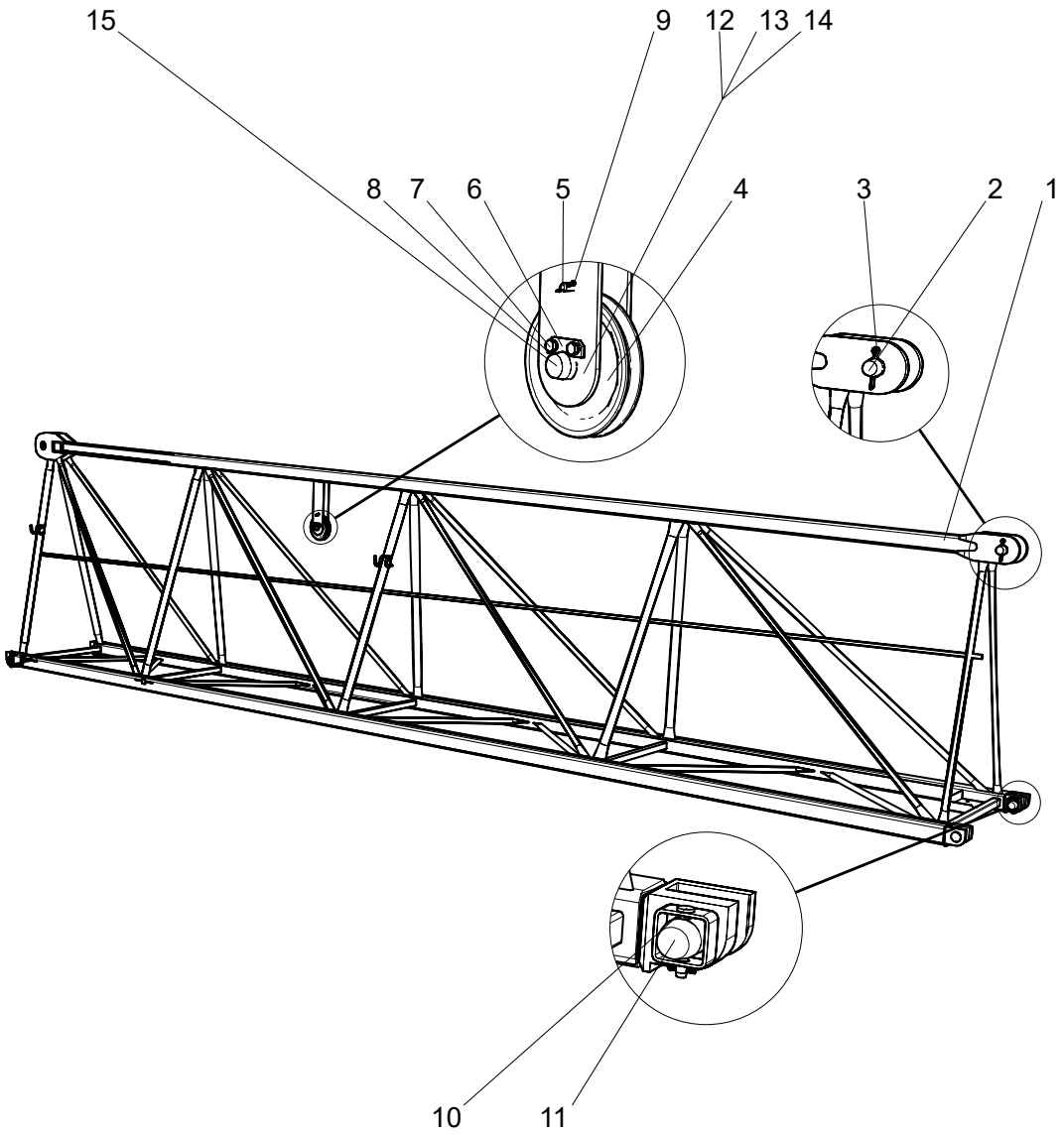
Jib □
(000281705JT004000)



Jib □
(000281705JT004000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib IV structure	000281705JT004100			1
2	Pin	000209910A4121801		60×180	1
3	Pin	1040500965	GB/T91-2000	13×110	2
4	Pulley	000209906A0017000			1
5	Pin	000209910A0000515		12×80	1
6	Shaft-end baffle	000232805AR004001		t6	1
7	Bolt	1040000116	GB/T5783-2016	M10×20-8.8	2
8	Washer	1040300067	GB/T93-1987	10	2
9	Pin	1040500097	GB/T91-2000	4×30	4
10	Pin	000270405BT007002		φ16×90/105	2
11	Pin	000270405AT002001		60×143/190	2
12	Shaft sleeve	000210105A0010002		Ow48×4	2
13	Deep groove ball bearing	1050201563	GB/T276-2004	6208-2RS1	2
14	Retainer ring	1040300322	GB/T893.2-1986	80	2

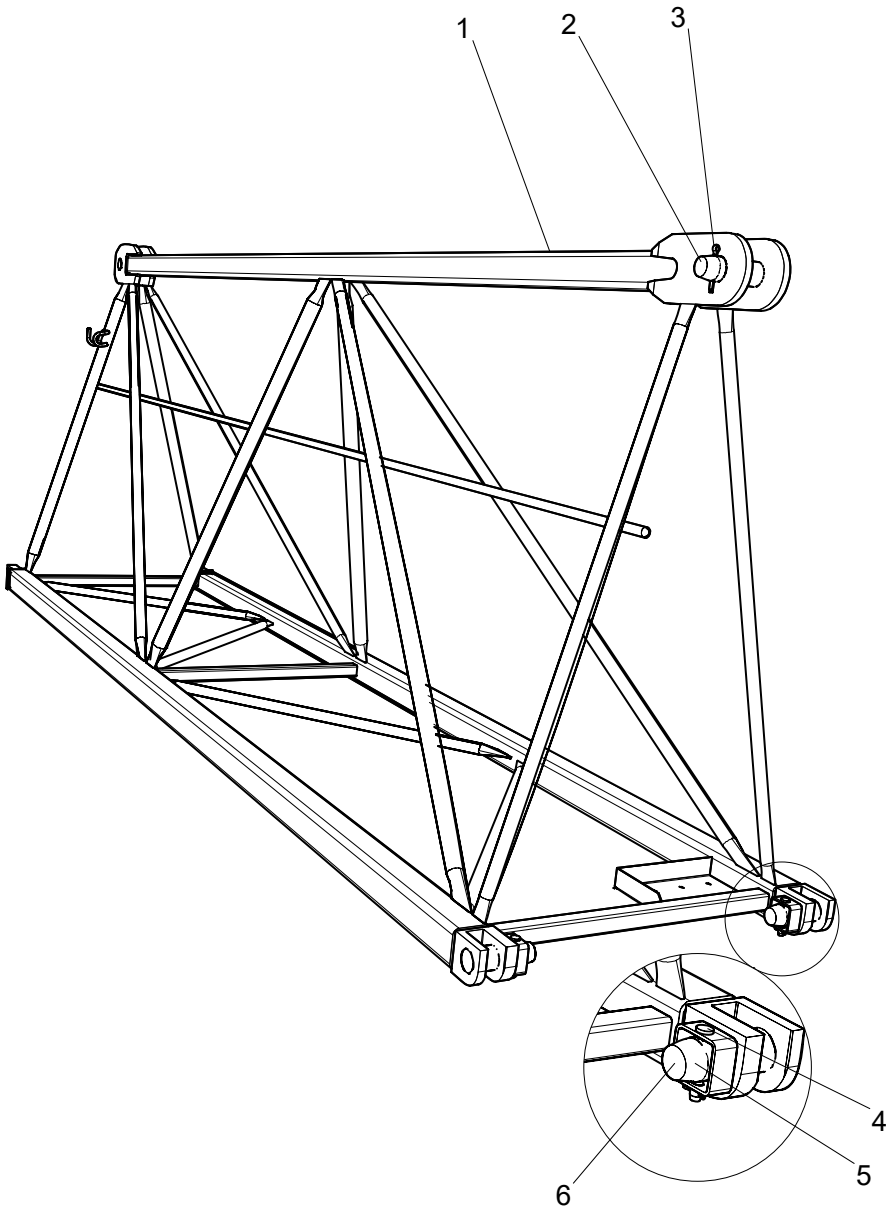
Jib □
(000281705JT004000)



Jib □
(000281705JT004000)

No.	Name	Numbering code	Code	Specification	Quantity
15	Pin	000270405DT003001		φ40×68/100	1

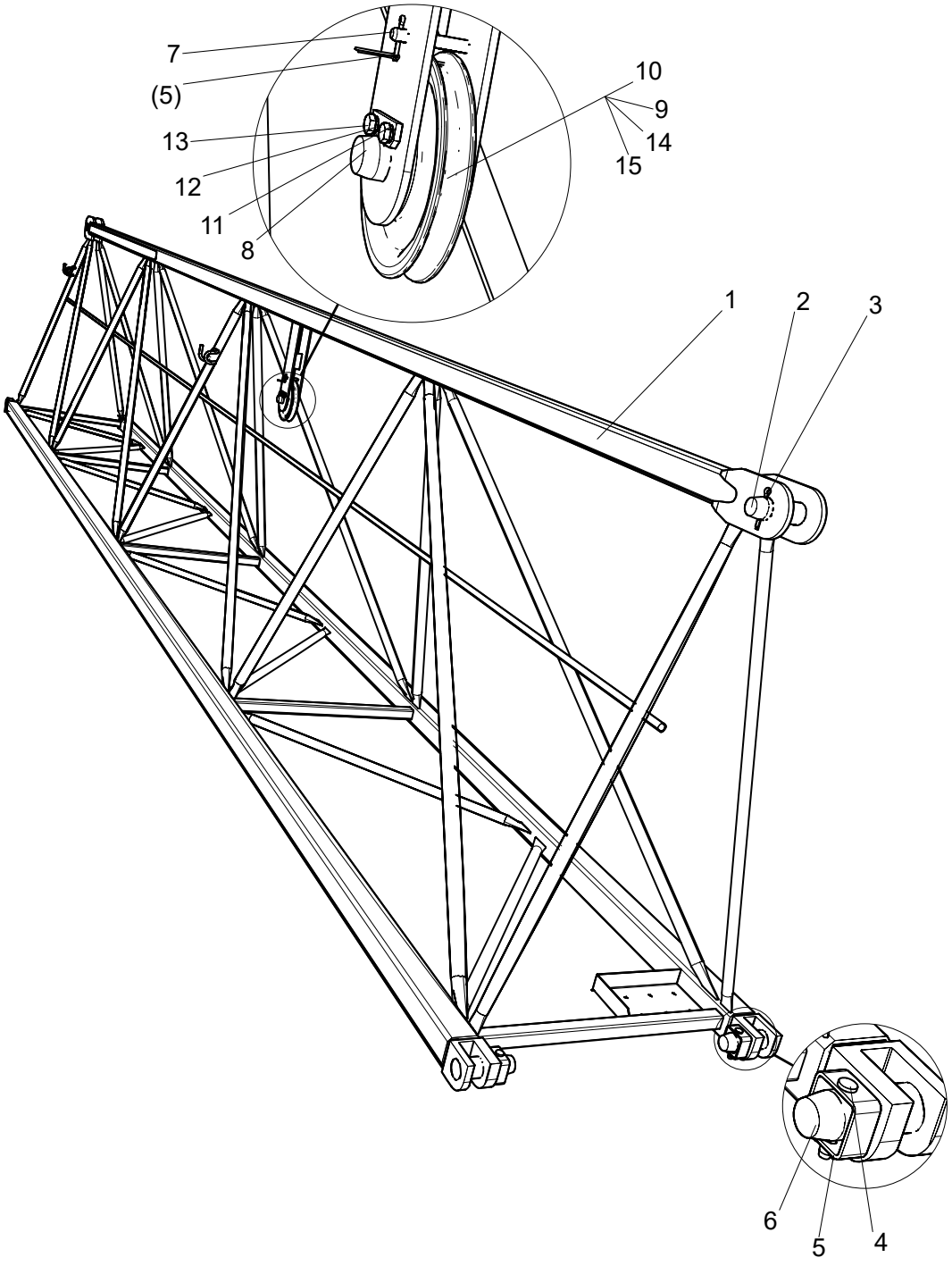
Jib □
(000219705CT005000)



Jib □
(000219705CT005000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib V structure	000219705CT005100			1
2	Pin	000209910A412160 1		60×160	1
3	Pin	1040500186	GB/T91-2000	10×90	2
4	Pin	000270405BT007002		φ16×90/105	2
5	Pin	1040500228	GB/T91-2000	4×32	2
6	Pin	000231805AT009001		60×133/182	2

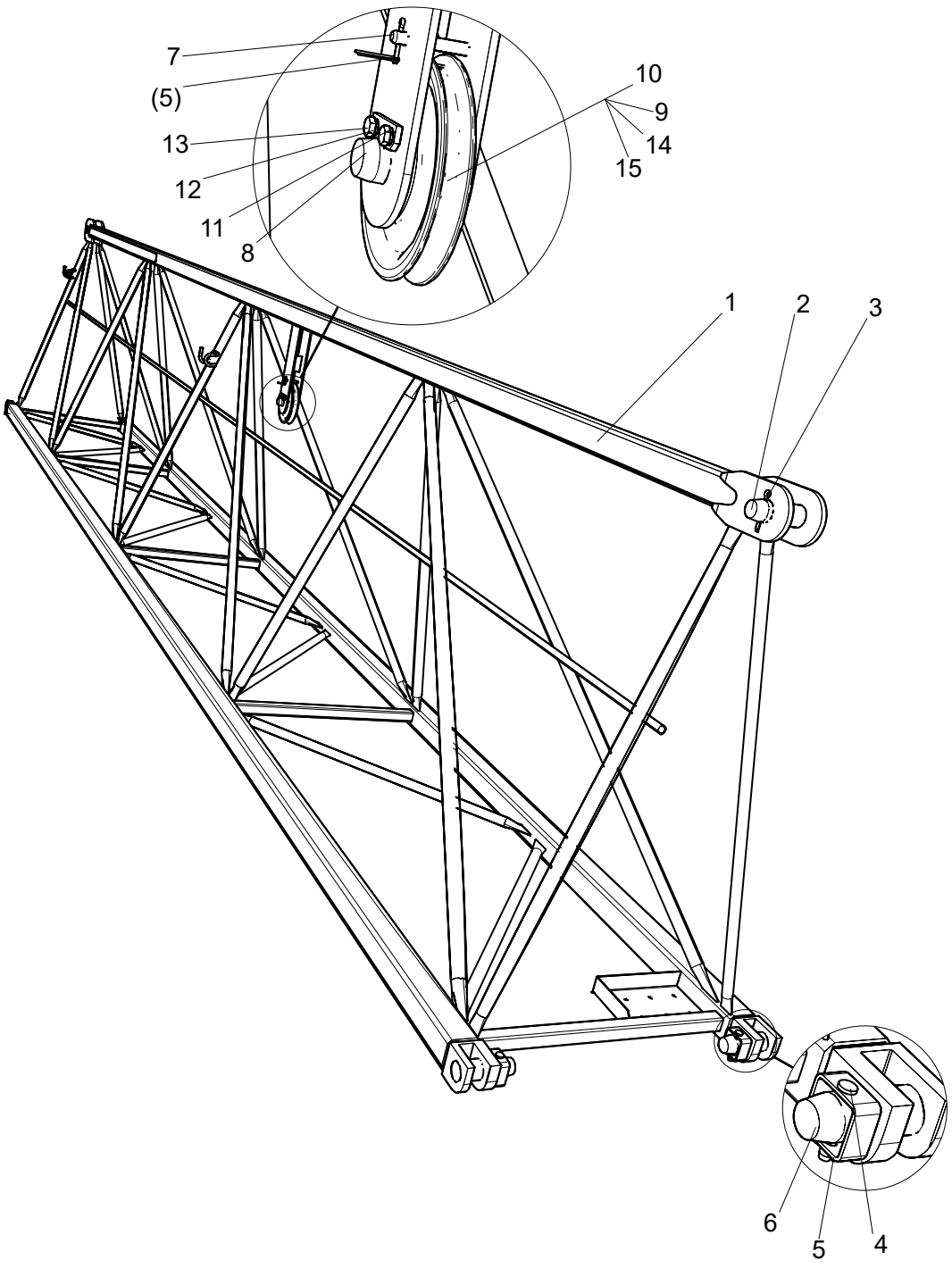
Jib □
(000219705CT006000)



Jib □
(000219705CT006000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib VI structure	000219705CT006100			1
2	Pin	000209910A4121501		60×150	1
3	Pin	1040500186	GB/T91-2000	10×90	2
4	Pin	000270405BT007002		φ16×90/105	2
5	Pin	1040500228	GB/T91-2000	4×32	4
6	Pin	000231805AT009001		60×133/182	2
7	Pin	000209910A0000515		12×80	1
8	Pin	000270405DT003001		φ40×68/100	1
9	Retainer ring	1040300322	GB/T893.2-1986	80	2
10	Pulley	000209906A0017000			1
11	Shaft-end baffle	000210105A0010001		Tp6	1
12	Washer	1040300067	GB/T93-1987	10	2
13	Bolt	1040000116	GB/T5783-2016	M10×20-8.8	2
14	Shaft sleeve	000210105A0010002		Ow48×4	2

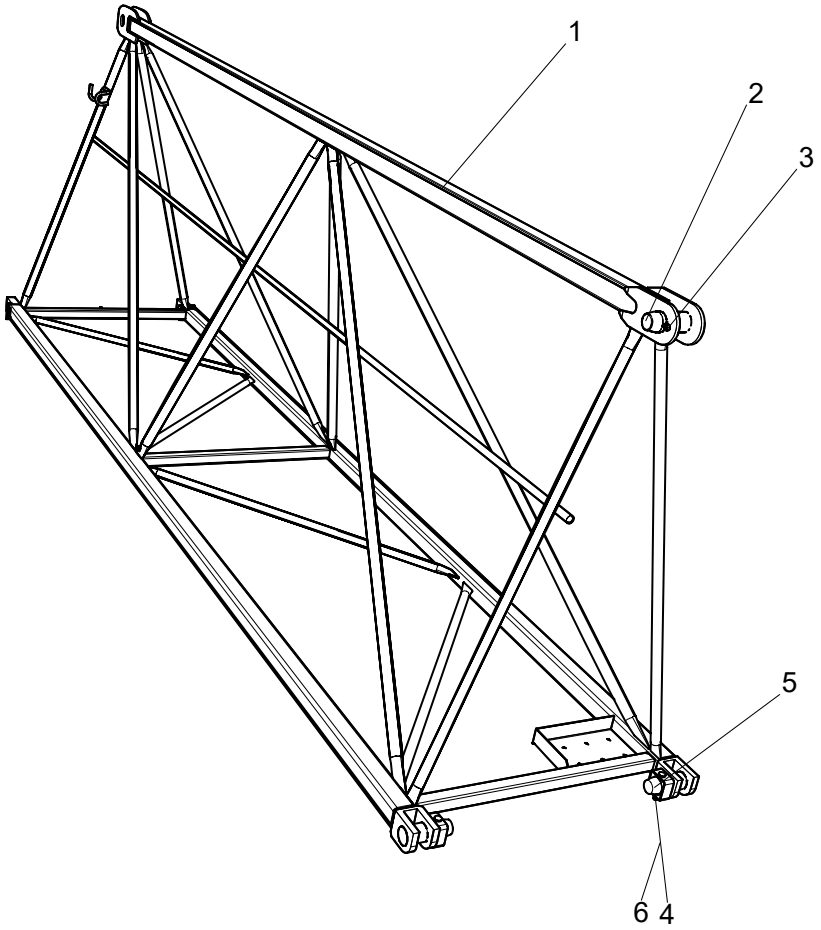
Jib □
(000219705CT006000)



Jib □
(000219705CT006000)

No.	Name	Numbering code	Code	Specification	Quantity
15	Deep groove ball bearing	1050201563	GB/T276-2004	6208-2RS1	2

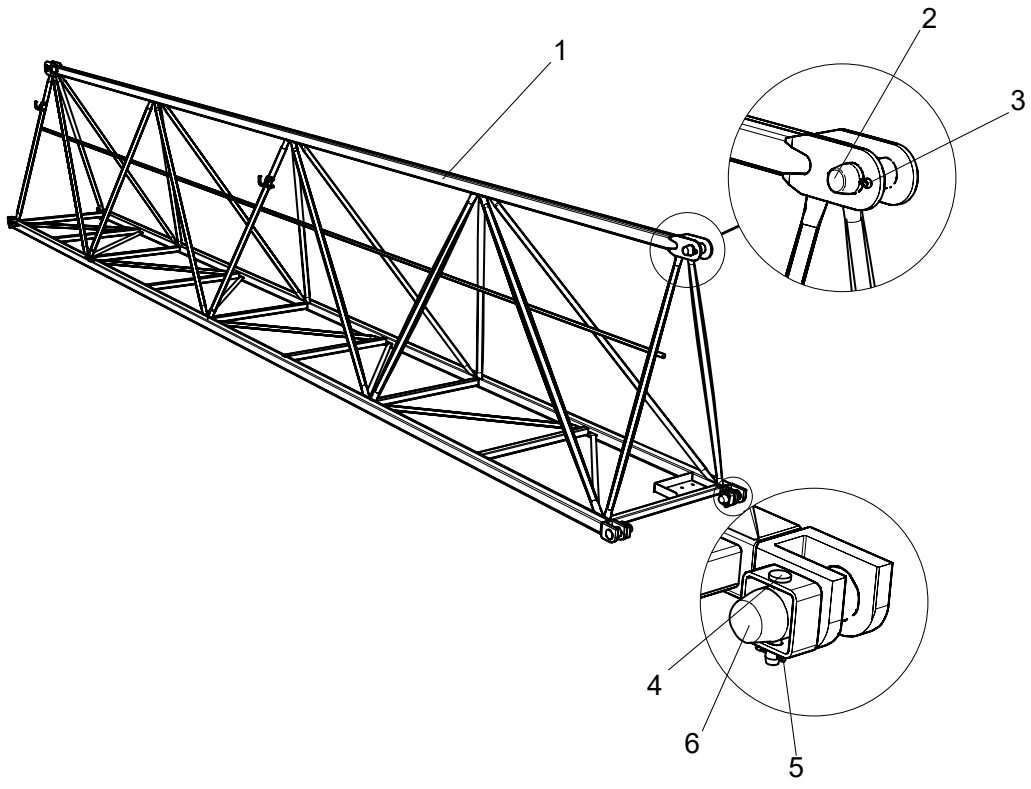
Jib □
(000219705CT007000)



Jib □
(000219705CT007000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib Ⅶ structure	000219705CT007100			1
2	Pin	000209910A4121201		60×120	1
3	Pin	1040500186	GB/T91-2000	10×90	2
4	Pin	000270405BT007002		φ16×90/105	2
5	Pin	1040500228	GB/T91-2000	4×32	2
6	Pin	000231805AT008001		60×121/170	2

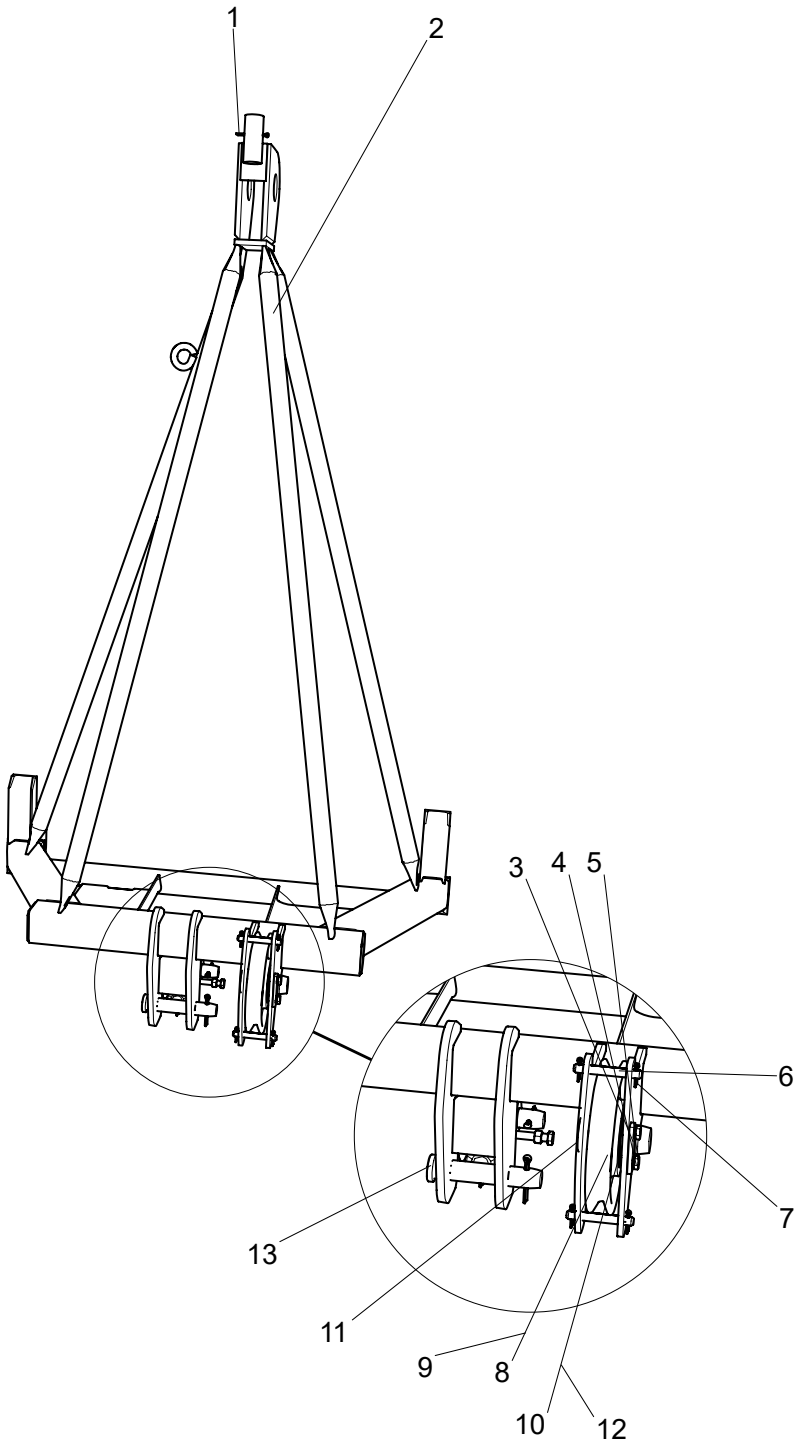
Jib □
(000219705CT008000)



Jib □
(000219705CT008000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib structure Ⅷ	000219705CT008100			1
2	Pin	000209910A4121201		60×120	1
3	Pin	1040500186	GB/T91-2000	10×90	2
4	Pin	000270405BT007002		φ16×90/105	2
5	Pin	1040500228	GB/T91-2000	4×32	2
6	Pin	000231805AT008001		60×121/170	2

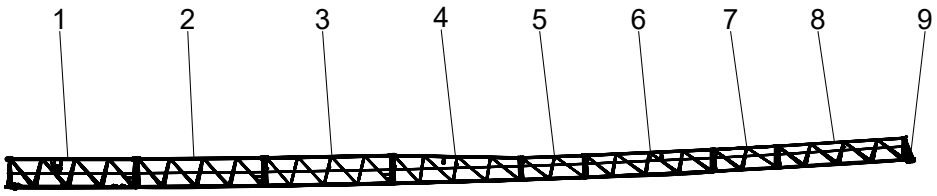
Jib end
(000270505FT008000)



Jib end
(000270505FT008000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Pin	1040500215	GB/T91-2000	5×63	1
2	Jib end structure	000270505FT008100			1
3	Shaft-end baffle	000210105A010001		Tp6	1
4	Washer	1040300067	GB/T93-1987	10	2
5	Bolt	1040000116	GB/T5783-2016	M10×20-8.8	2
6	Pin	000209910A000051		12×80	2
7	Pin	1040500298	GB/T91-2000	4×25	4
8	Pulley	000209906A001700			1
9	Retainer ring	1040300322	GB/T893.2-1986	80	2
10	Deep groove ball bearing	1050201563	GB/T276-2004	6208-2RS1	2
11	Pin	000270405DT003001		φ40×68/100	1
12	Shaft sleeve	000210105A010002		Ow48×4	2
13	Anti-twist device	000209923A000290			1

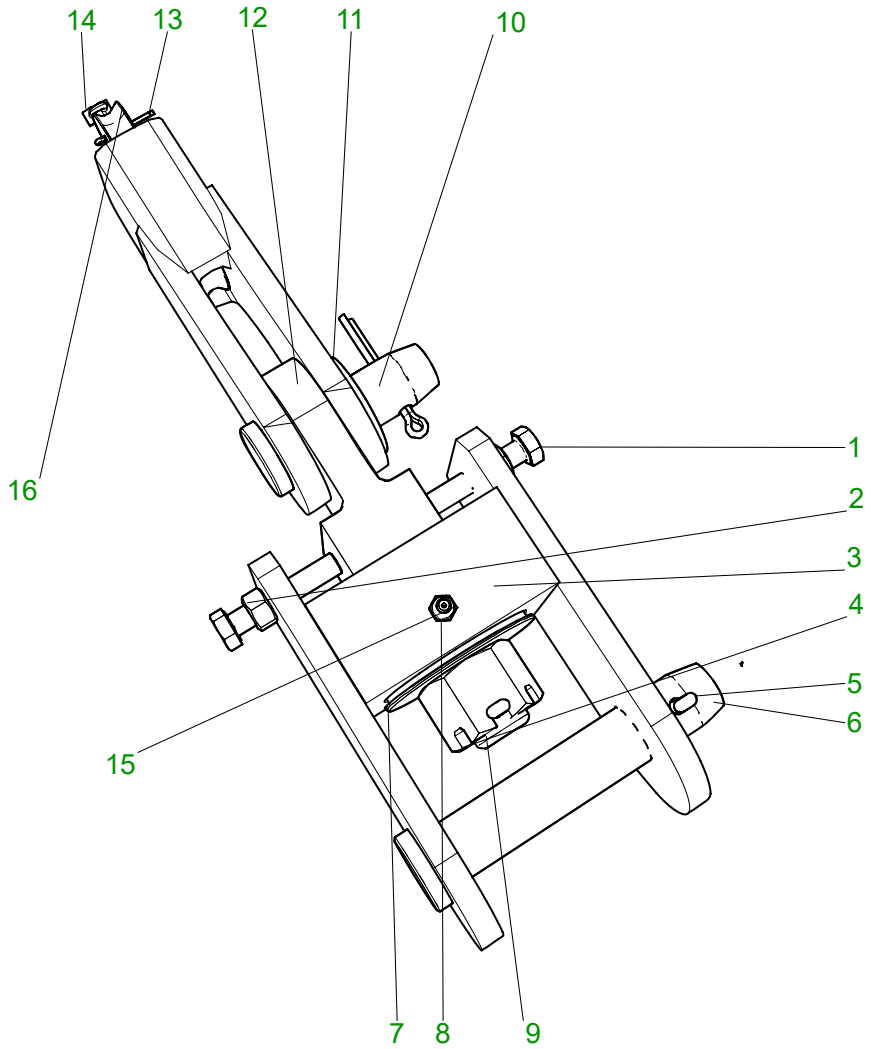
Jib
(000281705JT000000)



Jib
(000281705JT000000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Jib i	000219705CT001000			1
2	Jib Ⅱ	000219705CT002000			1
3	Jib Ⅲ	000281705JT003000			1
4	Jib IV	000281705JT004000			1
5	Jib Ⅴ	000219705CT005000			1
6	Jib VI	000219705CT006000			1
7	Jib Ⅶ	000219705CT007000			1
8	Jib Ⅷ	000219705CT008000			1
9	Jib end	000270505FT008000			1

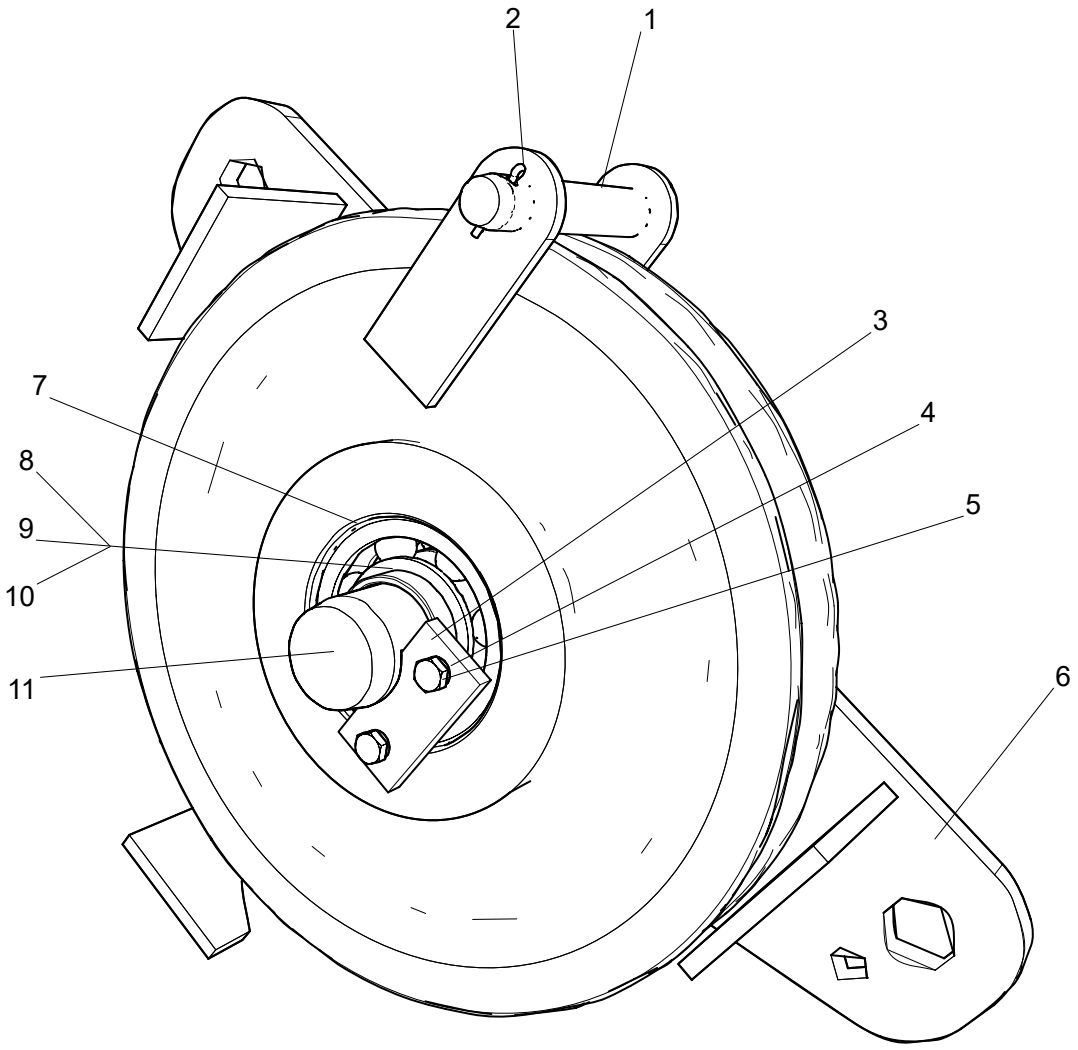
Anti-twist device
(000209923A0002900)



Anti-twist device (000209923A0002900)

No.	Name	Numbering code	Code	Specification	Quantity
1	Bolt	1040000251	GB/T5783-2016	M12×60-8.8	2
2	Nut	1040200096	GB/T6170-2000	M12-8	2
3	Lug seat	000209923A0002110			1
4	Nut	1040200215	GB/T6178-1986	M30-8	1
5	Pin	1040500224	GB/T91-2000	6.3×63	3
6	Pin	000200914A0000011		30×140	1
7	Platen	000209923A0002101			1
8	Trust ball bearing	1050200429	GB/T301-1995	51308	1
9	Shaft	000209923A0002102		Tp50	1
10	Pin	000209910A0000130		30×70	1
11	Washer	1040300074	GB/T97.1-2002	30-200HV	2
12	Wedge sleeve	1140117274	14-129KN		1
13	Pin	1040500003	GB/T91-2000	2.5×30	1
14	Rope clip	1090100354	GB/T5976-1986	14KTH	1
15	Oil cup	1080000206	JB/T7940.1-	M10×1	1
16	Wedge	1140117276	14-129.0KN		1

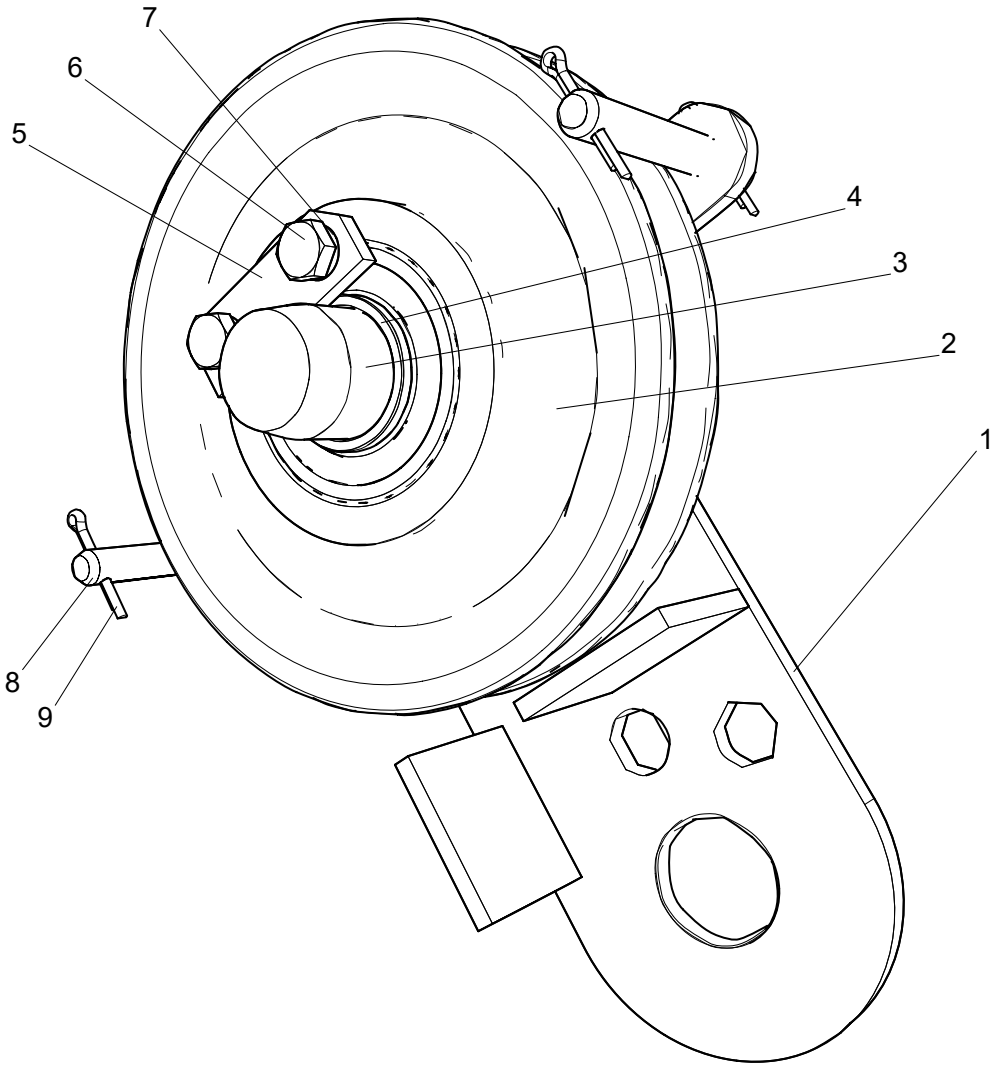
Hoisting pulley assembly
(000291605ET001500)



Hoisting pulley assembly (000291605ET001500)

No.	Name	Numbering code	Code	Specification	Quantity
1	Lock pin	000209910A3051501		25×150	1
2	Pin	1040500097	GB/T91-2000	4×30	2
3	Locking plate	000209605A0000018			1
4	Washer	1040300067	GB/T93-1987	10	2
5	Bolt	1040000114	GB/T5783-2016	M10×25-8.8	2
6	Hoisting pulley support	000291605ET001510			1
7	Pulley	000209906A0040051			1
8	Shaft sleeve	000201105B0000402			2
9	Deep groove ball bearing	1050202084	GB/T276-2013	6312-2RS	2
10	Retainer ring	1040300281	GB/T893.2-1986	130	2
11	Pulley shaft	000251705BT001801		φ60×134/176	1

Trolley pulley assembly
(000290505CT001400)



Trolley pulley assembly (000290505CT001400)

No.	Name	Numbering code	Code	Specification	Quantity
1	Trolley pulley support	000290505CT001410			1
2	Pulley assembly	000290505CT001420			1
3	Pin	000270405DT003001		φ40×68/100	1
4	Shaft sleeve	000210105A001002		Ow48×4	2
5	Shaft-end baffle	000210105A001001		Tp6	1
6	Bolt	1040000116	GB/T5783-2016	M10×20-8.8	2
7	Washer	1040300067	GB/T93-1987	10	2
8	Pin	000209910A000051 5		12×80	2
9	Pin	1040500228	GB/T91-2000	4×32	4

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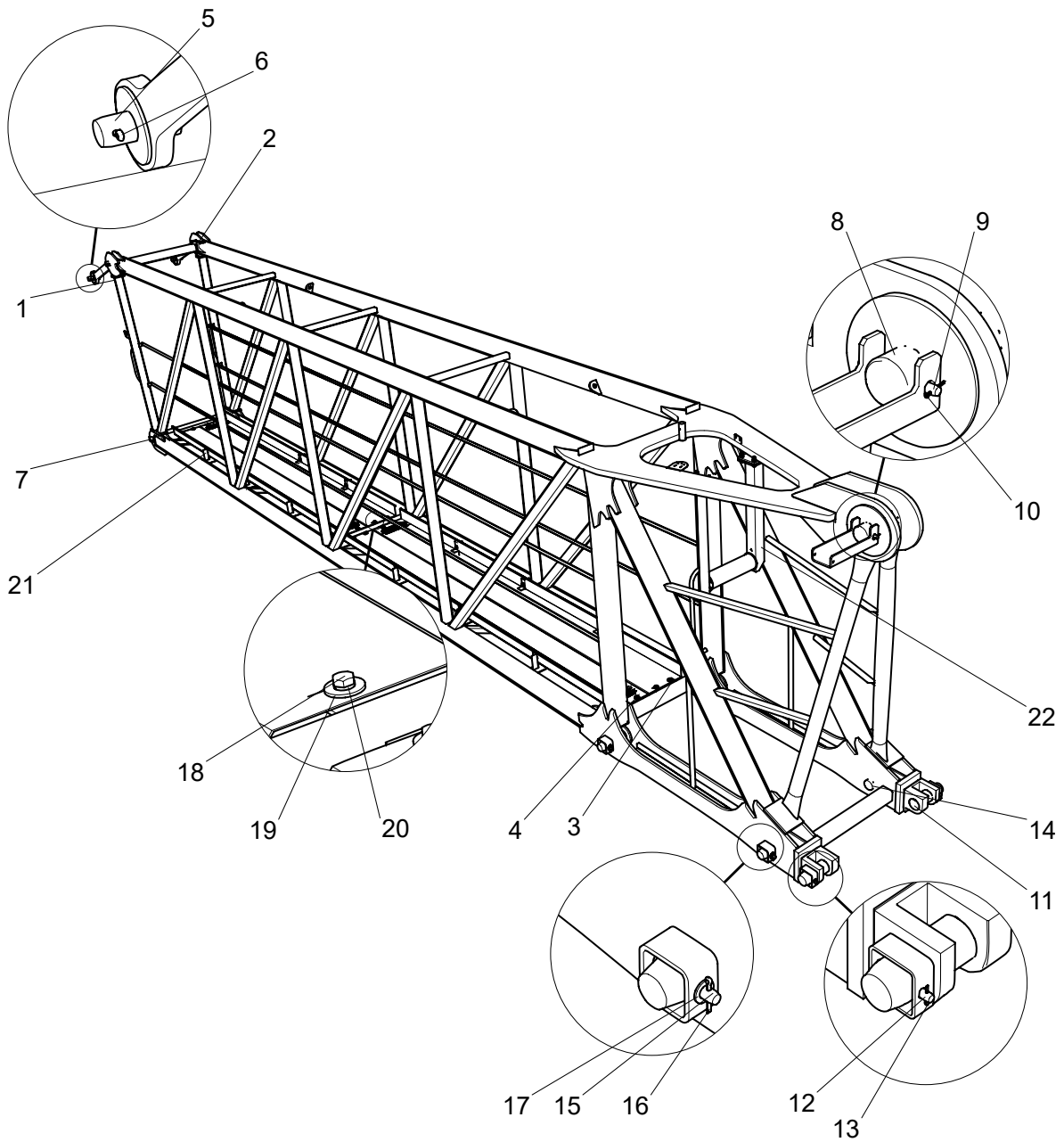
WA7025-10E

Spare Parts Manual

Chapter 2 Counter jib

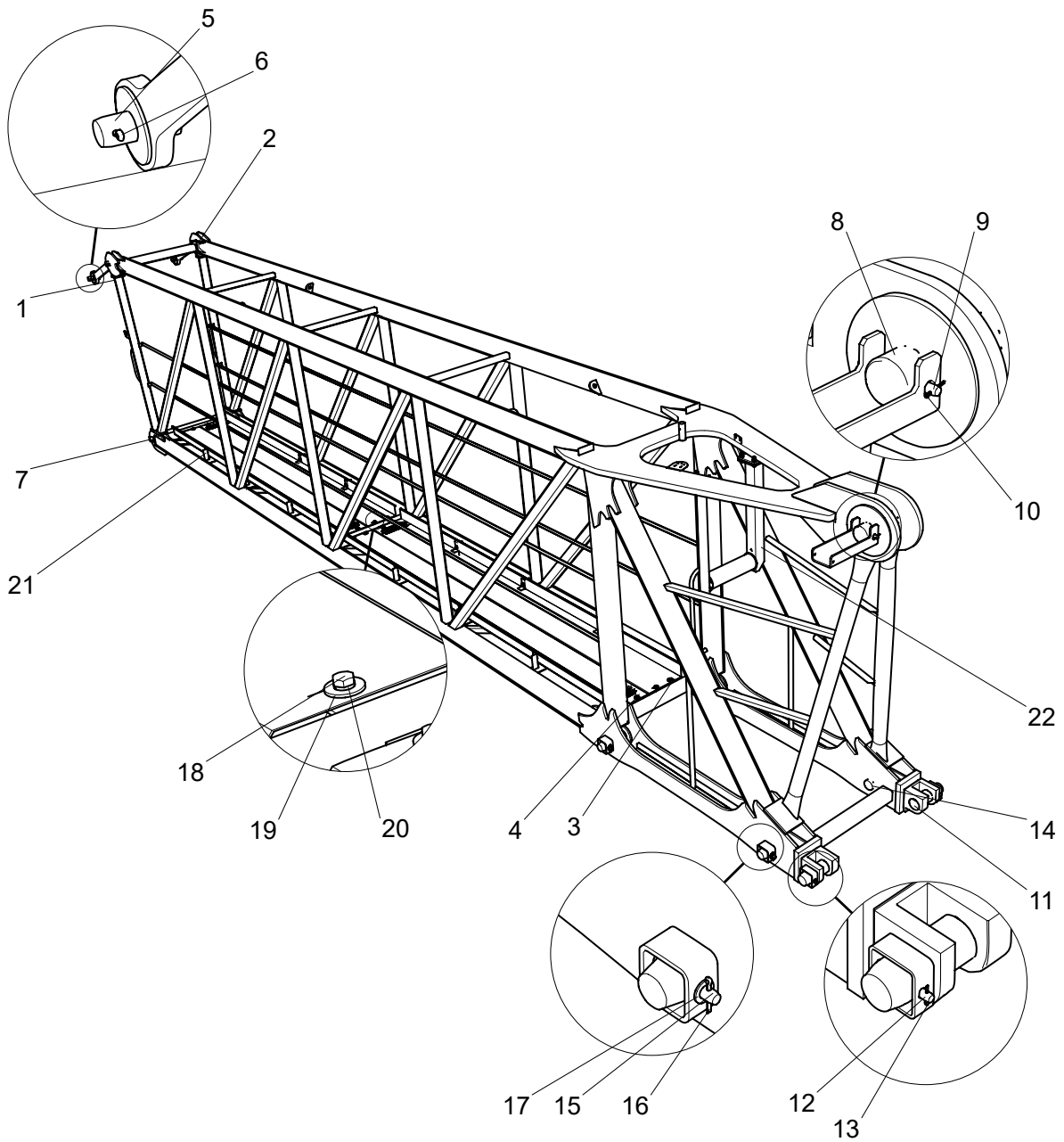
Front jib
(000219701CR010000)



Front jib
(000219701CR010000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Front counter jib structure	000219701CR011000			1
2	Counter-jib tie bar i	000270501JT010010			2
3	Walkway	000281701BT000900		Tp2	2
4	Walkway	000281701BT000800		Tp2	2
5	Pin	000209910A1101002		50×100	4
6	Pin	1040500186	GB/T91-2000	10×90	6
7	Pin	000209910A1111001		55×100	2
8	Pin	000219701CR010001			1
9	Pin	000209910A3041601		20×160	1
10	Pin	1040500005	GB/T91-2000	5×45	2
11	Pin	000252805BT001001		80×201/255	2
12	Pin	000231705AT003002		φ16×110/125	2
13	Pin	1040500097	GB/T91-2000	4×30	2

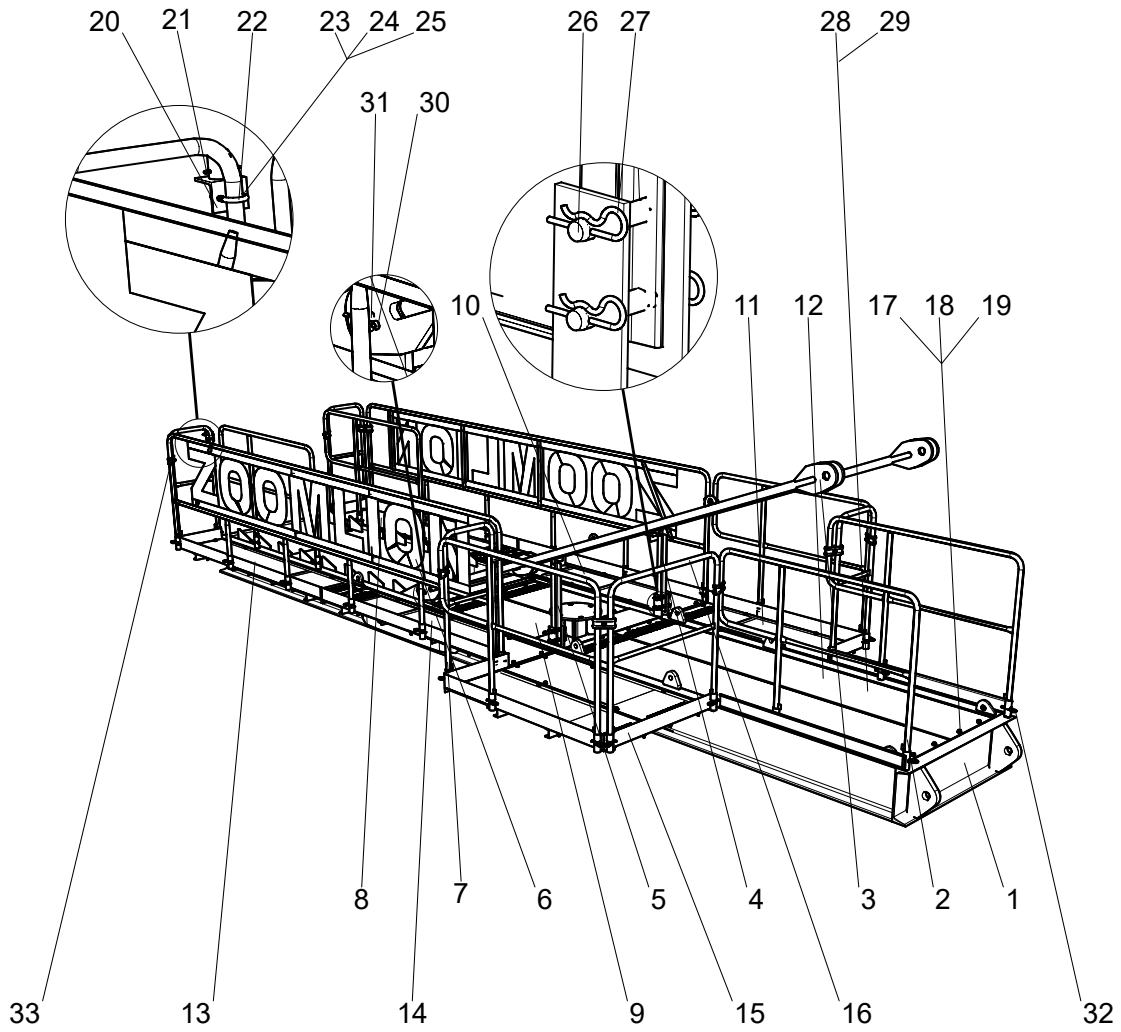
Front jib
(000219701CR010000)



Front jib
(000219701CR010000)

No.	Name	Numbering code	Code	Specification	Quantity
14	Pin	000270501ET000002			4
15	Pin	000251701BT000002		20×110	4
16	Pin	1040500216	GB/T91-2000	6.3×50	4
17	Washer	1040300983	GB/T97.1-2002	20-200HV	8
18	Bolt	1040000101	GB/T5783-2016	M12×40-8.8	28
19	Washer	1040300651	GB/T96-1985	12-140HV	40
20	Washer	1040300054	GB/T93-1987	12	28
21	Nut	1040200096	GB/T6170-2000	M12-8	12
22	Rope wheel	000271701CT007000			1

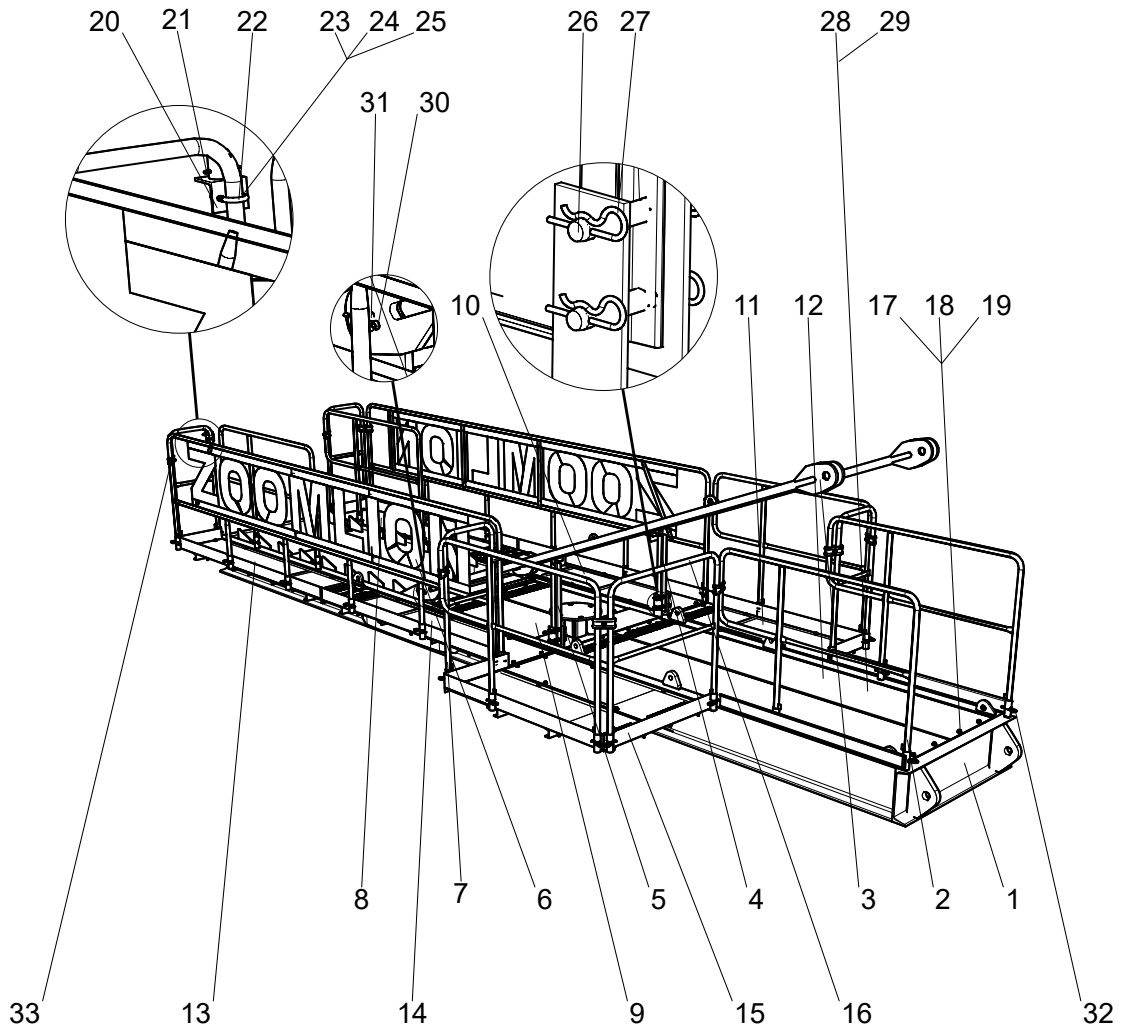
Rear jib
(000281701HT020000)



Rear jib
(000281701HT020000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Rear counter jib structure	000281701HT021000			1
2	Handrail	000209913C0015000			6
3	Counter jib strut a	000251701AT000200			2
4	Push rod	000270501AT000060			1
5	Push rod	000281701AT000020			1
6	Logo handrail	000281701BT000200			2
7	Handrail	000209913C0004300			4
8	Platform Ⅱ	000270501JT020200			1
9	Walkway	000281701BT000015		Tp2	2
10	Platform i	000270501JT020100			1
11	Platform i	000211101AT000100			1
12	Walkway	000281701BT000025		Tp2	2

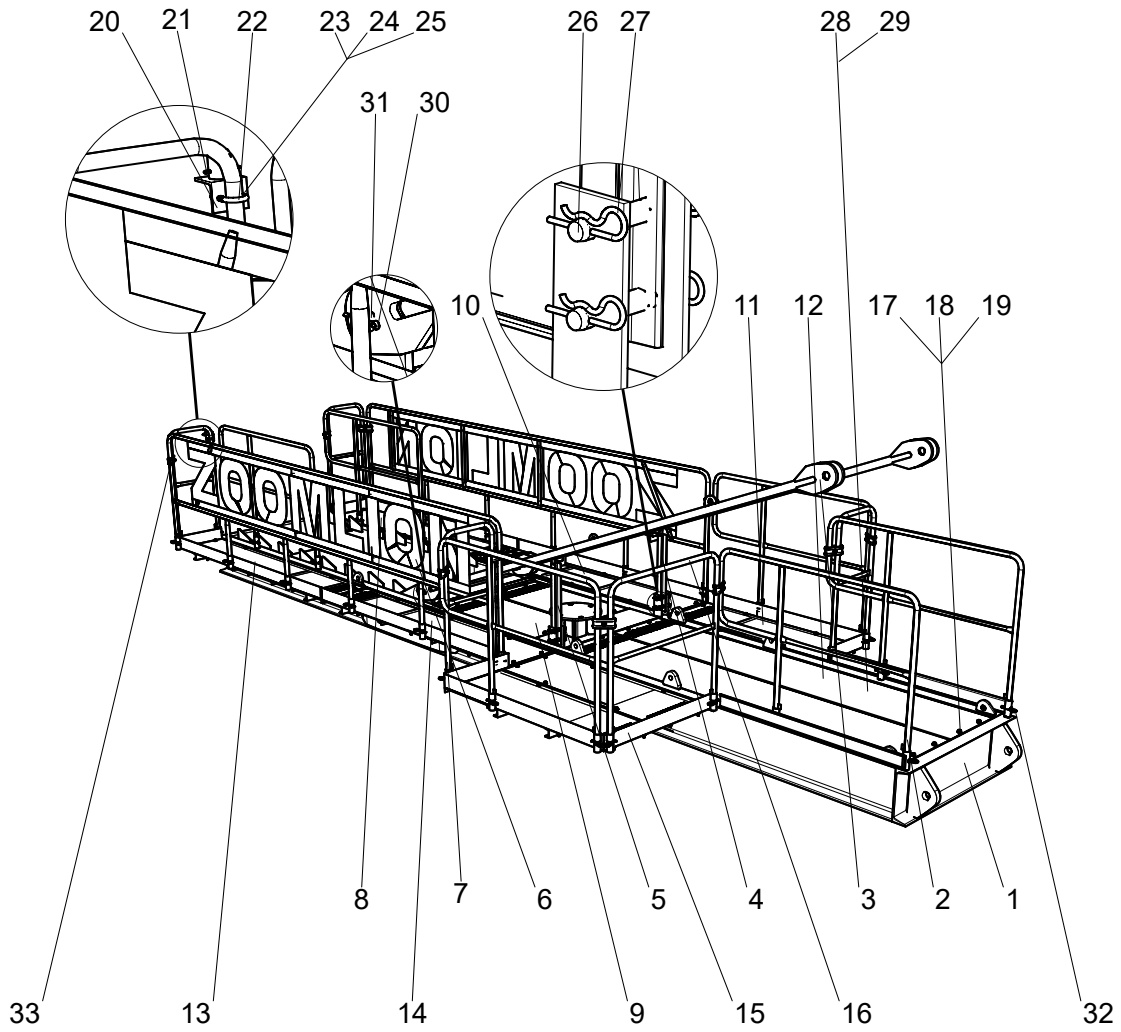
Rear jib
(000281701HT020000)



Rear jib
(000281701HT020000)

No.	Name	Numbering code	Code	Specification	Quantity
13	Platform Ⅲ	000270501JT020300			1
14	Platform Ⅳ	000270501JT020400			1
15	Platform Ⅳ	000211101AT000400			1
16	Handrail	000209913D001000			1
17	Bolt	1040000101	GB/T5783-2016	M12×40-8.8	16
18	Washer	1040300041	GB/T97.1-2002	12-200HV	16
19	Washer	1040300054	GB/T93-1987	12	16
20	Obstacle light seat	000209915A000100			1
21	Pin	1040500047	GB/T91-2000	5×70	1
22	U-bolt	1040000696	JB/ZQ4321-2006	33-Zn	1
23	Washer	1040300067	GB/T93-1987	10	2
24	Washer	1040300061	GB/T97.1-2002	10-200HV	2
25	Nut	1040200113	GB/T6170-2000	M10-8	2
26	Pin	000209910A304101		20×100	4
27	Spring pin	000201213A000003			8
28	Pin	000200111T000024		16×45	12

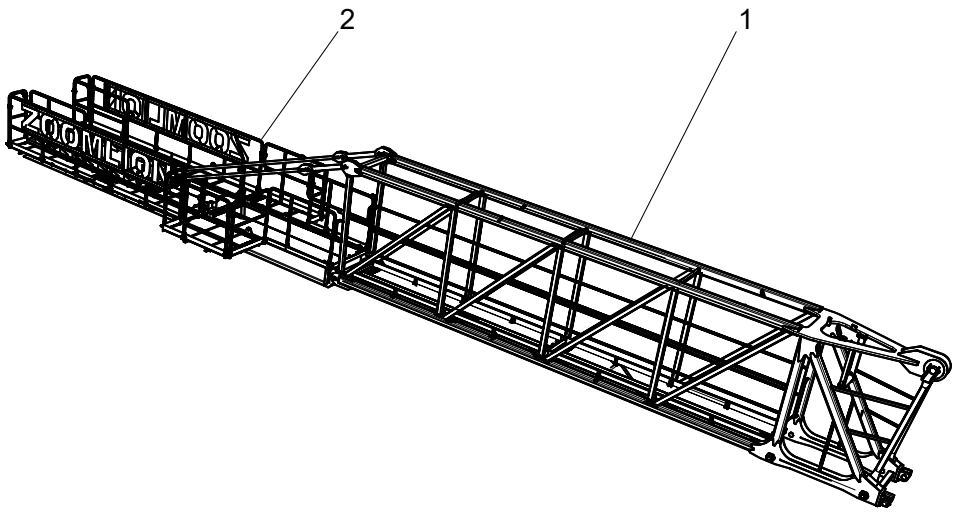
Rear jib
(000281701HT020000)



Rear jib
(000281701HT020000)

No.	Name	Numbering code	Code	Specification	Quantity
29	Spring pin	000209938A0000060			12
30	Pin	1040500186	GB/T91-2000	10×90	2
31	Pin	000209910A1101002		50×100	2
32	Spring pin	000208899A0002076		φ6×117	34
33	Handrail splint	000209913A7000000			11

WA7025平衡臂
(000281701JT000000)



WA7025平衡臂
(000281701JT000000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Front jib	000219701CR010000			1
2	Rear jib	000281701HT020000			1

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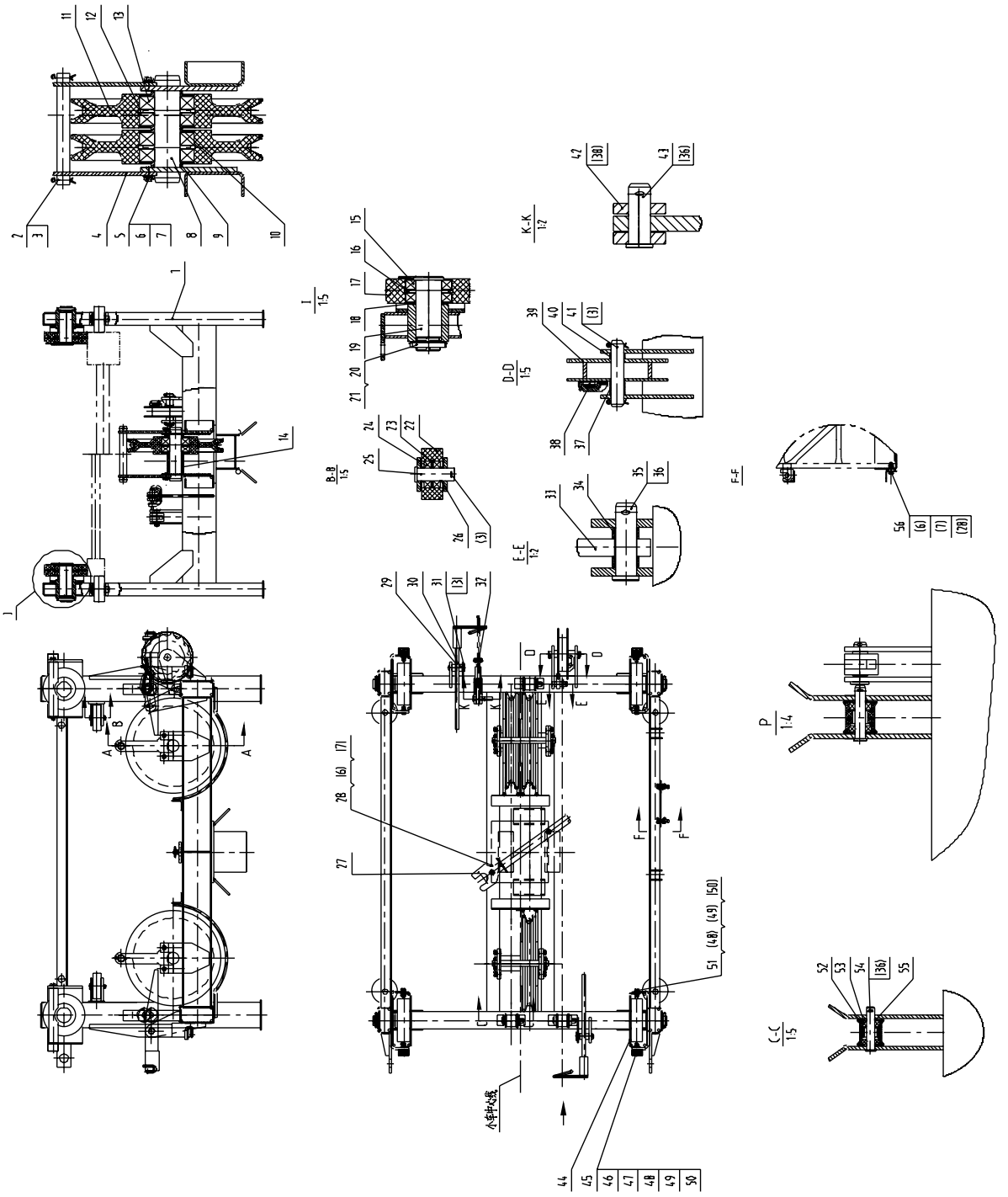
Spare Parts Manual

Chapter 3 Trolley

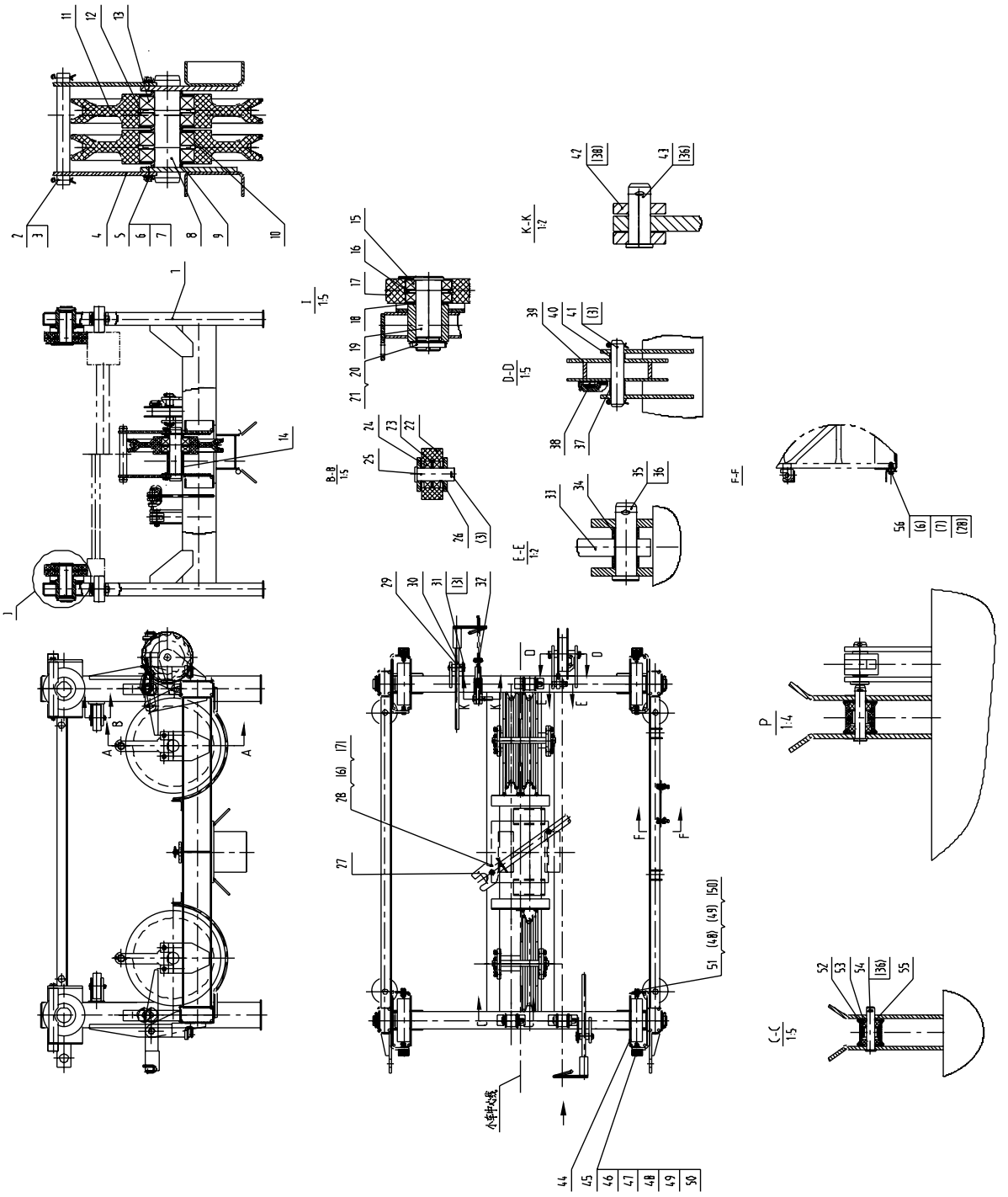
Trolley (without basket)
(000209707L0101000)



Trolley (without basket)
(000209707L0101000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Trolley structure	000209707L0101100			1
2	Rope-blocking rod	000209707L0101007		φ26.8×2.5	2
3	Pin	1040500216	GB/T91-2000	6.3×50	12
4	Pallet support	000209707L0101008		t8	4
5	Bolt	1040002436	GB/T5783-2016	M12×25-8.8	8
6	Washer	1040300041	GB/T97.1-2002	12-200HV	14
7	Washer	1040300054	GB/T93-1987	12	12
8	Pulley shaft	000209707L0101002			2
9	Shaft sleeve	000209707K0101004			3
10	Shaft sleeve	000209707K0101005			1
11	Pulley	000209906A0040051			3
12	Retainer ring	1040300281	GB/T893.2-1986	130	6
13	Deep groove ball bearing	1050202084	GB/T276-2013	6312-2RS	6
14	Shaft sleeve	000209707L0101003			1

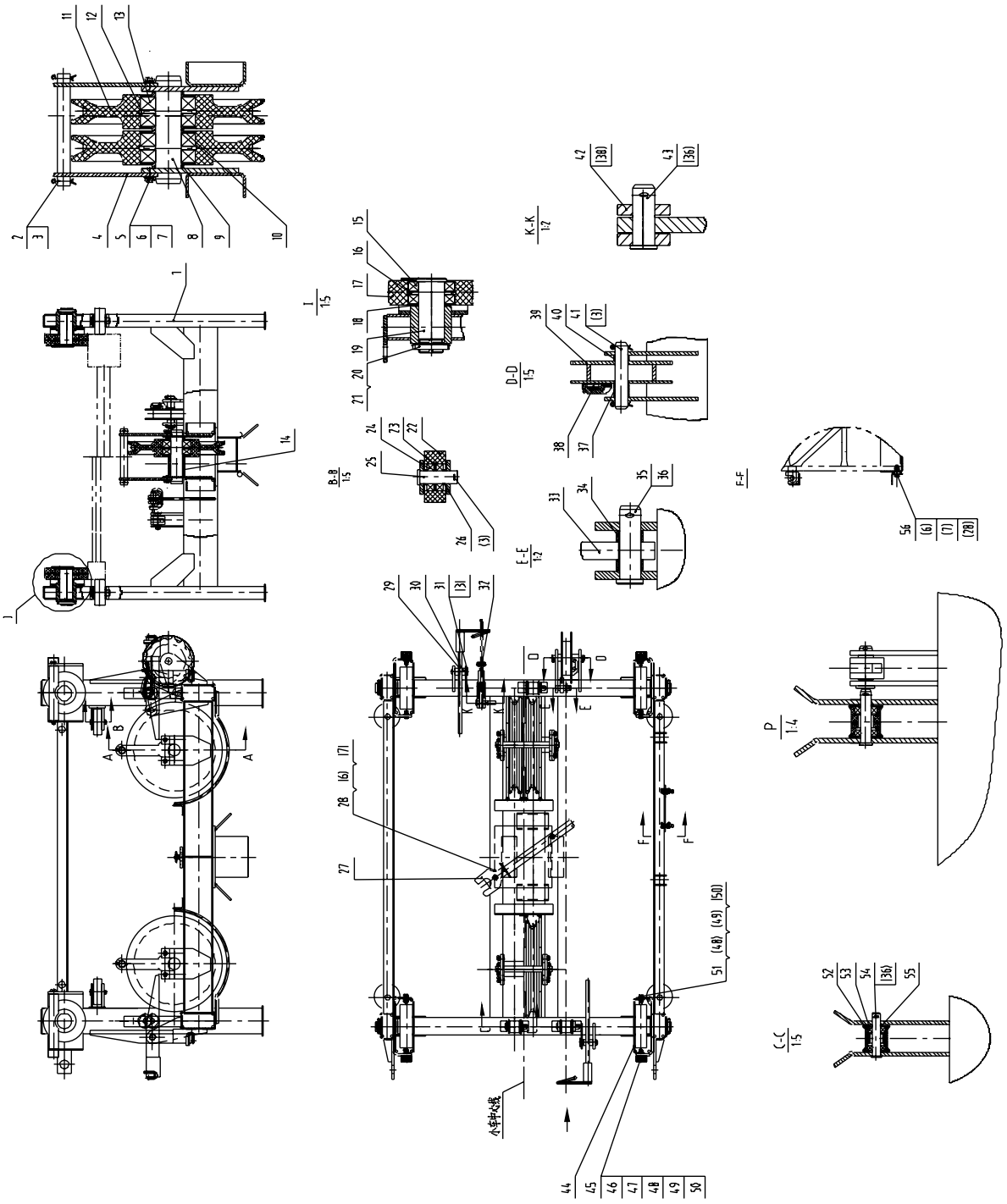
Trolley (without basket)
(000209707L0101000)



Trolley (without basket)
(000209707L0101000)

No.	Name	Numbering code	Code	Specification	Quantity
15	Deep groove ball bearing	1050201562	GB/T276-2004	6212-2RS1	8
16	Retainer ring	1040300283	GB/T893.2-1986	110	8
17	Roller	000209709A0003003			4
18	Shaft sleeve	000209707J0101004			4
19	Roller shaft	000209707L0101005		φ60-171	4
20	Nut	1040200342	GB/T812-1988	M52×1.5	4
21	Washer	1040300265	GB/T858-1988	52	4
22	Side roller	000209710A0600001		φ120-50	4
23	Retainer ring	1040300226	GB/T893.2-1986	62	8
24	Deep groove ball bearings	1050201944	GB/T276-2013	6206-2RS	8
25	Side roller shaft	000209710A0600002		φ30	4
26	Shaft sleeve	000209710A0601003		φ30-8.8	8
27	Tensioning splint	000209707L0101020			1
28	Nut	1040200096	GB/T6170-2000	M12-8	6

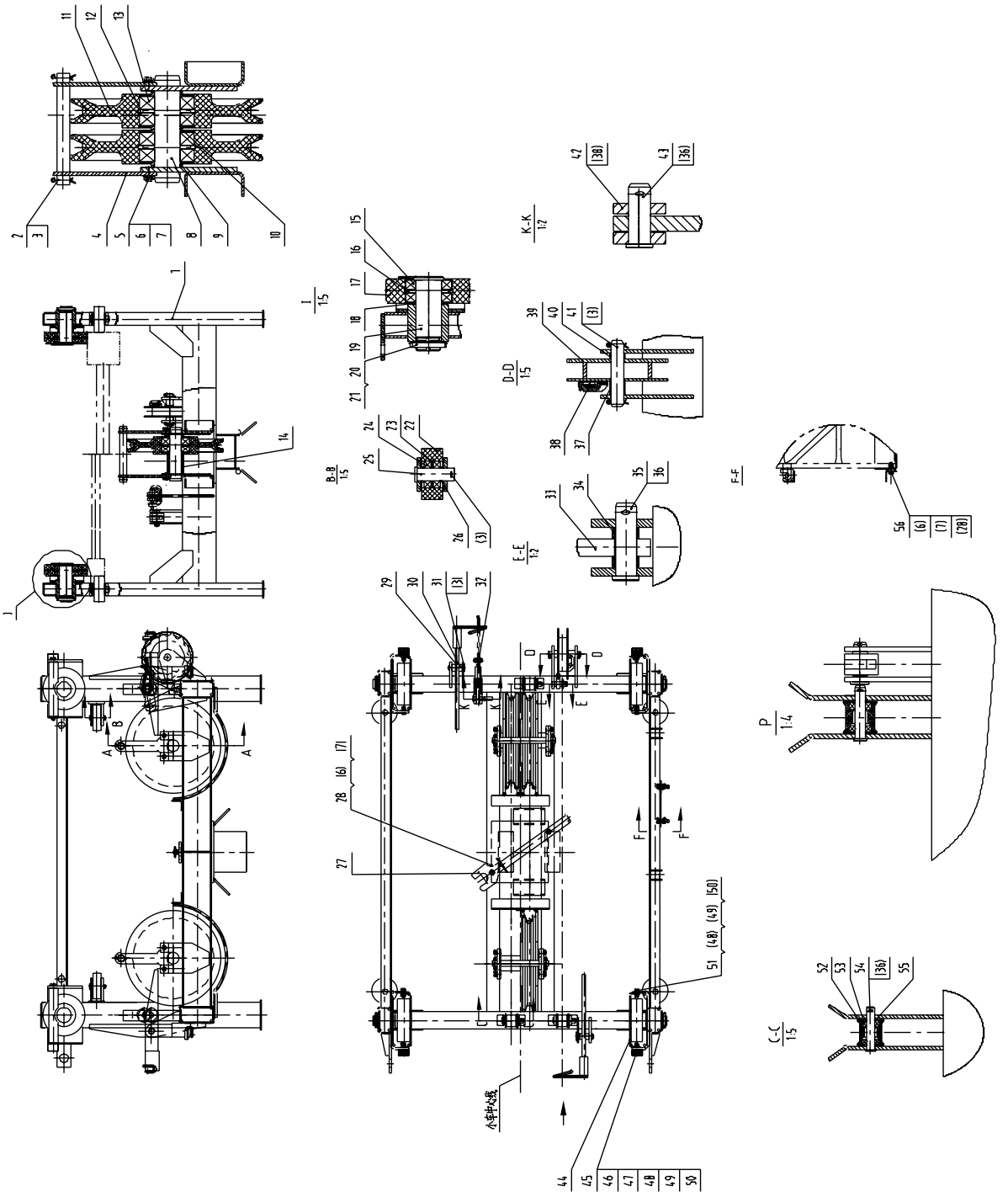
Trolley (without basket)
(000209707L0101000)



Trolley (without basket)
(000209707L0101000)

No.	Name	Numbering code	Code	Specification	Quantity
29	Safety brake	000209707K0101020			2
30	Shaft sleeve	000209719A0601008			4
31	Pin	000209910A1050701		25×70	2
32	Rope clip	1090100081	GB/T5976-2006	10KTH	1
33	Baffle	000209719A0601006		t16	1
34	Shaft sleeve	000209719A0601007			2
35	Pin	000209910A1040601		20×60	1
36	Pin	1040500253	GB/T91-2000	5×32	5
37	Shaft sleeve	000209705D0000002			1
38	Wedge	1090100713	GB/T5973-2006	10	2
39	Tensioning wheel	000209719A0601010			1
40	Shaft sleeve	000209705D0000009			1
41	Pin	000209910A4061341		30×135	1
42	Wedge sleeve	1090100722	GB/T5973-2006	10	1

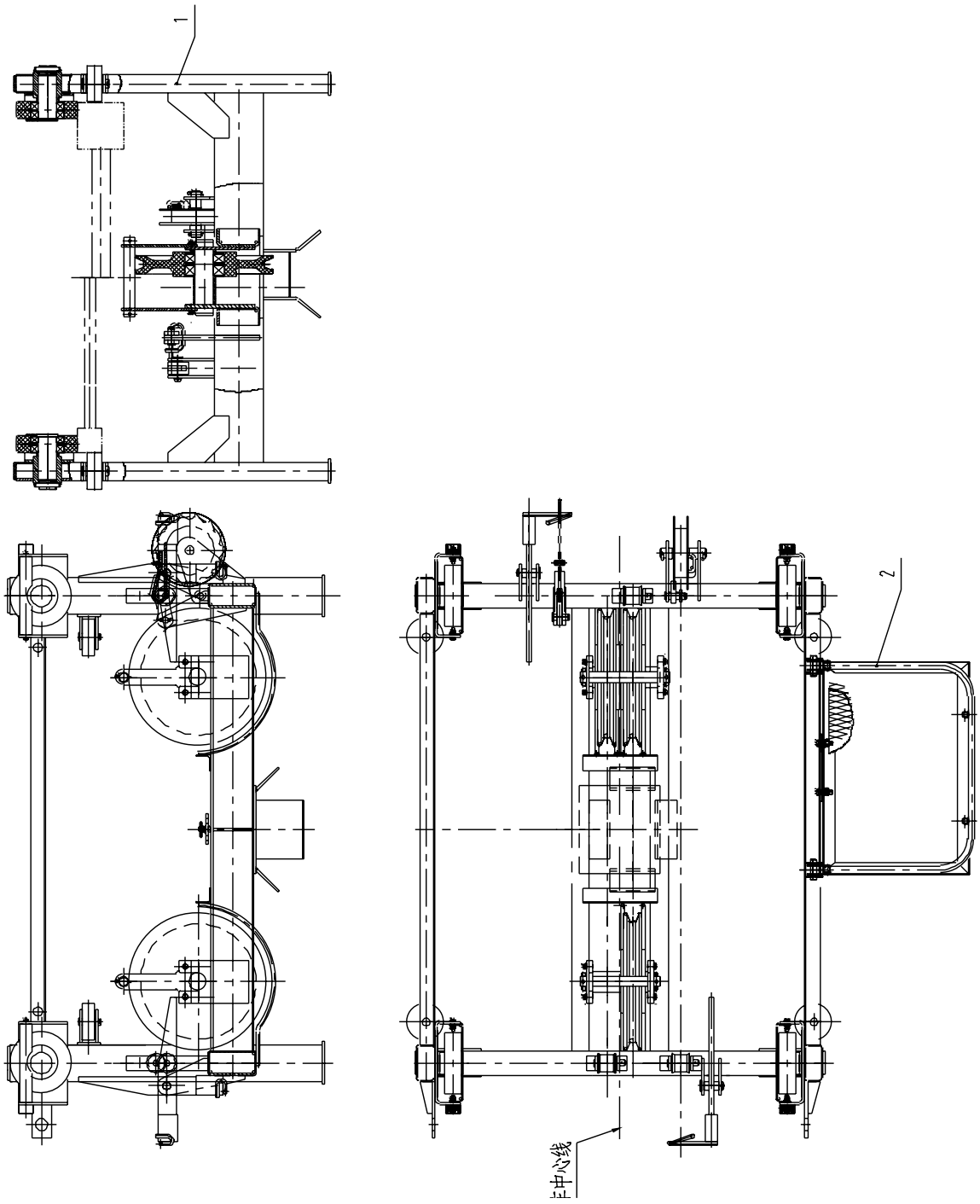
Trolley (without basket)
(000209707L0101000)



Trolley (without basket)
(000209707L0101000)

No.	Name	Numbering code	Code	Specification	Quantity
43	Pin	000209910A0000113		20×45	1
44	Idler wheel cover	000209707L0101006		Tp2	4
45	Buffer block	000209708A0001063			4
46	Bolt	1040000489	GB/T5783-2016	M10×50-8.8	4
47	Washer	1040300559	GB/T96-1985	10-200HV	4
48	Nut	1040200679	GB/T6170-2000	M10-8	8
49	Washer	1040300061	GB/T97.1-2002	10-200HV	12
50	Washer	1040300067	GB/T93-1987	10	8
51	Bolt	1040002435	GB/T5783-2016	M10×35-8.8	4
52	Riding wheel	000209705A0000900			3
53	Deep groove ball bearing	1050201565	GB/T276-2004	6004-2RS1	6
54	Shaft	000209707F0301003		φ20	3
55	Shaft sleeve	000209705A0001100			6
56	Bolt	1040002440	GB/T5783-2016	M12×45-8.8	2

Trolley
(000209707L0100000)



Trolley
(000209707L0100000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Trolley (without basket)	000209707L0101000			1
2	Maintenance cage	000209901A0900000			1

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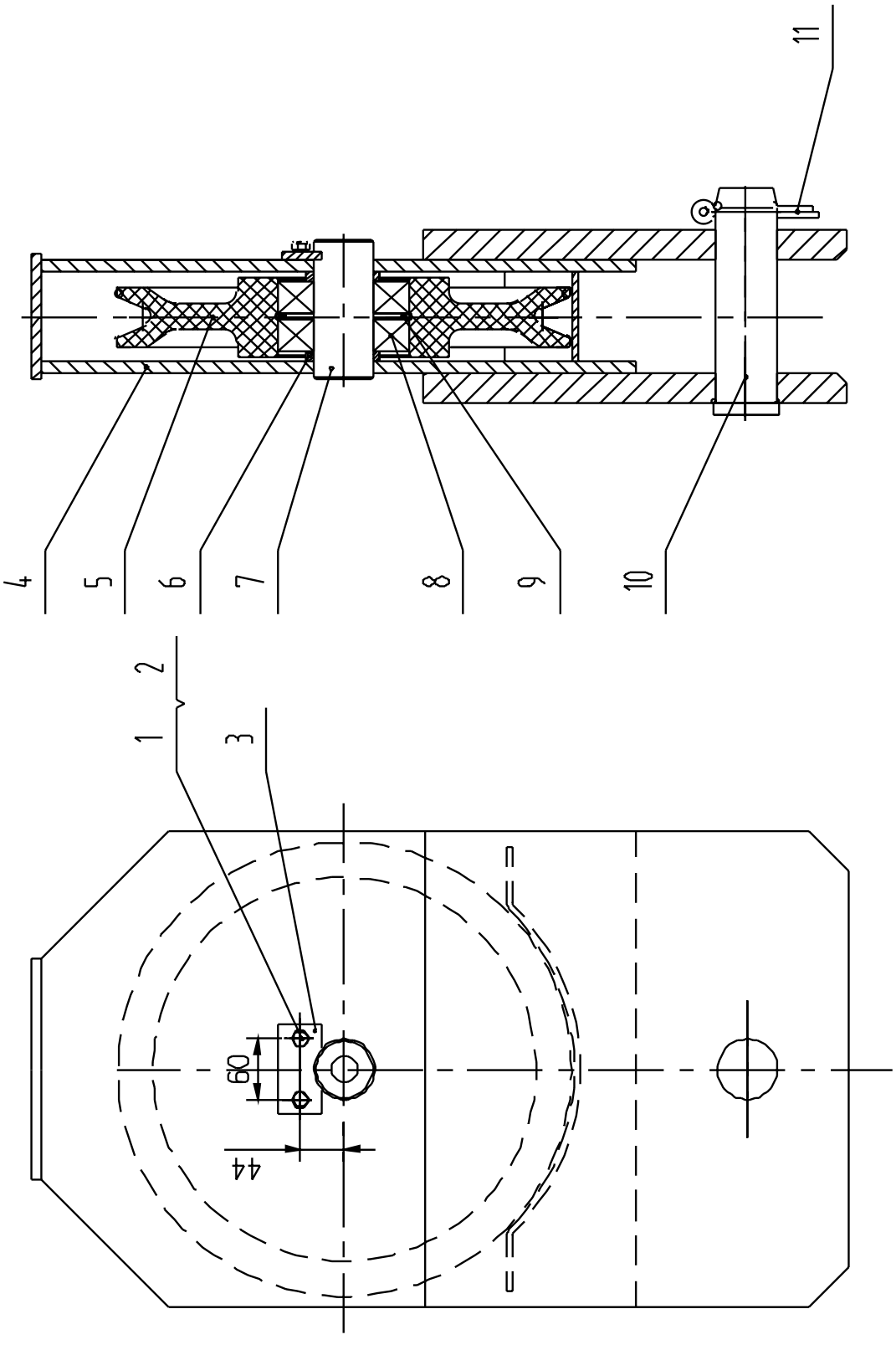
Spare Parts Manual

Chapter 4 Hook block

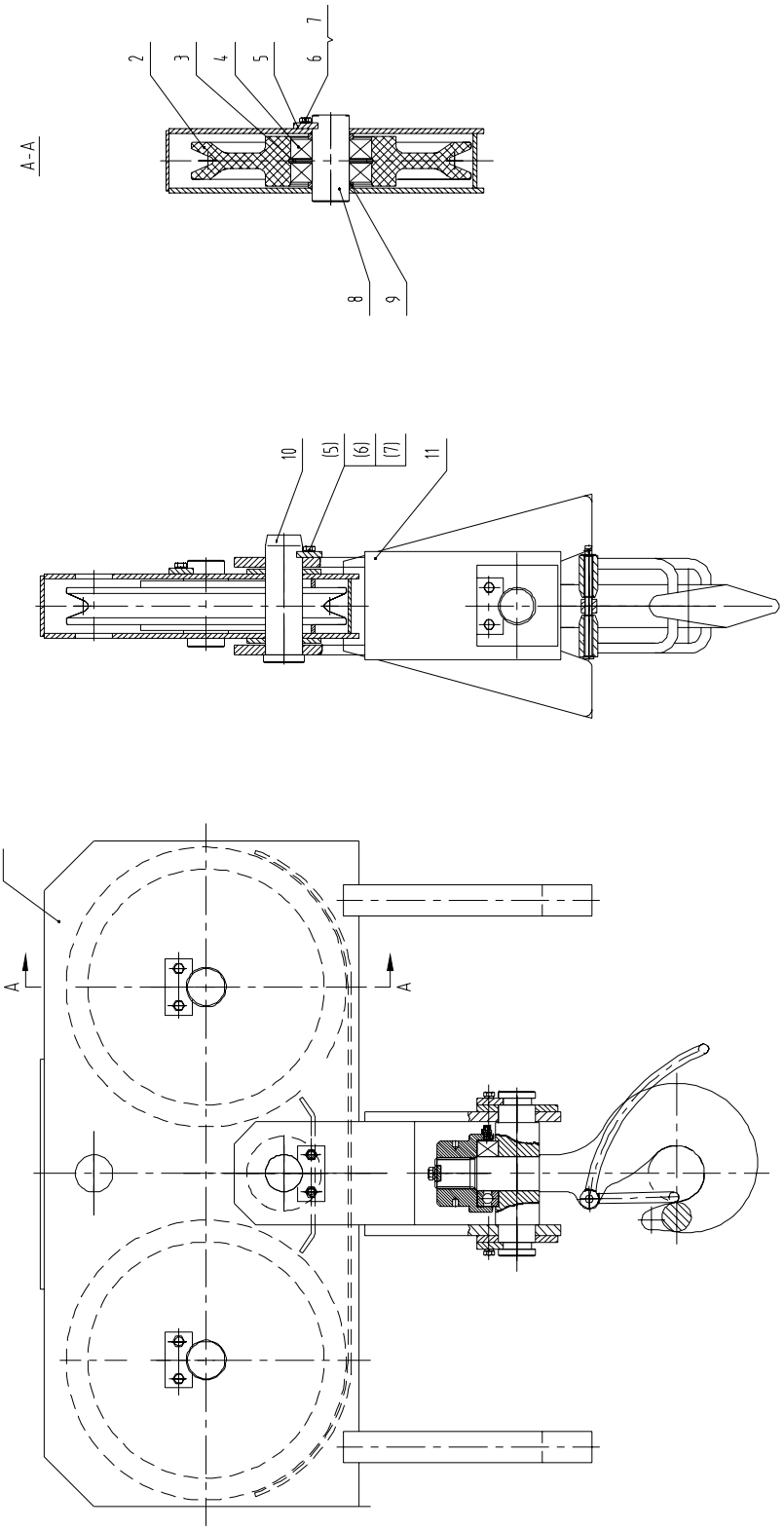
Upper part of the hook
(000209606A1701000)



Upper part of the hook (000209606A1701000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Washer	1040300067	GB/T93-1987	10	2
2	Bolt	1040000116	GB/T5783-2016	M10×20-8.8	2
3	Locking plate	000209605A0000018			1
4	Upper pulley frame	000209606A1401100			1
5	Pulley	000209906A0040051			1
6	Shaft sleeve	000209606A1401001			2
7	Pulley shaft	000209606A1702001			1
8	Deep groove ball bearing	1050202084	GB/T276-2013	6312-2RS	2
9	Retainer ring	1040300281	GB/T893.2-1986	130	2
10	Pin	000209910A1121901		60×190	1
11	Pin	1040500260	GB/T91-2000	10×80	1

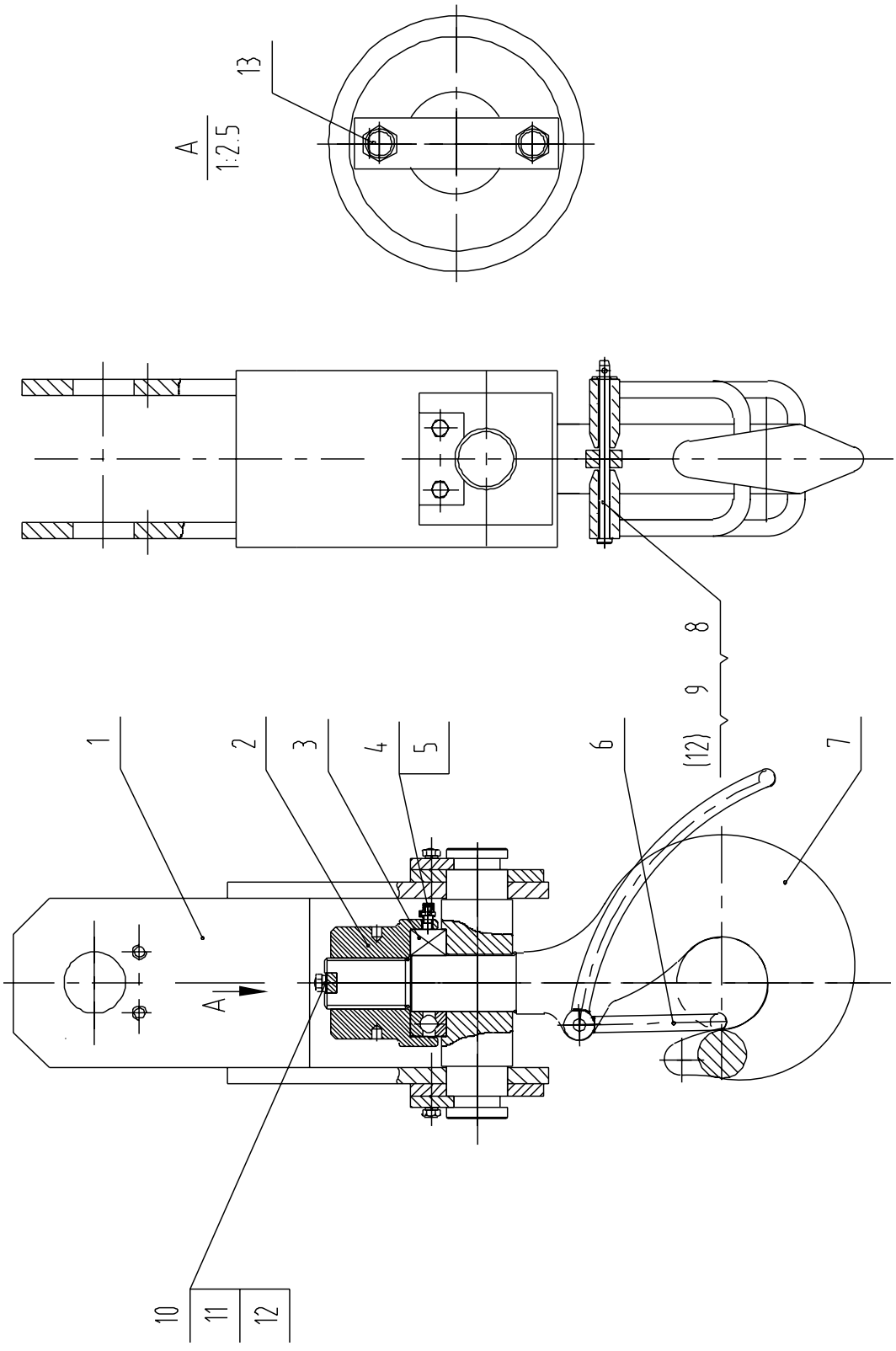
Lower part of the hook
(000209606A1702000)



Lower part of the hook (000209606A1702000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Lower pulley frame	000209606A1702100			1
2	Pulley	000209906A0040051			2
3	Retainer ring	1040300283	GB/T893.2-1986	110	4
4	Deep groove ball bearing	1050202084	GB/T276-2013	6312-2RS	4
5	Locking plate	000209605A0000018			3
6	Washer	1040300067	GB/T93-1987	10	6
7	Bolt	1040000116	GB/T5783-2016	M10×20-8.8	6
8	Pulley shaft	000209606A1702001			2
9	Shaft sleeve	000209606A1401001			2
10	Pin	000209606A1402001			1
11	Load hook	000209606A1702300			1

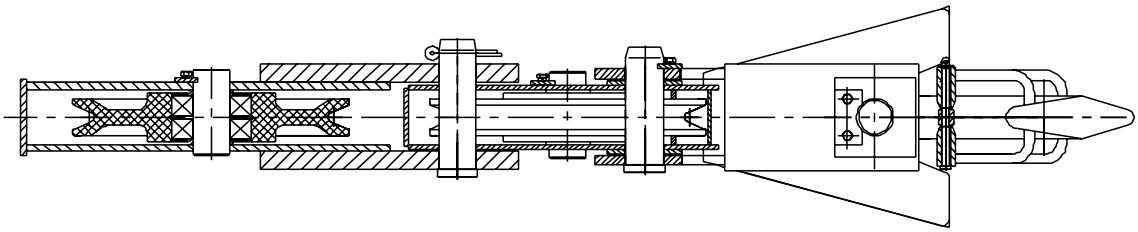
Load hook
(000209606A1702300)

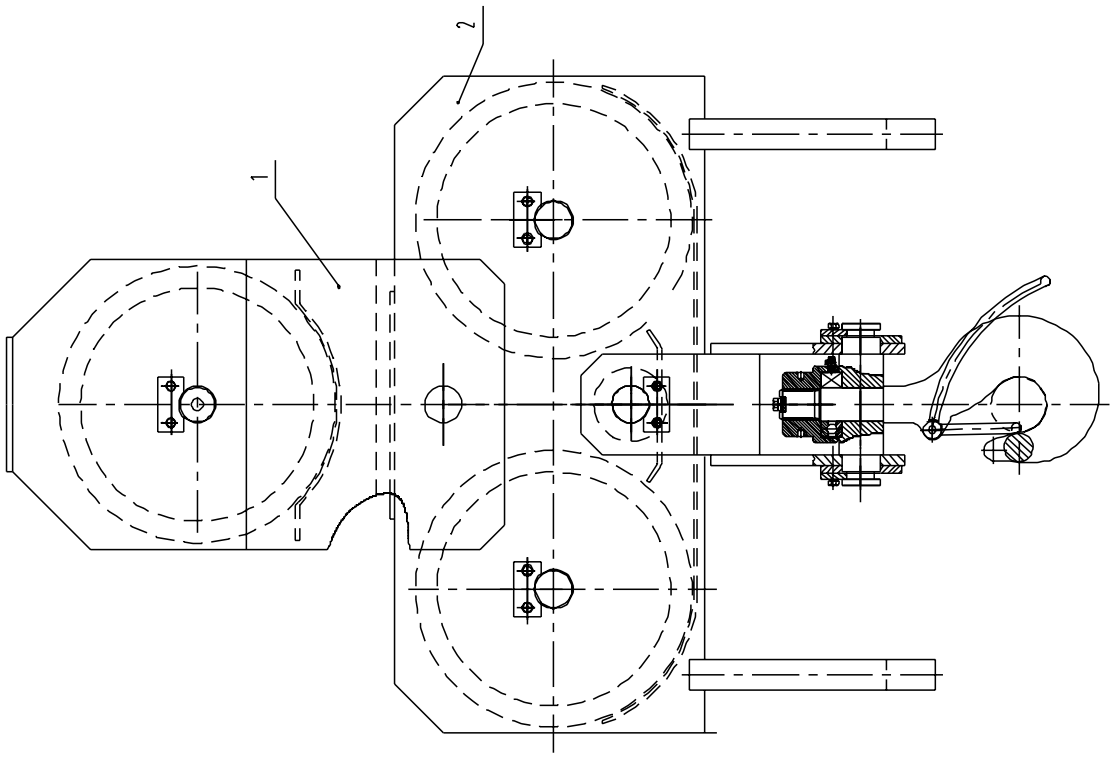


Load hook
(000209606A1702300)

No.	Name	Numbering code	Code	Specification	Quantity
1	Splint	000209606A1702310			1
2	Hook nut	000209606A1702302			1
3	Trust ball bearing	1050201317	GB/T301-1995	51311	1
4	Oil cup	1080000007	JB/T7940.1-	M10×1	1
5	Oil cup cover	1999904306	FCM(TPTC)	φ10	1
6	Hook pallet	000209606A1702330			1
7	Hook	000209606A1702301			1
8	Pin	000209606A1702305			1
9	Pin	1040500243	GB/T91-2000	5×25	1
10	Bolt	1040003935	GB/T5783-2000	M10×30-8.8	2
11	Washer	1040300067	GB/T93-1987	10	2
12	Washer	1040300061	GB/T97.1-2002	10-200HV	3
13	Anti-punching plate	000209606A1702303		t6	1

Hook block
(000209606A1700000)





Hook block
(000209606A1700000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Upper part of the hook	000209606A1701000			1
2	Lower part of the hook	000209606A1702000			1

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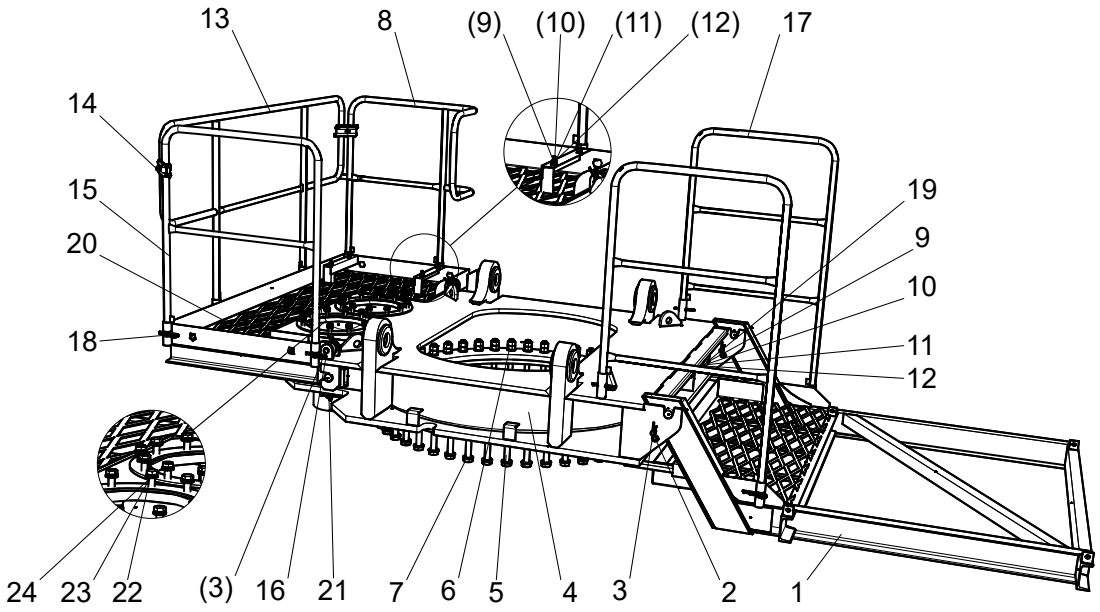
Spare Parts Manual

Chapter 5 Turntable

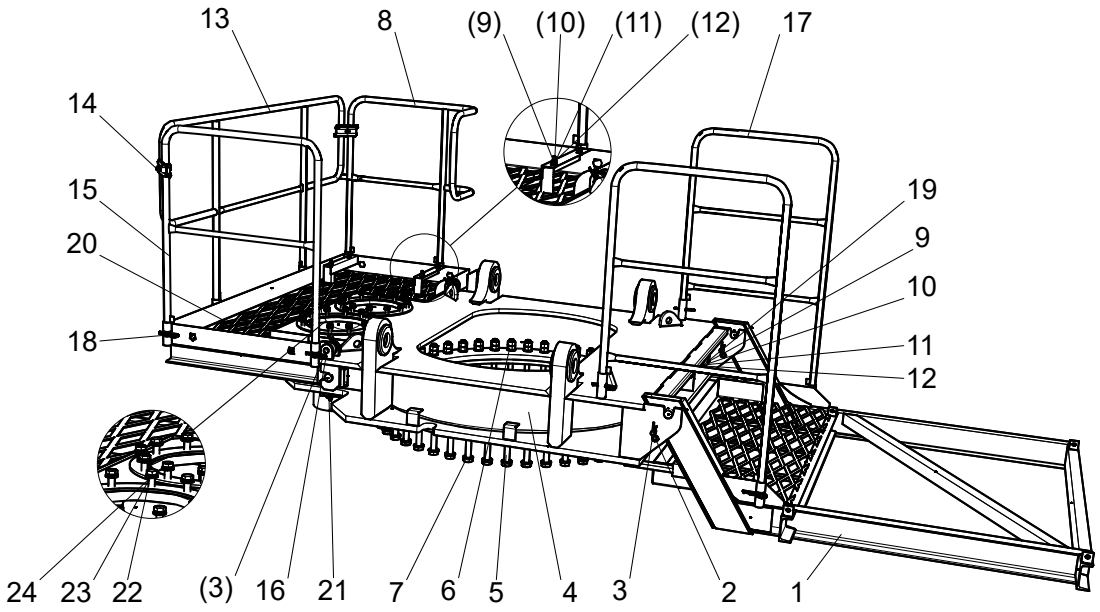
Turntable
(000201709CT000000)



Turntable
(000201709CT000000)

No.	Name	Numbering code	Code	Specification	Quantity
	Turntable	000201709CT000000			
1	Cabin platform	000201709CT004000			1
2	Pin	000209910A3041201		20×120	2
3	Spring pin	000201213A0000003			6
4	Turntable structure	000201709CT001000			1
5	Bolt	1040002952	GB/T5782-2000	M27×230-10.9	48
6	Nut	1040201105	GB/T6170-2000	M27-10	96
7	Washer	1040301787	GB/T97.1-2002	27-300HV	96
8	Handrail	000201709CT000110			1
9	Bolt	1040000122	GB/T5783-2016	M10×35-8.8	12
10	Nut	1040202414	GB/T6170-2000	M10-8	12
11	Washer	1040302268	GB/T97.1-2002	10-200Hv	24
12	Washer	1040300067	GB/T93-1987	10	12
13	Handrail	000209913C002000			1
14	Handrail splint	000209913A700000			2

Turntable
(000201709CT000000)



Turntable
(000201709CT000000)

No.	Name	Numbering code	Code	Specification	Quantity
15	Handrail	000209913C0008200			1
16	Pin	000209910A1040901		20×90	2
17	Handrail	000201709CT000100			2
18	Spring pin	000208899A0002076		φ6×117	10
19	Fixing plate	000201709CT000050			1
20	Resistor cabinet platform	000201709CT003000			1
21	Slewing mechanism shield	000200609C0000400			2
22	Washer	1040300052	GB/T97.1-2002	16-200HV	24
23	Washer	1040300065	GB/T93-1987	16	24
24	Bolt	1040000095	GB/T5783-2016	M16×60-8.8	24

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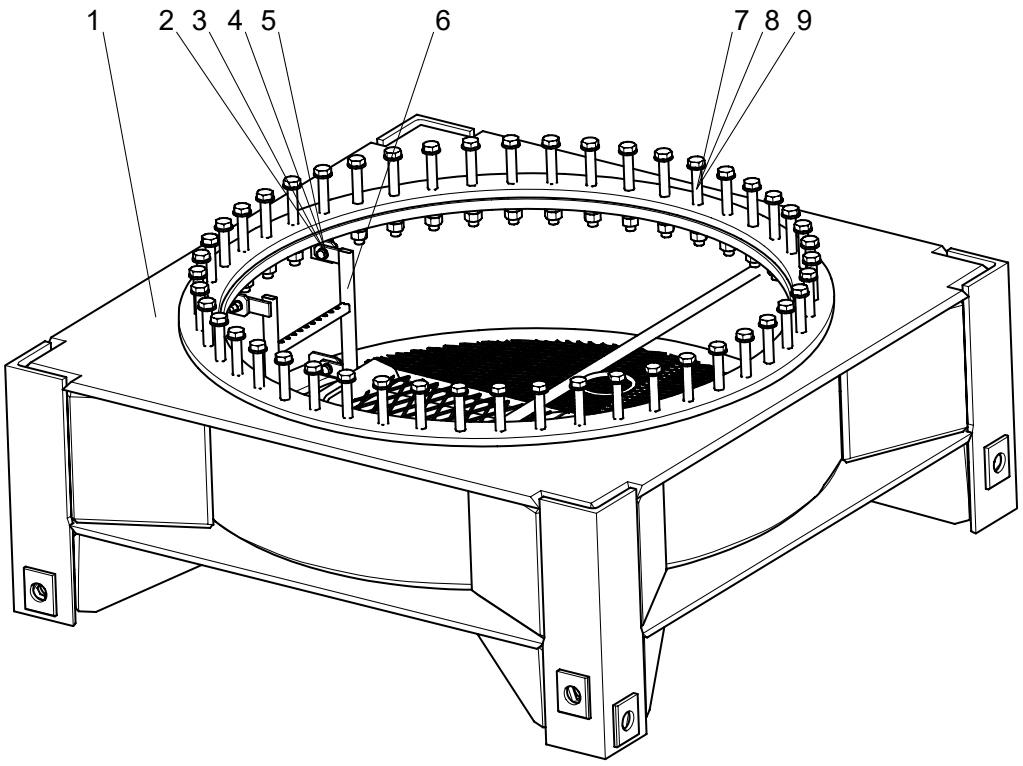
Spare Parts Manual

Chapter 6 Slewing support

Slewing support
(000281710HT000000)



Slewing support (000281710HT000000)

No.	Name	Numbering code	Code	Specification	Quantity
	Slewing support	000281710HT000000			
1	Slewing support structure	000281710HT010000			1
2	Bolt	1040000095	GB/T5783-2016	M16×60-8.8	4
3	Nut	1040200110	GB/T6170-2000	M16-8	4
4	Washer	1040300052	GB/T97.1-2002	16-200HV	4
5	Washer	1040300065	GB/T93-1987	16	4
6	Ladder	000251710ET020000			1
7	Bolt	1040003331	GB/T5782-2000	M27×240-10.9	48
8	Nut	1040201105	GB/T6170-2000	M27-10	96
9	Washer	1040301787	GB/T97.1-2002	27-300HV	96

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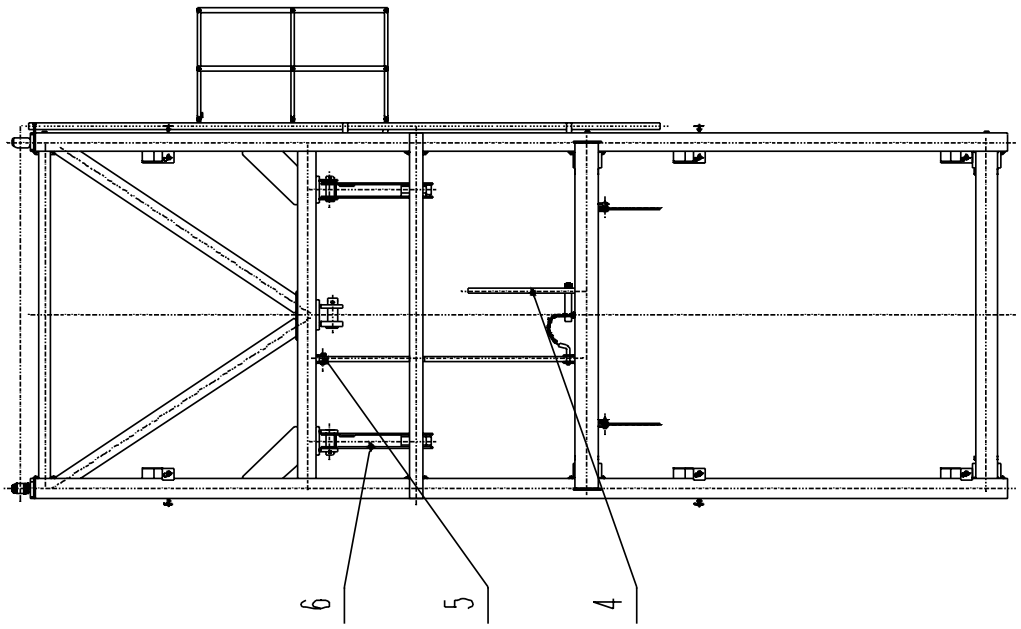
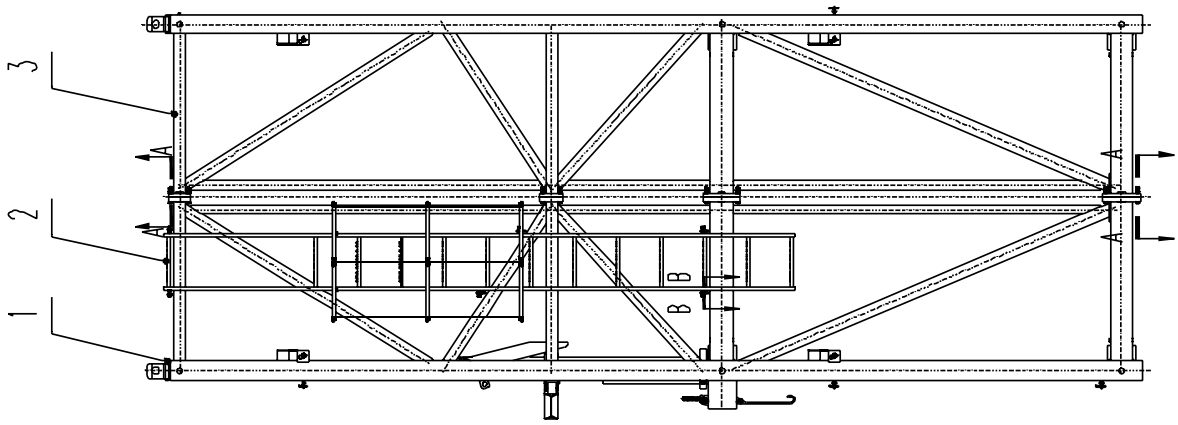
Spare Parts Manual

Chapter 7 Climbing equipment

Climbing frame components
(000261811FT010000)

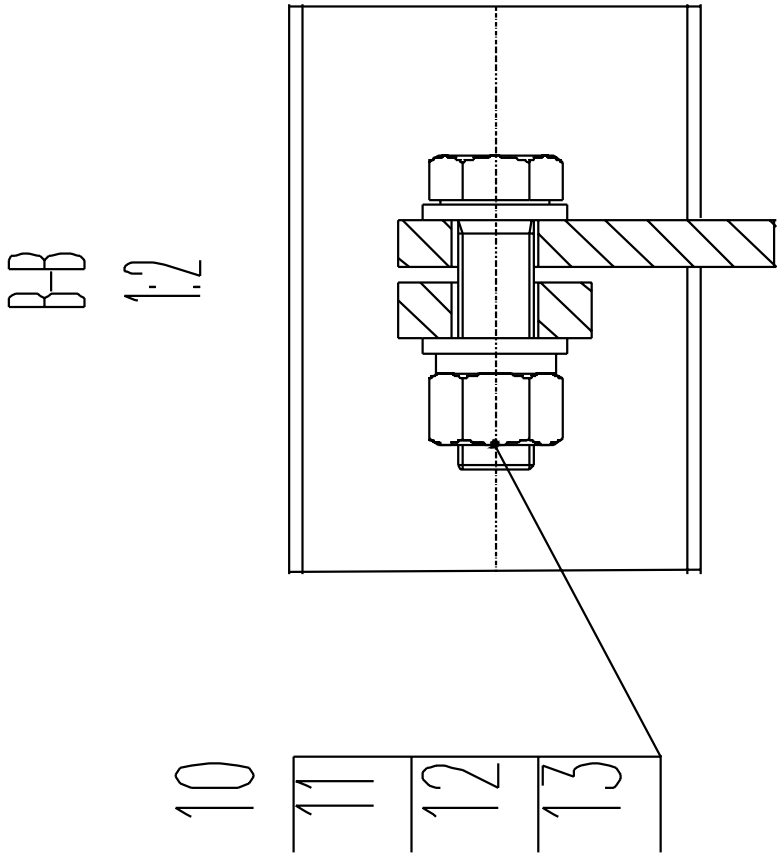


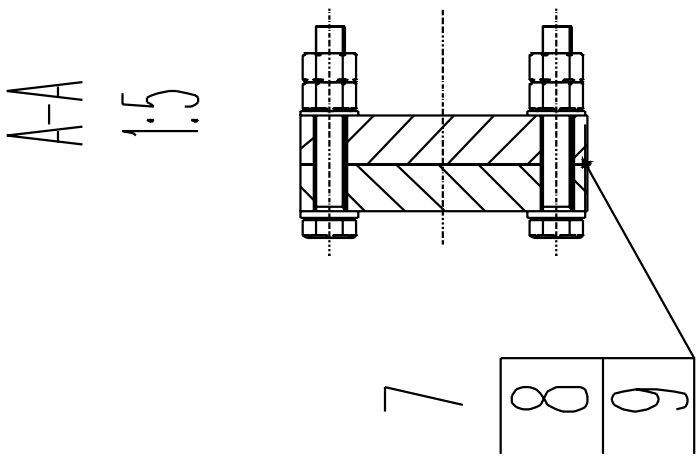


Climbing frame components (000261811FT010000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Back U component	000261811FT012000			1
2	Ladder	000261811FT010100			1
3	Front U component	000261811FT011000			1
4	booster thrust	000261811ET010200			1
5	Change step push	000261811BT000300			1
6	Step change device	000261811BT000400			1

Climbing frame components
(000261811FT010000)

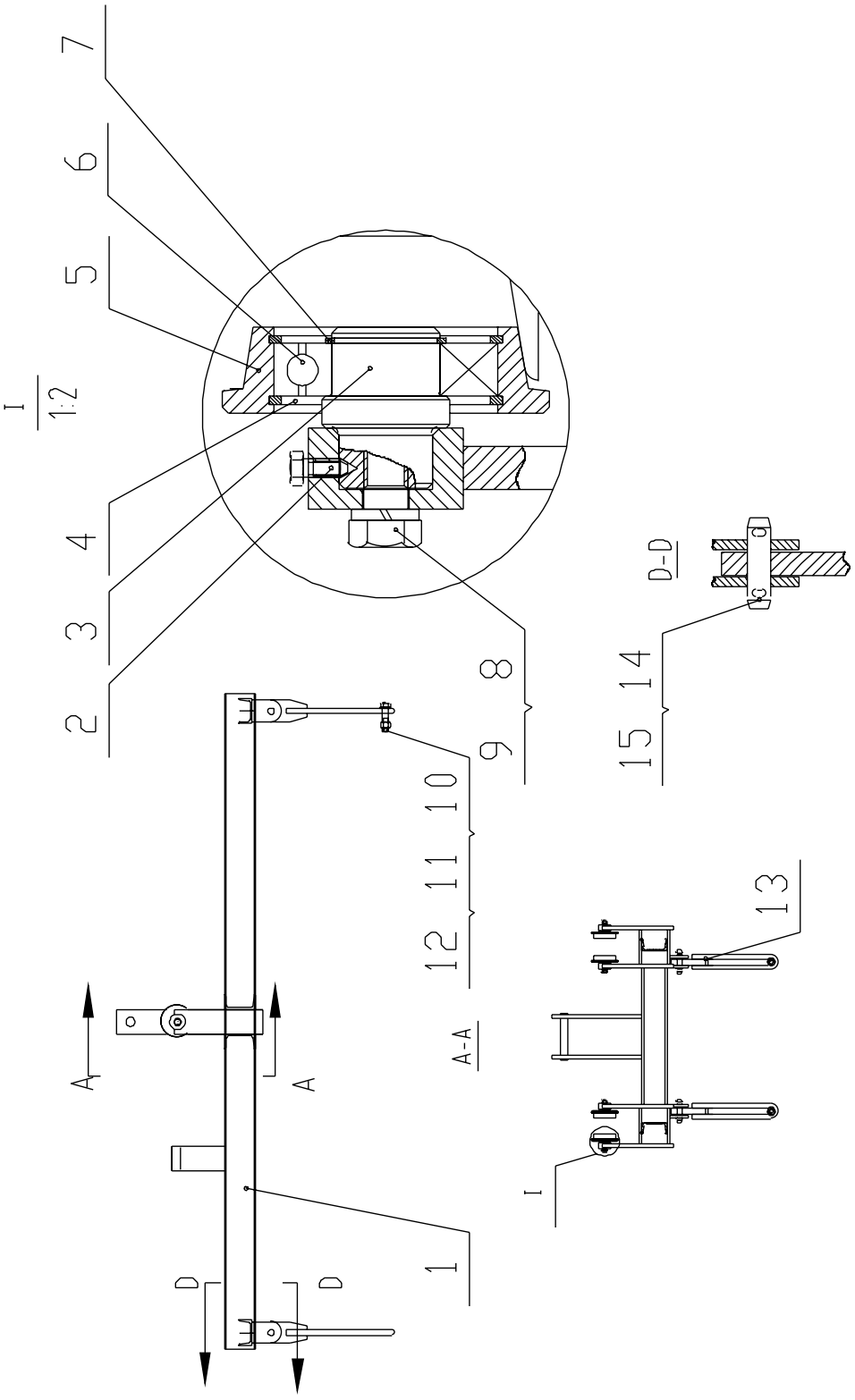




Climbing frame components (000261811FT010000)

No.	Name	Numbering code	Code	Specification	Quantity
7	Bolt	1040006509	GB/T5783-2016	M16×100-10.9	32
8	Nut	1040201848	GB/T6170-2000	M16-10	64
9	Washer	1040301016	GB/T97.1-2002	16-300HV	64
10	Bolt	1040000177	GB/T5783-2016	M16×55-8.8	4
11	Washer	1040300065	GB/T93-1987	16	4
12	Washer	1040300052	GB/T97.1-2002	16-200HV	8
13	Nut	1040200110	GB/T6170-2000	M16-8	4

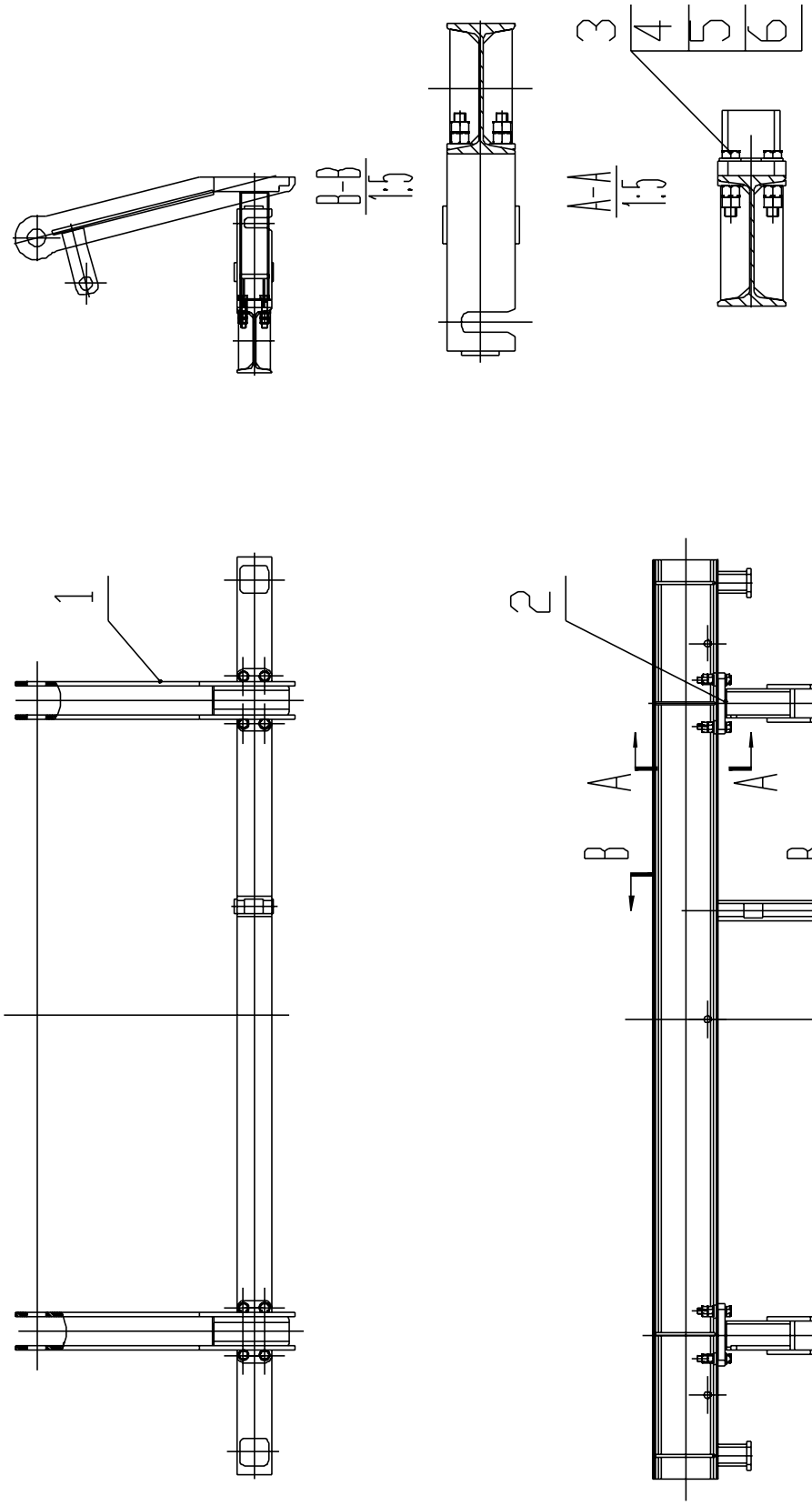
Hoisting device
(000200610A0007400)



Hoisting device (000200610A0007400)

No.	Name	Numbering code	Code	Specification	Quantity
1	Lifting beams	000200610A0007410			1
2	Screw	1040100950	GB/T6563-1986	M6×14	4
3	Roller shaft	000200610A0007201			4
4	Retainer ring	1040300129	GB/T893.1-1986	72	8
5	Roller body	000200610A0007202			4
6	Deep groove ball bearing	1050200499	GB/T276-1994	6207-z	4
7	Retainer ring	1040300184	GB/T894.1-1986	35	4
8	Bolt	1040000102	GB/T5783-2016	M14×35-8.8	4
9	Washer	1040300068	GB/T93-1987	14	4
10	Bolt	1040000089	GB/T5782-2000	M20×80-8.8	4
11	Nut	1040200097	GB/T6170-2000	M20-8	4
12	Washer	1040300256	GB/T96.1-2002	20-200HV	4
13	Introduction of hooks	000200610A0007420			4
14	Pin	000200610A0007401		20×65	4
15	Pin	1040500222	GB/T91-2000	8×80	8

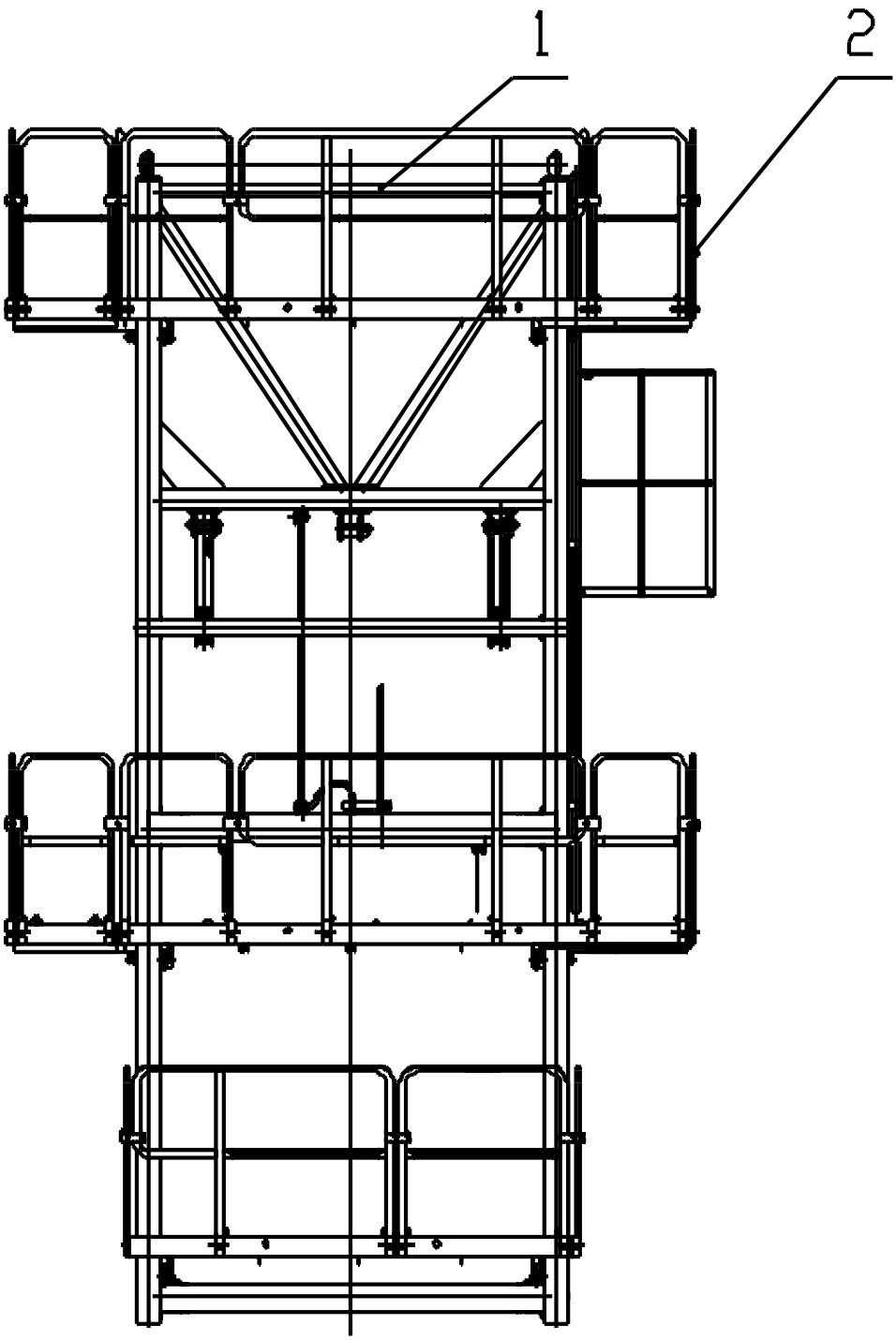
Step change device
(000261811BT000400)



Step change device
(000261811BT000400)

No.	Name	Numbering code	Code	Specification	Quantity
1	Push rod	000261811BT000410			2
2	Horizontal beam	000261811BT000420			1
3	Bolt	1040000145	GB/T5783-2016	M16×80-8.8	8
4	Washer	1040300052	GB/T97.1-2002	16-200HV	8
5	Washer	1040300441	GB/T852-1988	16	8
6	Nut	1040200110	GB/T6170-2000	M16-8	16

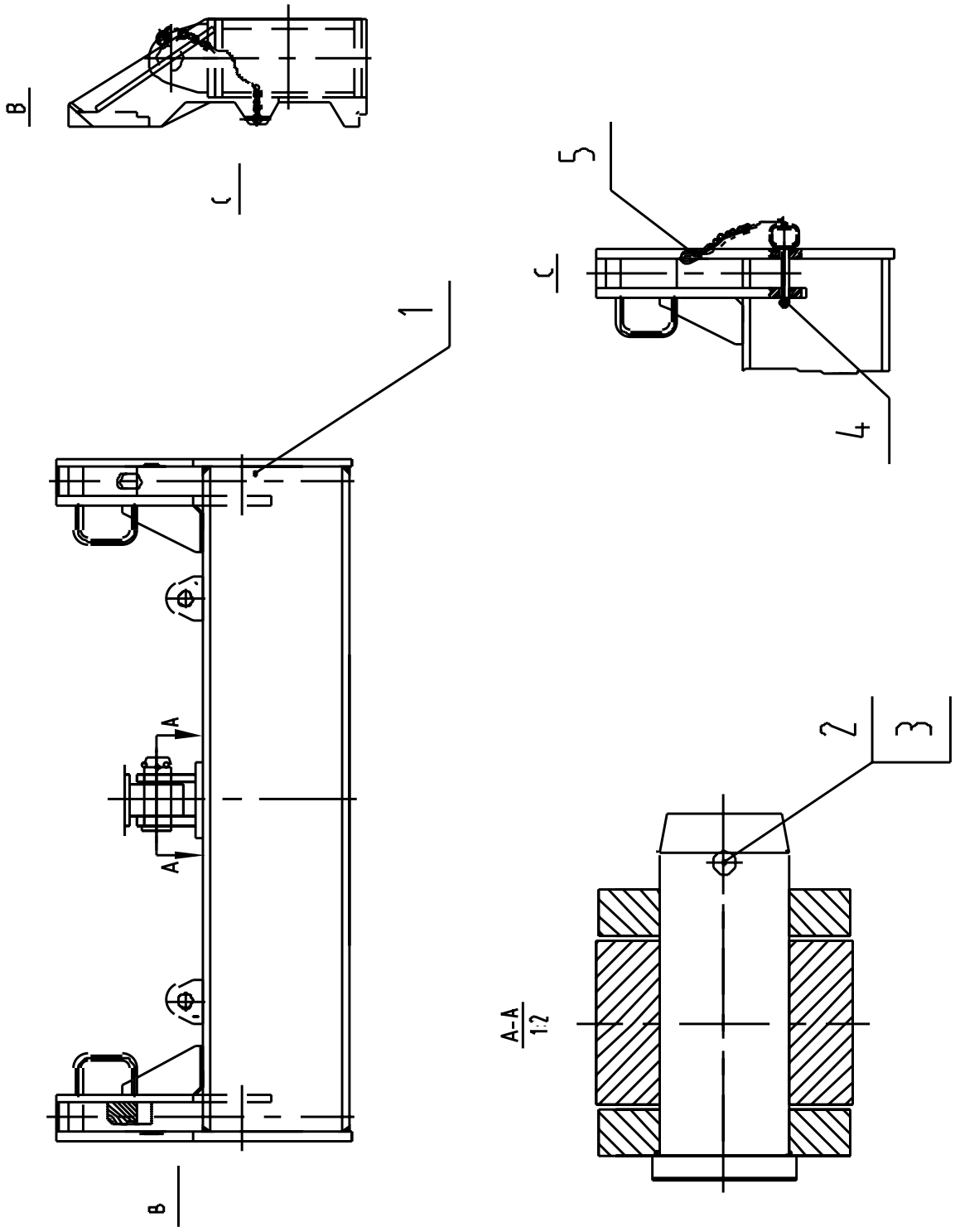
Climbing equipment
(000261811FT000000)



Climbing equipment (000261811FT000000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Climbing frame components	000261811FT010000			1
2	Platform Railing Kit	000261811FT020000			1

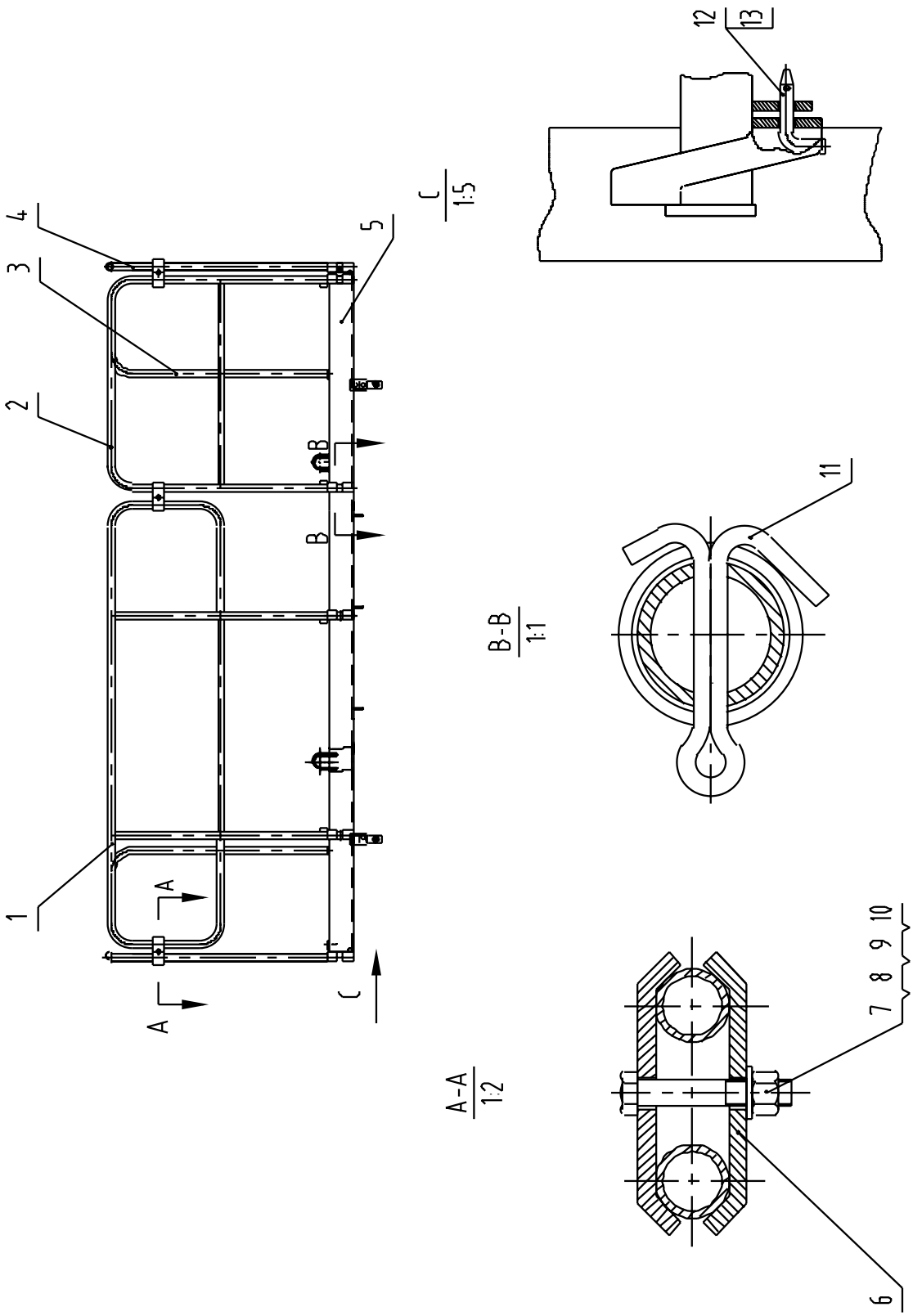
Climbing mechanism
(000251812AT000000)



Climbing mechanism (000251812AT000000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Climbing beam	000251812AT001000			1
2	Pin	000209910A1141601		70×160	1
3	Pin	1040500965	GB/T91-2000	13×110	1
4	Safety pin	000251812AT000200			2
5	Spring hook	1119900061	DIN5299C	8×80	2

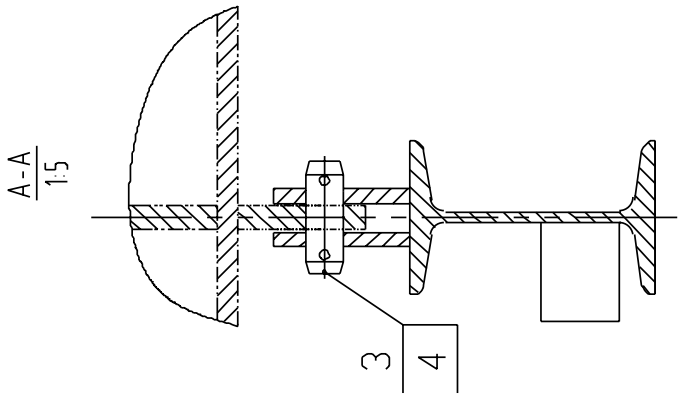
Mount platform
(000281720AT000000)

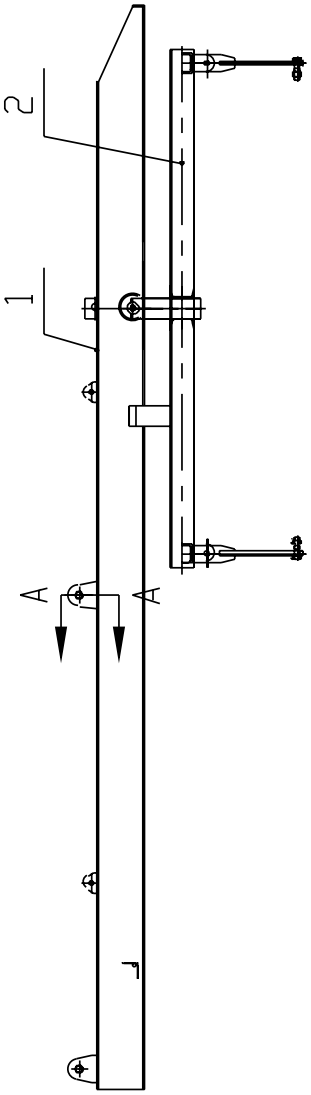


Mount platform
(000281720AT000000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Handrail	000209913B00200 00			2
2	Handrail	000209913B00095 00			2
3	Handrail	000209913B00043 00			4
4	Handrail	000209913B00053 00			4
5	Platform	000281720AT0300 00			2
6	Handrail splint	000209913A50000 01		t5	20
7	Bolt	1040000216	GB/T5783-2016	M12×70-8.8	10
8	Washer	1040300041	GB/T97.1-2002	12-200HV	10
9	Washer	1040300054	GB/T93-1987	12	10
10	Nut	1040200096	GB/T6170-2000	M12-8	10
11	Pin	1040500222	GB/T91-2000	8×80	24
12	Pin	000240811AT1000 03			4
13	Spring pin	000201213A00000 03			4

Mounting device
(000270319AT000000)





Mounting device
(000270319AT000000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Monorail beam	000270319AT000100			2
2	Hoisting device	000200610A000740			1
3	Pin	000209910A406061		30×60	4
4	Pin	1040500222	GB/T91-2000	8×80	8

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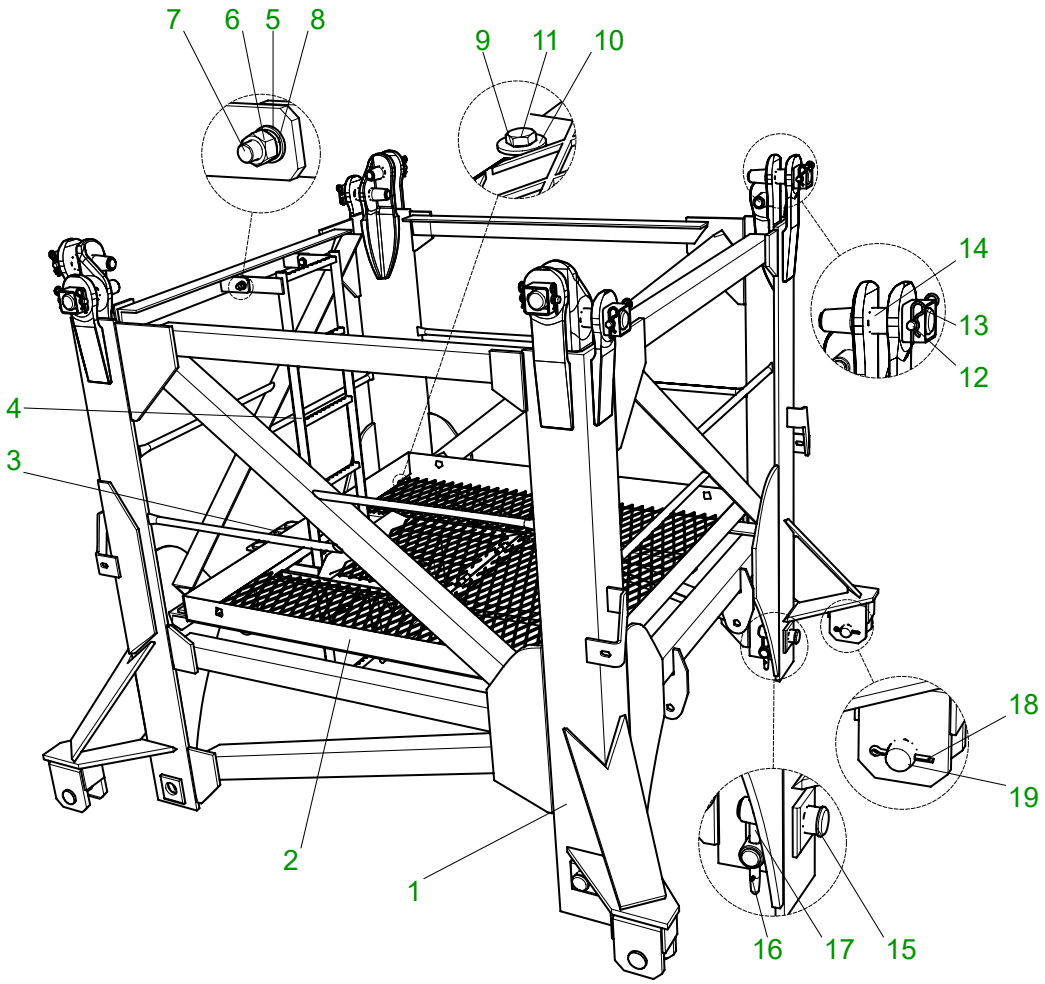
Spare Parts Manual

Chapter 8 Transition section

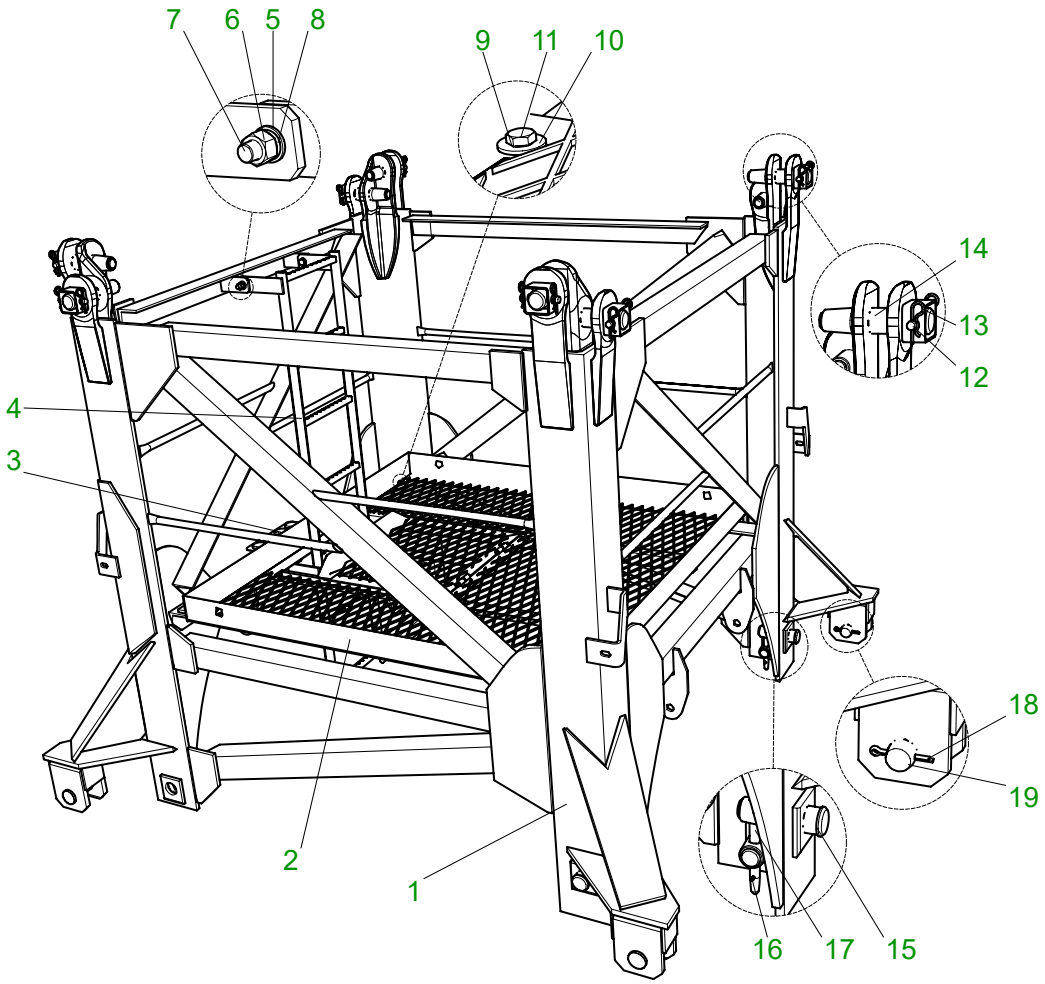
Transition section
(000209012A1010000)



Transition section (000209012A1010000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Transition section structure	000209012A1013000			1
2	Ladder	000209012A1012000			1
3	Pin	000200610A0007002			4
4	Platform	000209012A1703000			1
5	Washer	1040300052	GB/T97.1-2002	16-200HV	8
6	Nut	1040200110	GB/T6170-2000	M16-8	4
7	Bolt	1040000095	GB/T5783-2016	M16×60-8.8	4
8	Washer	1040300065	GB/T93-1987	16	4
9	Nut	1040200813	GB/T6170-2000	M10-8	4
10	Bolt	1040000152	GB/T5783-2016	M10×40-8.8	4
11	Washer	1040300211	GB/T96.1-2002	10-200HV	8
12	Pin	000209910A3041001		20×100	8
13	Spring pin	000201213A0000003			16
14	Pin	000231710BT000002		55×165	8
15	Pin	000209012A0000002			8
16	Pin	1040500228	GB/T91-2000	4×32	4

Transition section
(000209012A1010000)



Transition section
(000209012A1010000)

No.	Name	Numbering code	Code	Specification	Quantity
17	Pin	000209012A0000003			4
18	Pin	1040500252	GB/T91-2000	10×90	4
19	Pin	000209910A1101301		50×130	4

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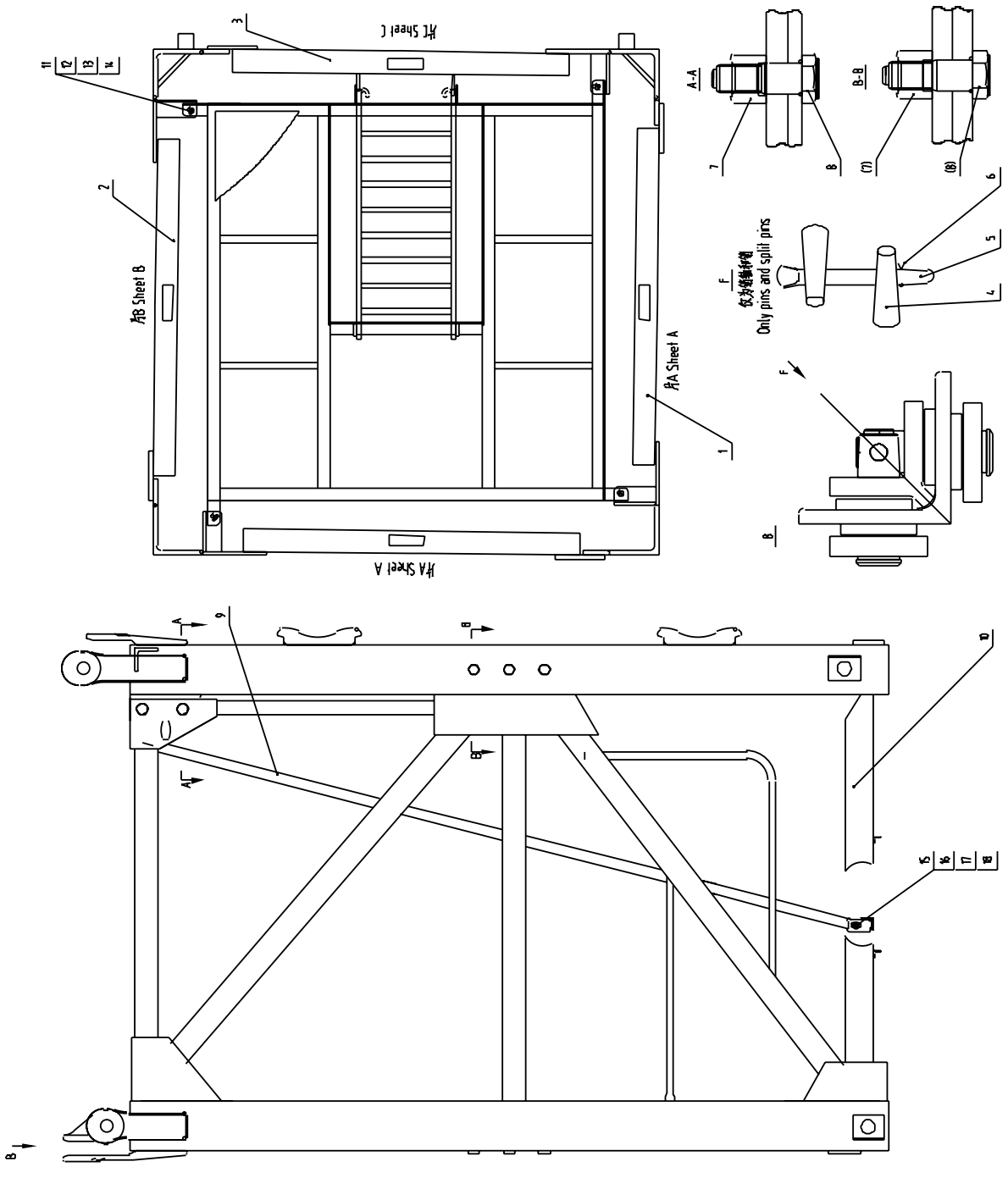
Spare Parts Manual

Chapter 9 Tower section

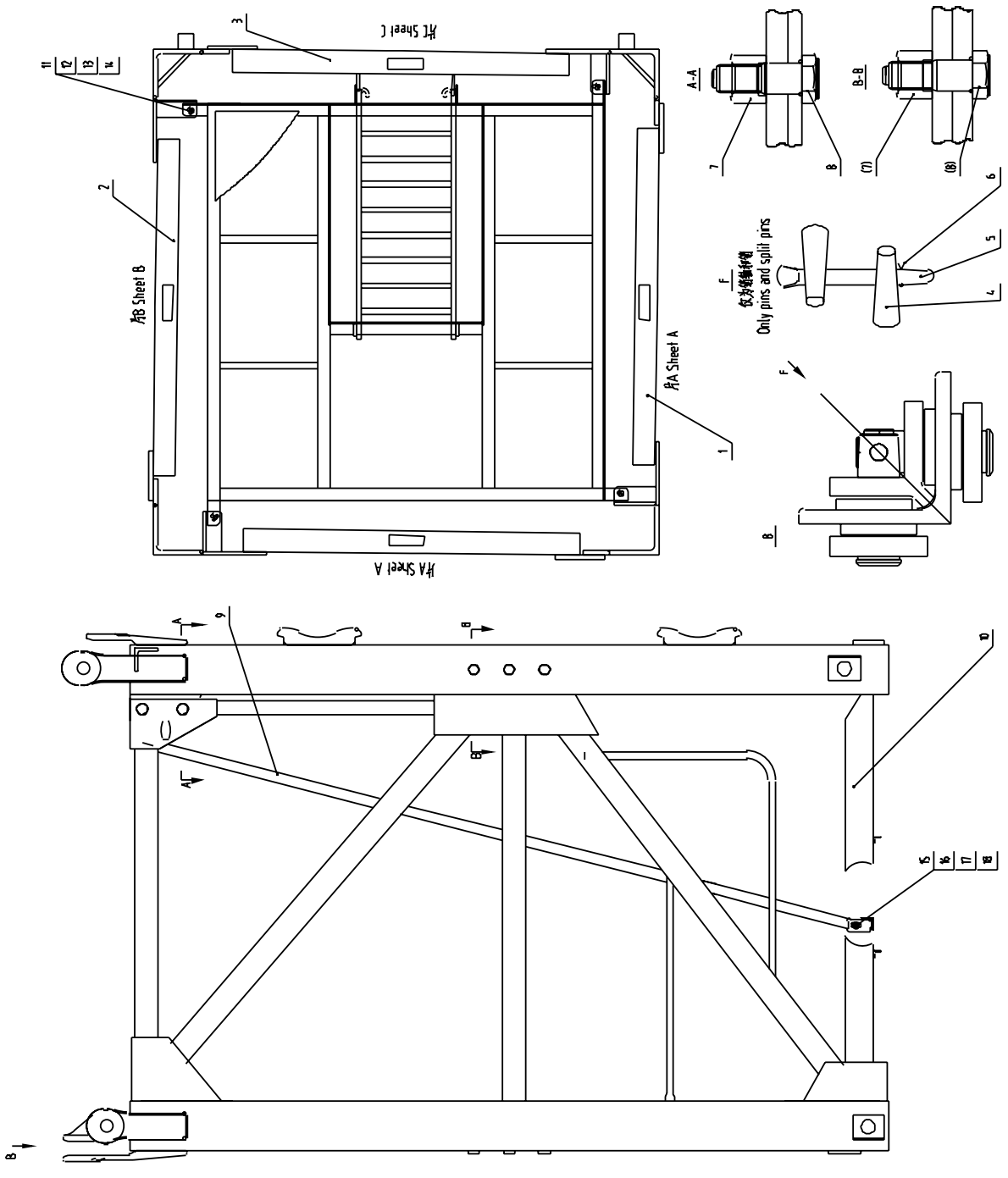
Tower section L68A1A
(000209012A3600000)



Tower section L68A1A (000209012A3600000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Plate a	000209012A3601000			2
2	Tower piece b	000209012A3602000			1
3	Tower piece c	000209012A3603000			1
4	Pin	000209012A0000002			8
5	Pin	000209012A0000003			4
6	Pin	1040500228	GB/T91-2000	4×32	4
7	Nut M27	000209012A6000002			20
8	Fish plate bolts	000209012A0000001			20
9	Long ladder	000209012A3608000			1
10	Platform	000209012A3607000			1
11	Bolt	1040000169	GB/T5783-2016	M12×45-8.8	4
12	Washer	1040300054	GB/T93-1987	12	4
13	Washer	1040300041	GB/T97.1-2002	12-200HV	4
14	Nut	1040200096	GB/T6170-2000	M12-8	4
15	Bolt	1040000095	GB/T5783-2016	M16×60-8.8	2

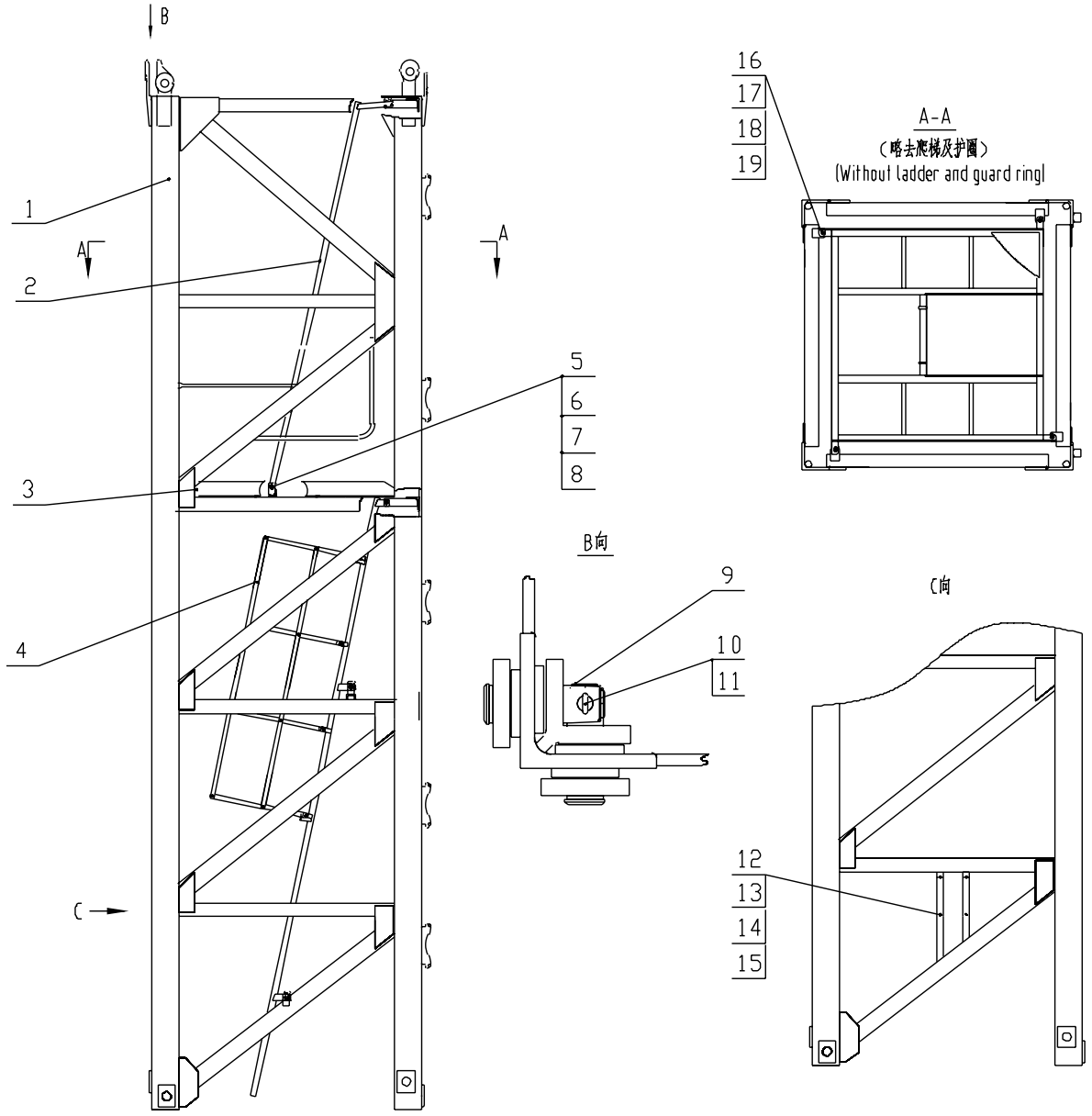
Tower section L68A1A
(000209012A3600000)



Tower section L68A1A
(000209012A3600000)

No.	Name	Numbering code	Code	Specification	Quantity
16	Washer	1040300052	GB/T97.1-2002	16-200HV	2
17	Washer	1040300065	GB/T93-1987	16	2
18	Nut	1040200110	GB/T6170-2000	M16-8	2

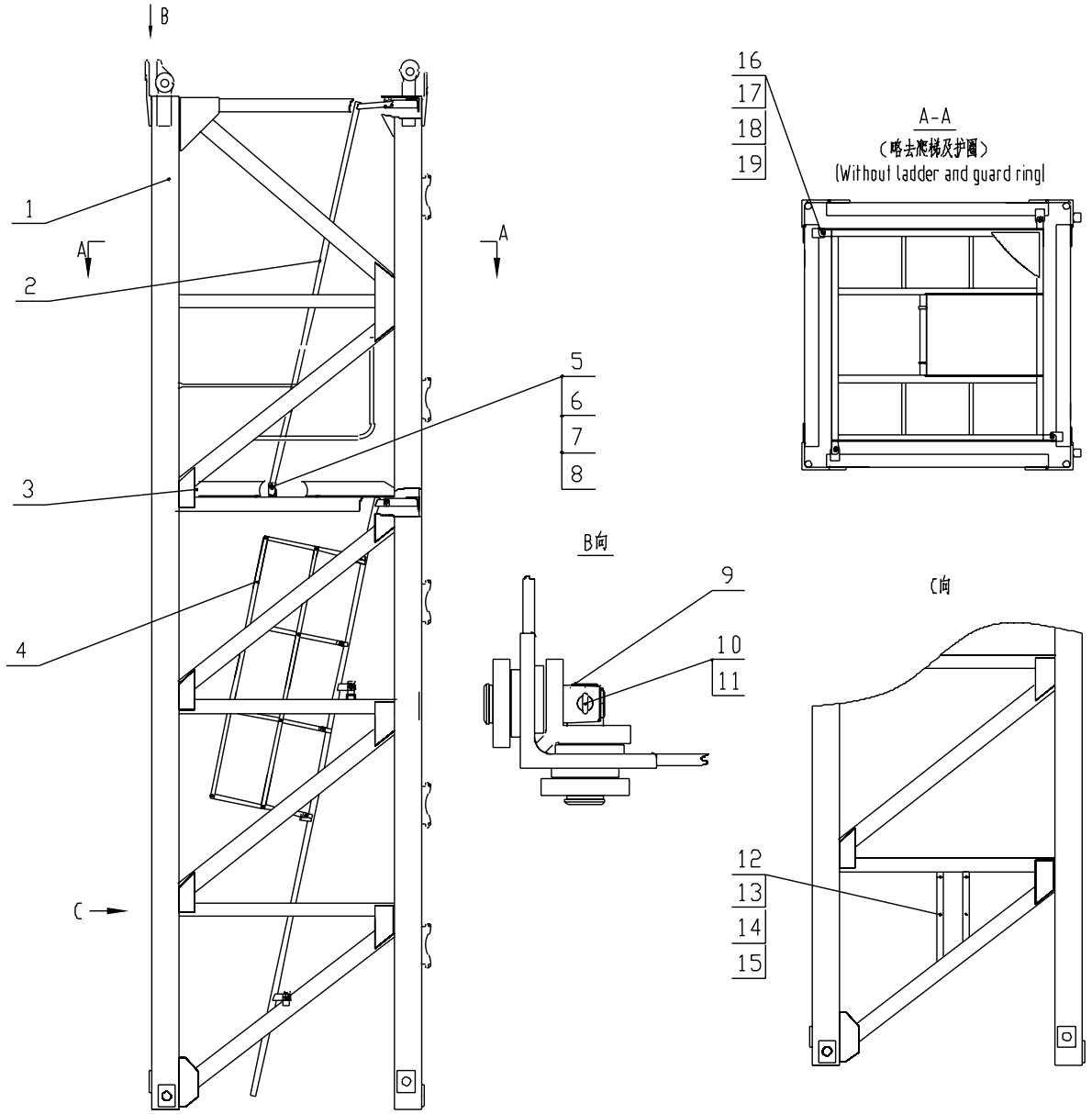
Base tower section for embedded anchors L68G23-C (000209012A9200000)



Base tower section for embedded anchors L68G23-C (000209012A9200000)

No.	Name	Numbering code	Code	Specification	Quantity
1	Base section framework	000209012A9201000			1
2	Long ladder	000209012A3608000			1
3	Platform	000209012A3607000			1
4	Long ladder and guard ring	000209012A8802000			1
5	Bolt	1040000095	GB/T5783-2016	M16×60-8.8	8
6	Washer	1040300052	GB/T97.1-2002	16-200HV	16
7	Washer	1040300065	GB/T93-1987	16	8
8	Nut	1040200685	GB/T6170-2000	M16-8	8
9	Pin	000200615F0000001			8
10	Pin	000209012A0000003			4
11	Pin	1040500228	GB/T91-2000	4×32	4
12	Bolt	1040000109	GB/T5783-2000	M6×16-8.8	4
13	Nut	1040200111	GB/T6170-2000	M6-8	4
14	Washer	1040300062	GB/T93-1987	6	4
15	Washer	1040300051	GB/T97.1-2002	6-200HV	4
16	Bolt	1040000169	GB/T5783-2016	M12×45-8.8	4
17	Washer	1040300054	GB/T93-1987	12	4
18	Washer	1040300041	GB/T97.1-2002	12-200HV	4

Base tower section for embedded anchors L68G23-C (000209012A9200000)



Base tower section for embedded anchors L68G23-C (000209012A9200000)

No.	Name	Numbering code	Code	Specification	Quantity
19	Nut	1040200096	GB/T6170-2000	M12-8	4

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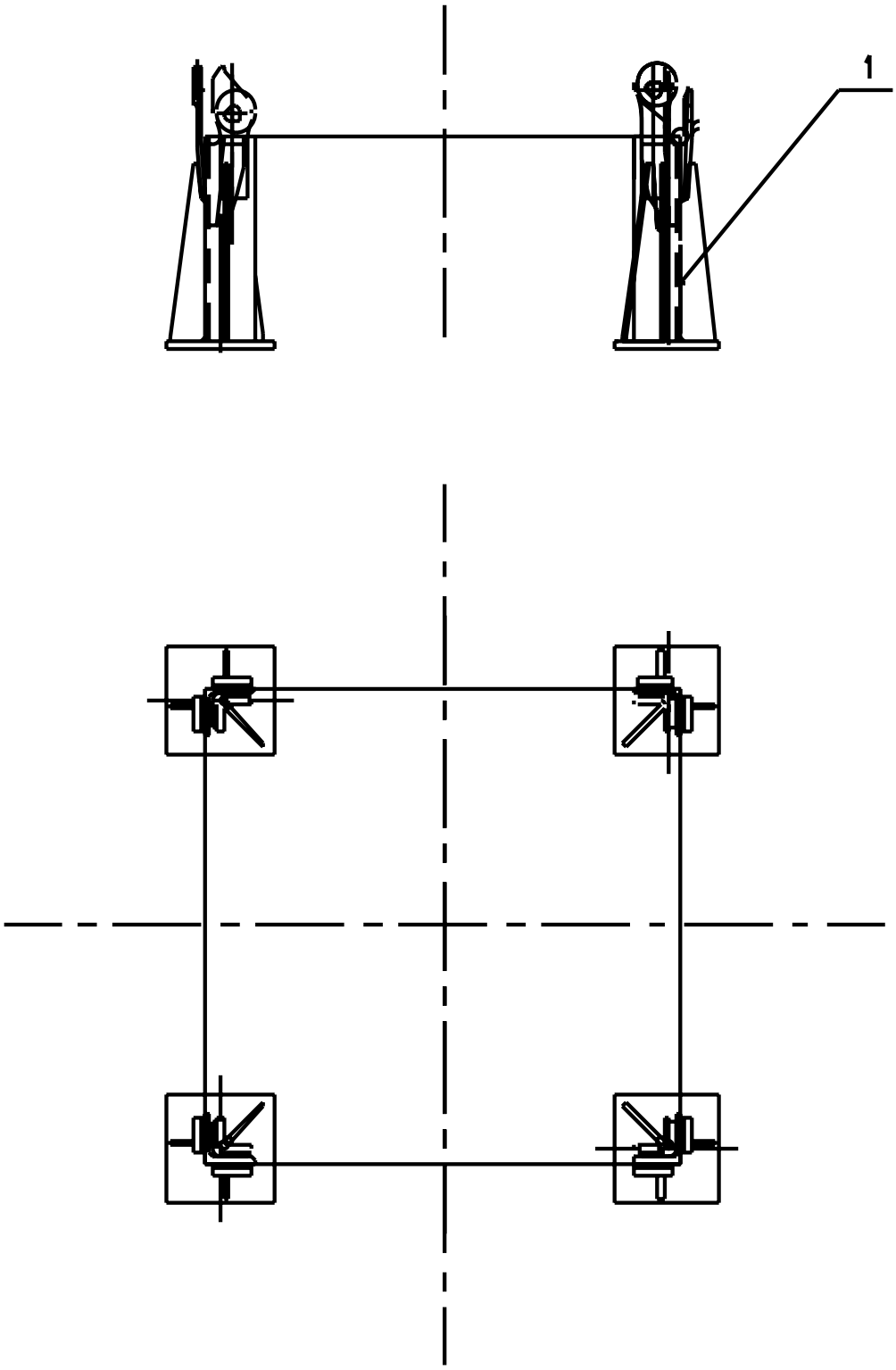
Spare Parts Manual

Chapter 10 Embedded part

Outrigger
(000271615DT000000)



Outrigger
(000271615DT000000)

No.	Name	Numbering code	Code	Specification	Quantity
	Outrigger	000271615DT000000			
1	Outrigger	000271615DT000010			4

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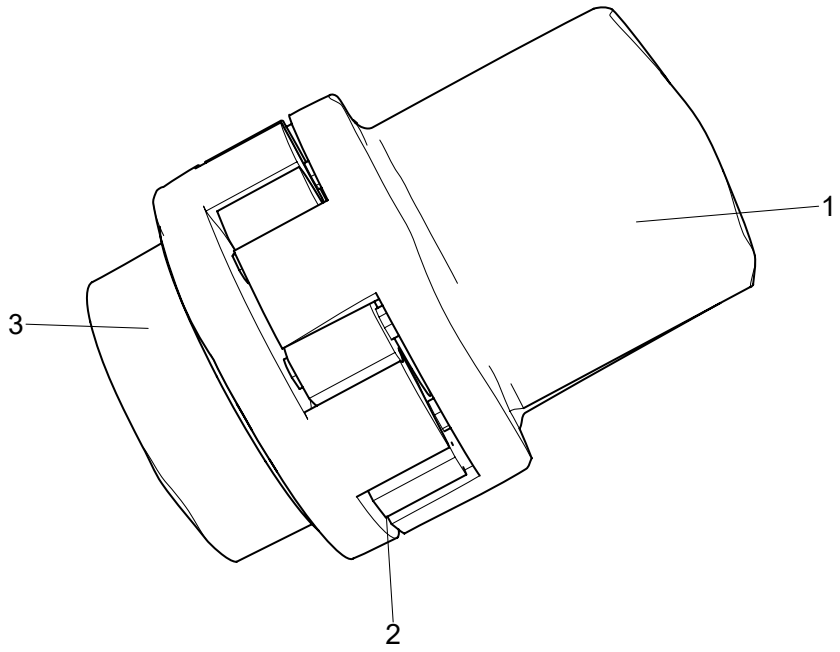
Spare Parts Manual

Chapter 11 Hoisting mechanism

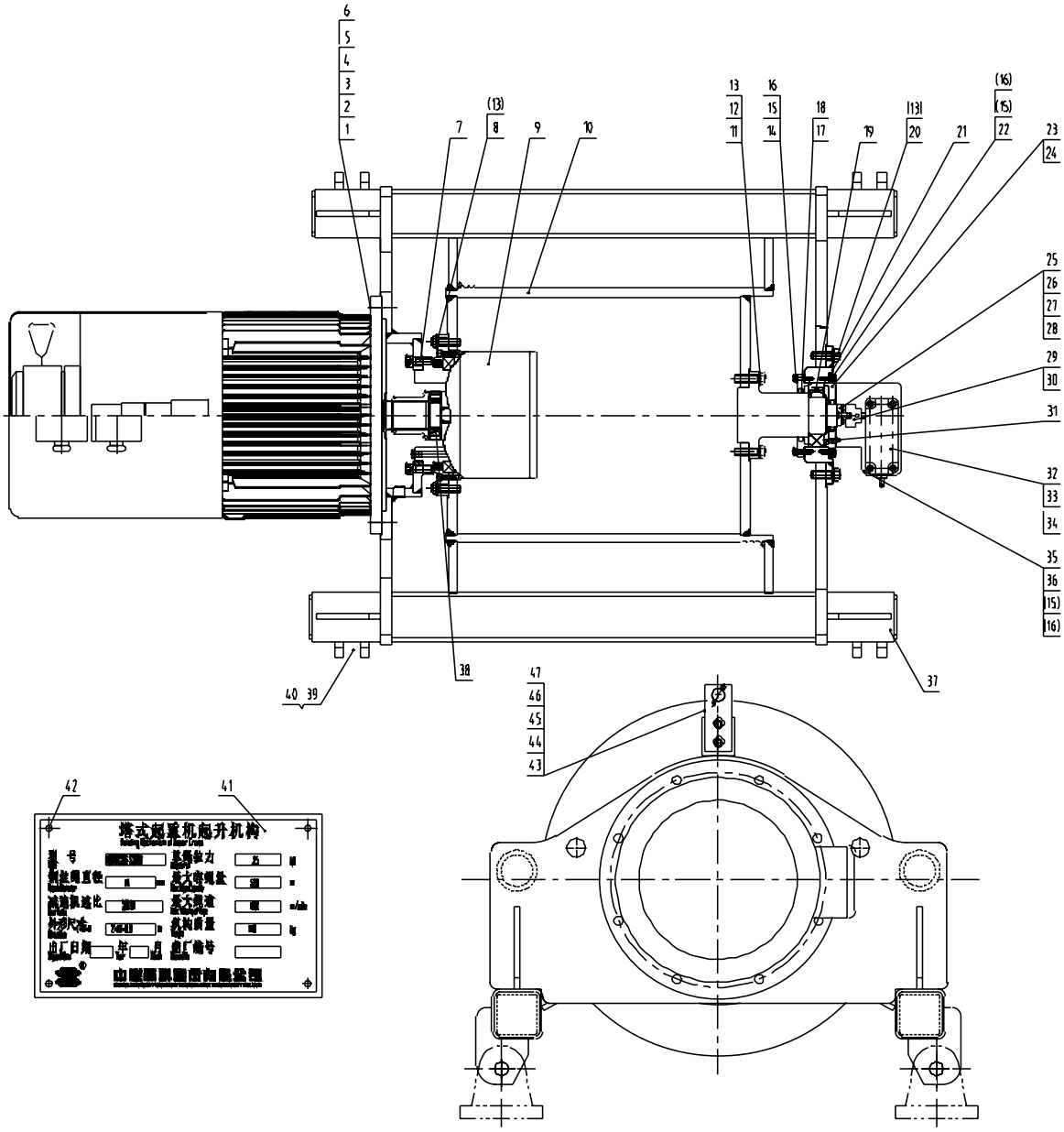
Coupling
(000209944A0001000)



Coupling
(000209944A0001000)

No.	Name	Numbering code	Code	Specification	Quantity
	Coupling	000209944A0001000			
1	Half coupling shaft a	000209944A0001011			1
2	Washer	000209944A0000962			1
3	Half coupling b	000209944A0001001			1

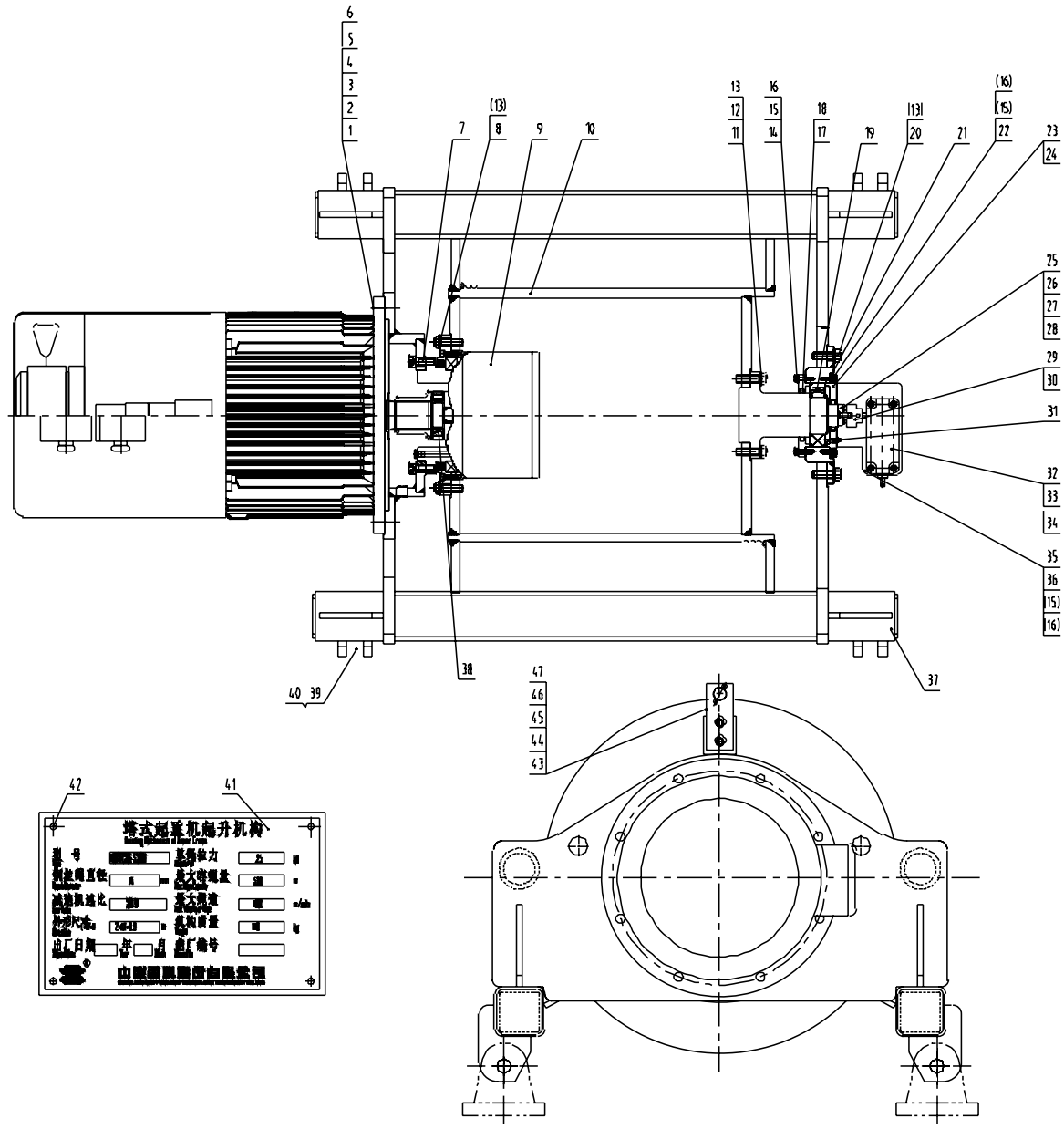
10t hoisting mechanism 1130
(000209101A6600000)



10t hoisting mechanism 1130 (000209101A6600000)

No.	Name	Numbering code	Code	Specification	Quantity
	10t hoisting mechanism 1130	000209101A6600000			
1	Motor	1020005707	YZPFME225M-4-Z	380V,50Hz,37kW	1
2	Bolt	1040000055	GB/T5783-2000	M20×60-8.8	8
3	Washer	1040300106	GB/T97.1-2002	20-200HV	8
4	Washer	1040300038	GB/T93-1987	20	8
5	Brake	1039906067	SPZ500C		1
6	Encoder	1020202010	ETF100-H(Nr:851223/0.8	ETF100-H(Nr:851223/0.8	1
7	Screw	1040100807	GB/T70.1-2000	M16×40-10.9	16
8	Bolt	1040005847	GB/T5783-2016	M16×50-10.9	20
9	Reducer	1030202793	P250T240-2W(BLZ)		1
10	Drum	000209101A7001000			1
11	Shaft	000209101A6900001			1
12	Bolt	1040000148	GB/T5782-2000	M16×55-8.8	8
13	Washer	1040300052	GB/T97.1-2002	16-200HV	36
14	Bolt	1040000018	GB/T5783-2000	M8×30-8.8	8
15	Washer	1040300063	GB/T93-1987	8	20
16	Washer	1040300066	GB/T97.1-2002	8-200HV	20

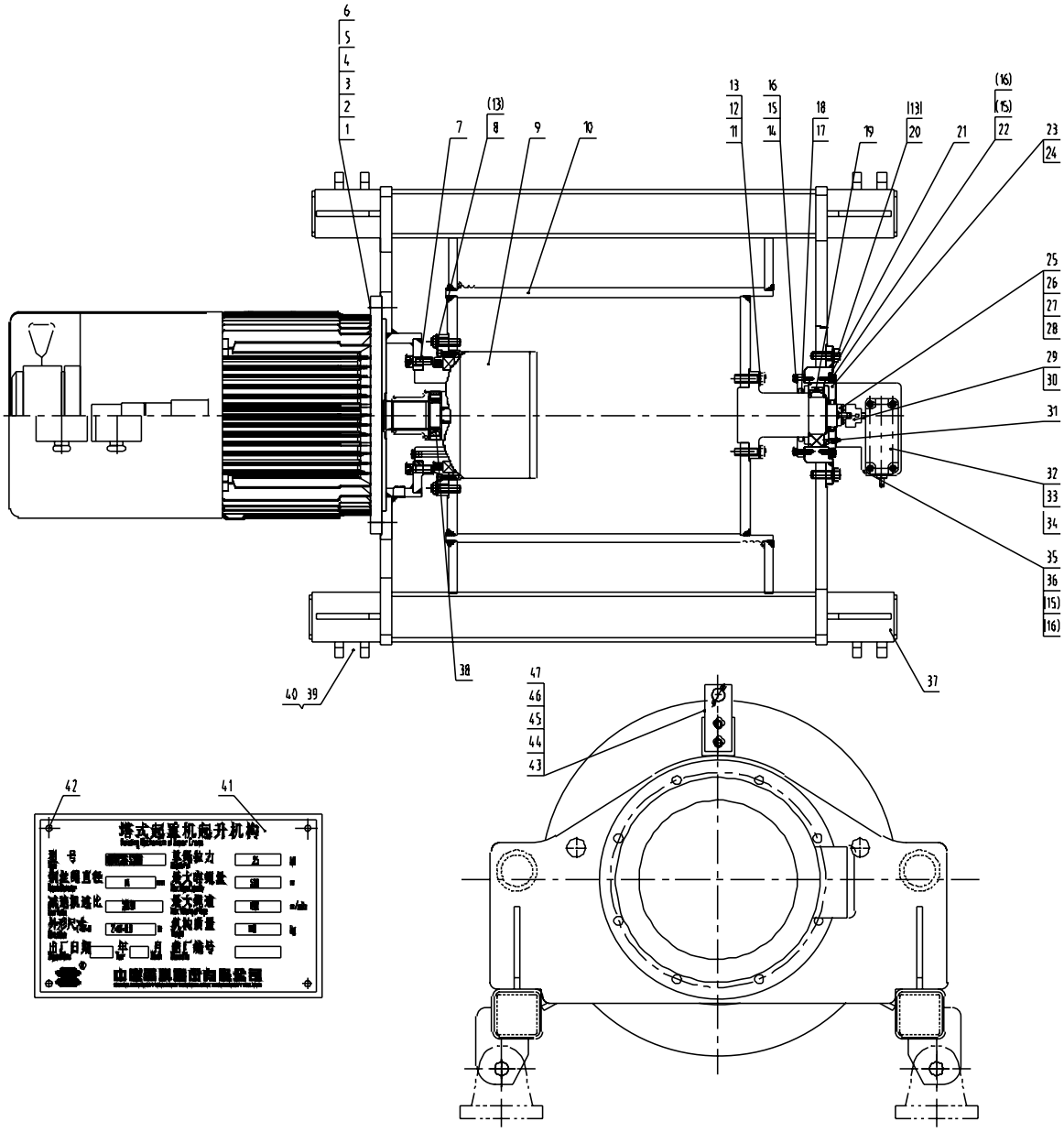
10t hoisting mechanism 1130
(000209101A6600000)



10t hoisting mechanism 1130 (000209101A6600000)

No.	Name	Numbering code	Code	Specification	Quantity
17	Bearing cover i	000209101A6900002			1
18	Felt ring	000209195A8600003			1
19	Aligning roller bearing	1050200175	GB/T288-1994	22216C	1
20	Bolt	1040000198	GB/T5783-2016	M16×50-8.8	8
21	End cover	000209101A6900100			1
22	Screw	1040100069	GB/T70.1-2008	M8×20-8.8	8
23	Bearing cover Ⅱ	000209101A6900003			1
24	Oil seal	000209195A5700002			1
25	Pin	000209195A6500003			1
26	Platen	000209195A5700004		t8	1
27	Bolt	1040000107	GB/T5783-2000	M6×20-8.8	2
28	Washer	1040300062	GB/T93-1987	6	2
29	Nylon sleeve	000209944A0200023			1
30	Pin	1040500054	GB/T91-2000	4×40	1
31	Oil cup	1080000007	JB/T7940.1-	M10×1	1
32	Bolt	1040000151	GB/T5783-2000	M5×12-8.8	4

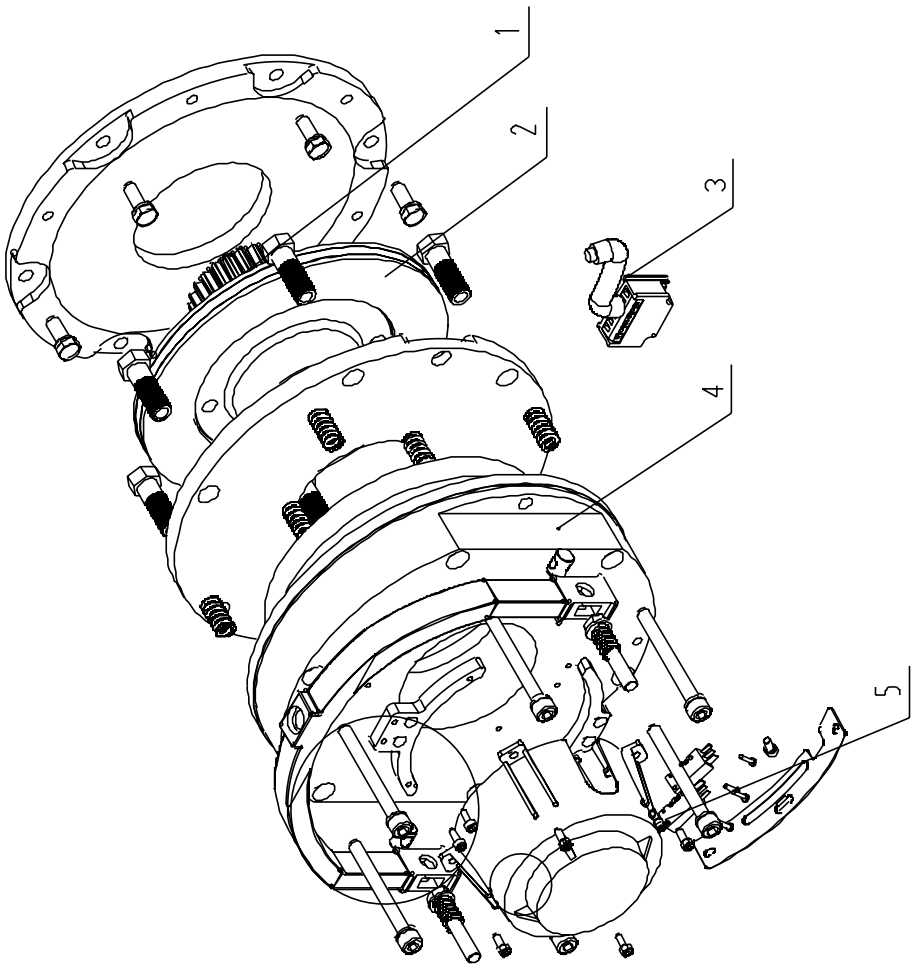
10t hoisting mechanism 1130
(000209101A6600000)



10t hoisting mechanism 1130 (000209101A6600000)

No.	Name	Numbering code	Code	Specification	Quantity
33	Washer	1040300048	GB/T97.1-2002	5-200HV	4
34	Washer	1040300060	GB/T93-1987	5	4
35	Limiter support	000209944A0400060		t5	1
36	Bolt	1040000267	GB/T5783-2000	M8×20-8.8	4
37	Rack	000209101A6601000			1
38	Coupling	000209944A0001000			1
39	Pin	000200610A0007004		30×90	4
40	Pin	1040500040	GB/T91-2000	6.3×50	8
41	Nameplate	000209101A6600009			1
42	Rivet	1040400058	GB/T827-1986	2.5×8	4
43	Rope-blocking device	000209101A7004000			1
44	Bolt	1040001283	GB/T5782-2000	M10×45-8.8	4
45	Nut	1040200813	GB/T6170-2000	M10-8	4
46	Washer	1040300061	GB/T97.1-2002	10-200HV	8
47	Washer	1040302328	GB/T93-1987	10	4

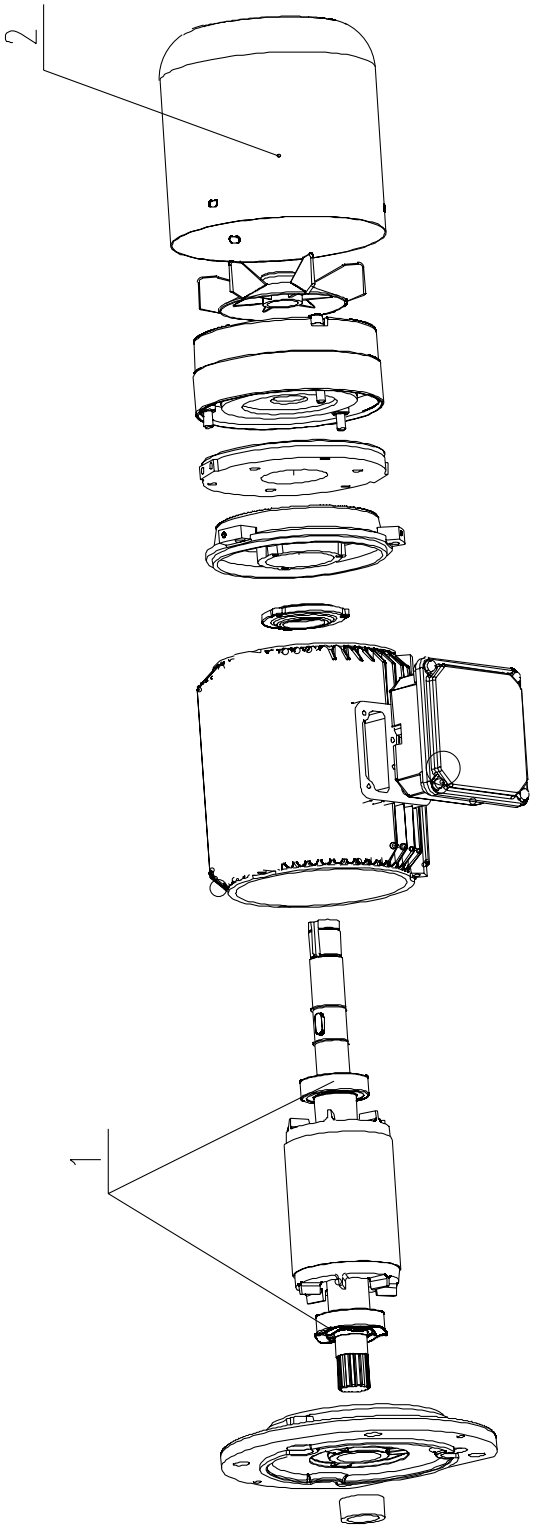
Brake
(1039906067_933)



Brake
(1039906067_933)

No.	Name	Numbering code	Code	Specification	Quantity
1	花键套	1039907017	SPZ600-10		1
2	Friction components	1030600120(2)	SPZ400C.4		1
3	Rectifier	1021904286	TDR1-170-5		1
4	Static iron core assembly	1039907016	SPZ600C.1A		1
5	micromotion switch	1020522013	D2VW-5-1M		1

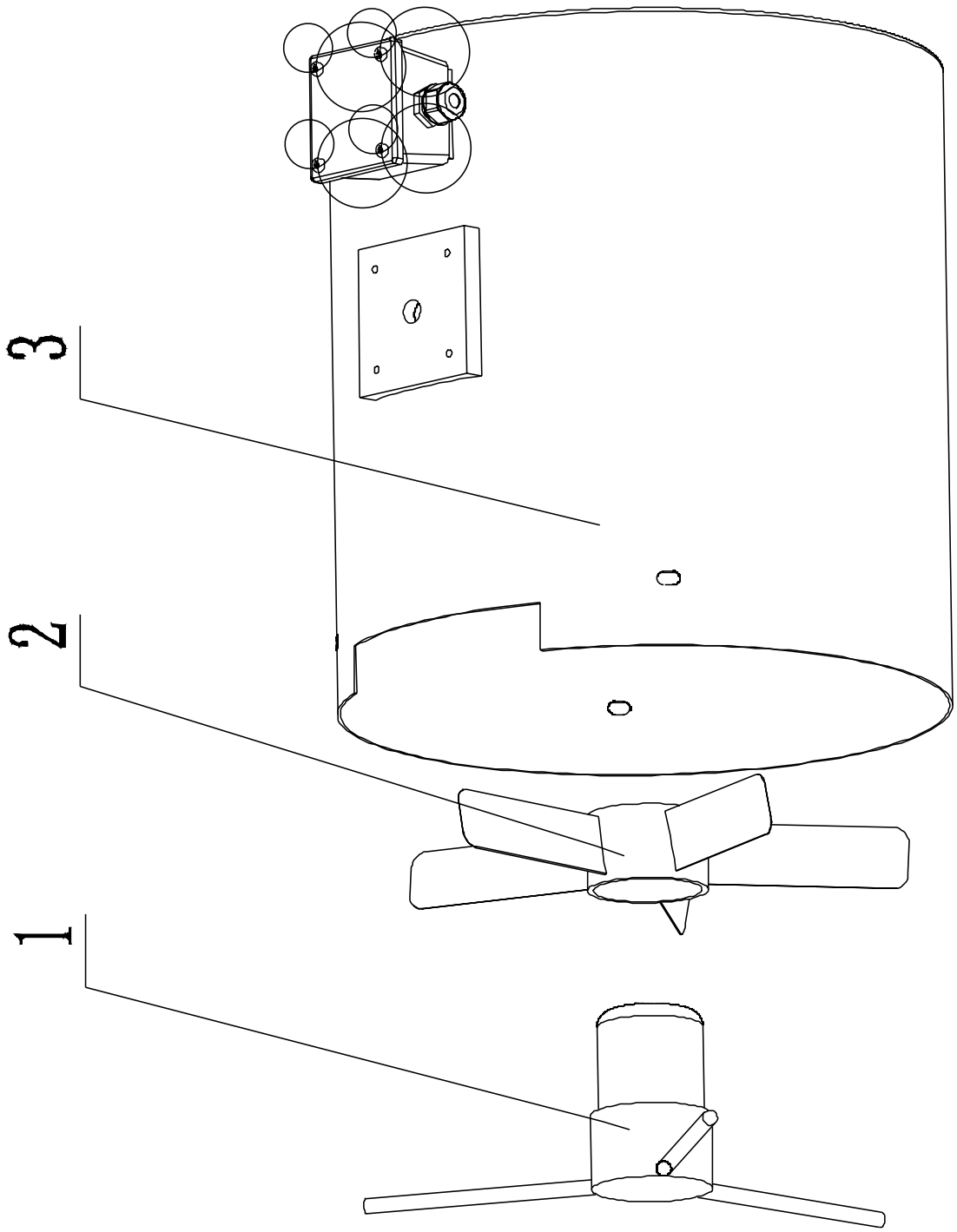
Motor
(1020005707_916)



Motor
(1020005707_916)

No.	Name	Numbering code	Code	Specification	Quantity
1	Deep groove ball bearing	1050203736	GB/T276-2013	6313-2RS	2
2	Compressor blower and fan assembly	1029807166	G-225B2-5607	风机总成	1

Compressor blower and fan assembly (1029807166_916)



Compressor blower and fan assembly (1029807166_916)

No.	Name	Numbering code	Code	Specification	Quantity
1	Compressor blower and fan motor	1029925474	5JT.435.5607.1		1
2	Fan blades	1029925476	5JT.435.5607.2		1
3	Compressor blower and fan housing	1029925475	5JT.435.5607.3		1

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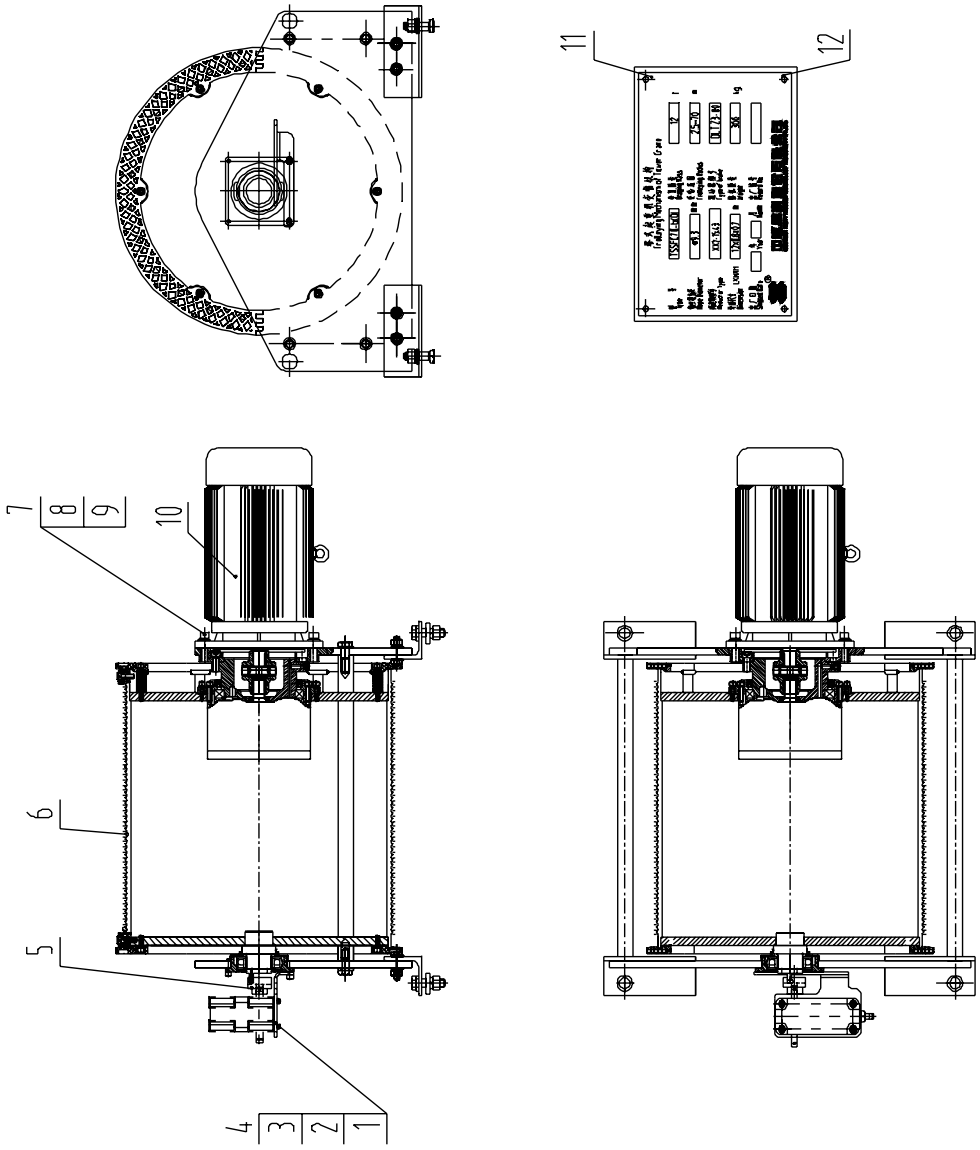
Spare Parts Manual

Chapter 12 Trolley mechanism

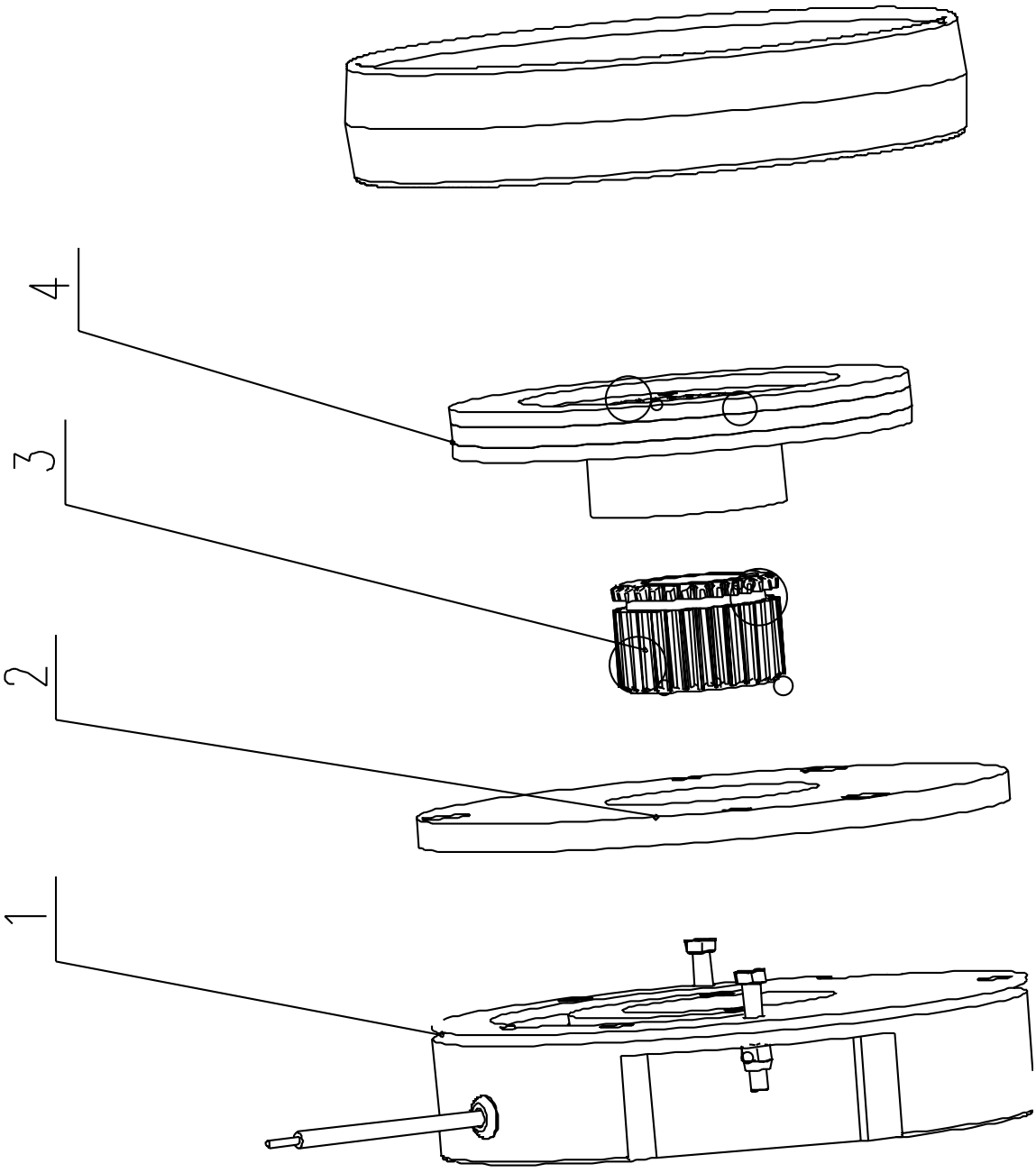
Trolley mechanism
(000209370A5000000)



Trolley mechanism (000209370A5000000)

No.	Name	Numbering code	Code	Specification	Quantity
	Trolley mechanism	000209370A5000000			
1	Bolt	1040000118	GB/T5783-2000	M5×16-8.8	4
2	Washer	1040300060	GB/T93-1987	5	4
3	Washer	1040300048	GB/T97.1-2002	5-200HV	4
4	Pin	1040500054	GB/T91-2000	4×40	1
5	Nylon sleeve	000209944A0200023			1
6	Trolleying mechanism assembly	000209370A5001000			1
7	Bolt	1040000176	GB/T5783-2016	M14×45-8.8	4
8	Washer	1040300055	GB/T97.1-2002	14-200HV	4
9	Washer	1040302295	GB/T93-2000	14	4
10	Motor	1029805687	YVFE132S-4B5(HJ)	5.5kW/380V/50Hz	1
11	Nameplate	000209370A5000003			1
12	Rivet	1040400045	GB/T827-1986	2×5	4

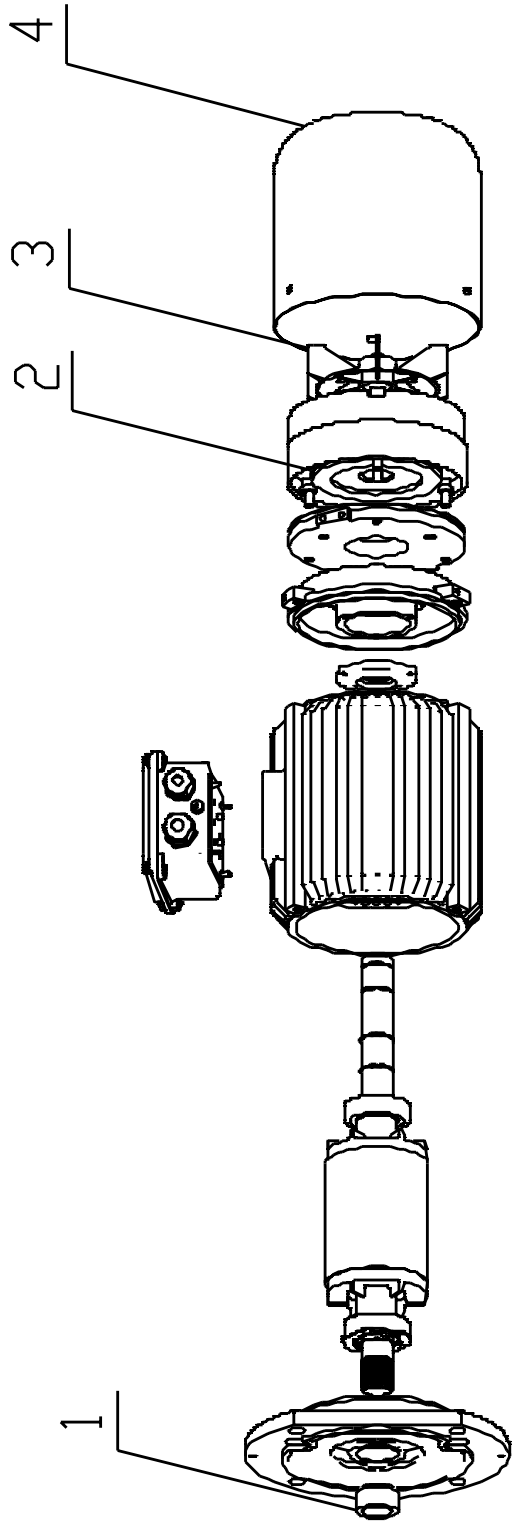
Brake
(1039907015_916)



Brake
(1039907015_916)

No.	Name	Numbering code	Code	Specification	Quantity
1	Electromagnet components	1039907014	5JT.274.0848.1		1
2	Armature	1039907013	5JT.274.0848.2		1
3	Gear sleeve	1039907012	5JT.274.0848.3		1
4	制动盘组件	1039907018	5JT.274.0848.4		1

Motor
(1029805687_916)



Motor
(1029805687_916)

No.	Name	Numbering code	Code	Specification	Quantity
1	Bearing	1050202065	GB/T276-2013	6308-2RS	1
2	Brake	1039907015	5JT.274.0848		1
3	Air fan	1021000616	8JT.435.0961		1
4	风罩	1029910612	5YD.306.018		1

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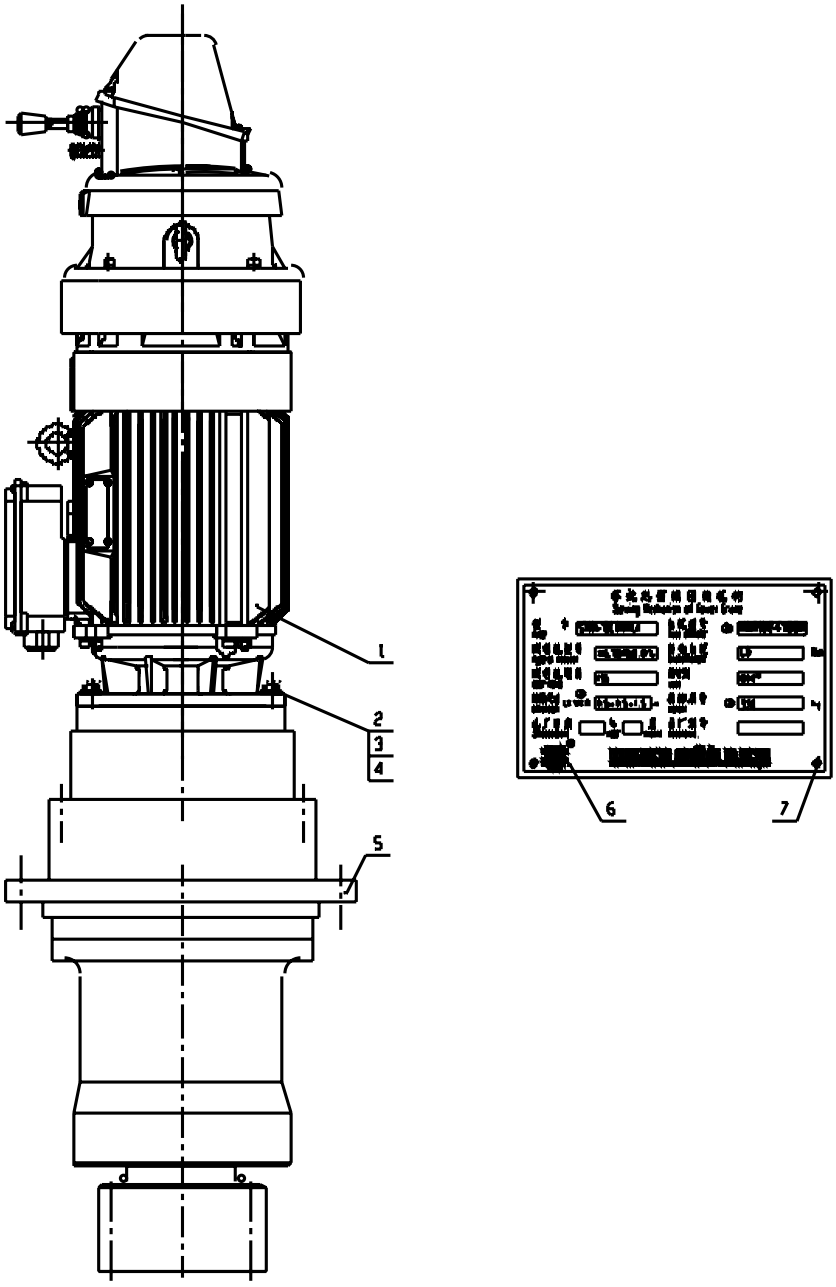
Spare Parts Manual

Chapter 13 Slewing mechanism

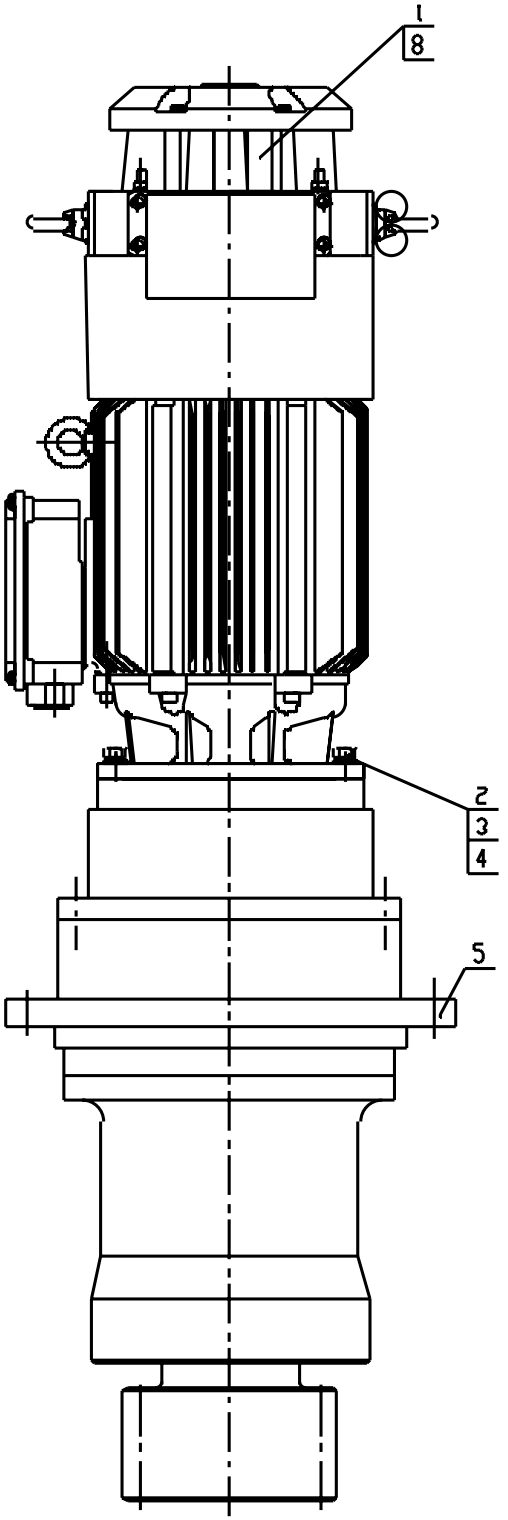
Slewing mechanism
(000209289A6700000)

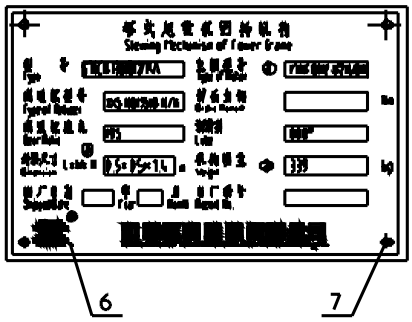


Slewing mechanism (000209289A6700000)

No.	Name	Numbering code	Code	Specification	Quantity
	Slewing mechanism	000209289A6700000			
1	Motor	1020005445	YTRVF132M2-4F1/B/BM1	7.5kW	1
2	Bolt	1040000101	GB/T5783-2016	M12×40-8.8	4
3	Washer	1040300054	GB/T93-1987	12	4
4	Washer	1040300041	GB/T97.1-2002	12-200HV	4
5	Reducer	1030202399	XX5-130.195LB-12/14		1
6	Nameplate	000209289A6700100		t1	1
7	Rivet	1040400058	GB/T827-1986	2.5×8	4

Slewing mechanism
(000209289A6800000)





Slewing mechanism (000209289A6800000)

No.	Name	Numbering code	Code	Specification	Quantity
	Slewing mechanism	000209289A6800000			
1	Motor	1020005446	YTRVF132M2-4F2/B/BM1	7.5kW	1
2	Bolt	1040000101	GB/T5783-2016	M12×40-8.8	4
3	Washer	1040300054	GB/T93-1987	12	4
4	Washer	1040300041	GB/T97.1-2002	12-200HV	4
5	Reducer	1030202399	XX5-130.195LB-12/14		1
6	Nameplate	000209289A6800100		t1	1
7	Rivet	1040400058	GB/T827-1986	2.5×8	4
8	Encoder	1020202364	ECK58B(Nr:851249/7.5)	1024PPR	1

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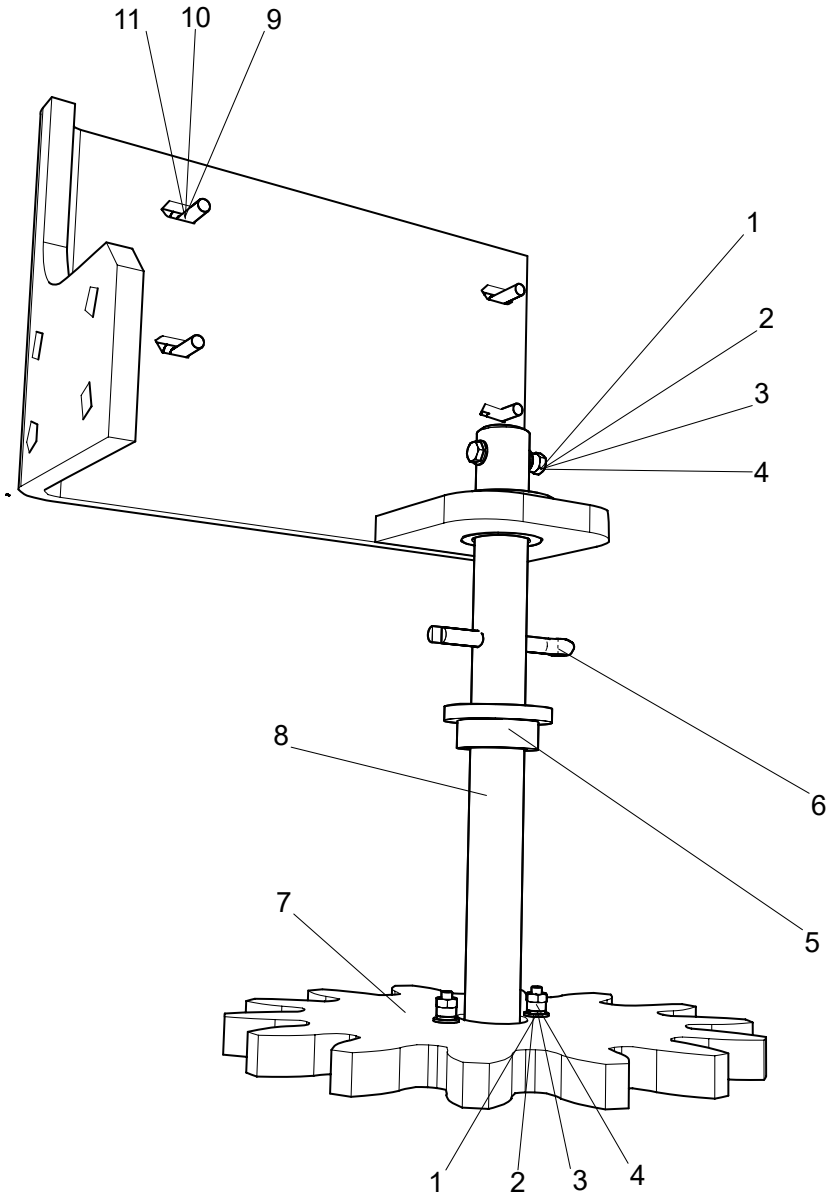
Spare Parts Manual

Chapter 14 Limiter

Slewing limit mechanism
(000201709CT000800)



Slewing limit mechanism (000201709CT000800)

No.	Name	Numbering code	Code	Specification	Quantity
	Slewing limit mechanism	000201709CT000800			
1	Washer	1040301697	GB/T97.1-2002	4-160HV	6
2	Washer	1040300044	GB/T93-1987	4	3
3	Bolt	1040001599	GB/T5782-2000	M4×30-8.8	3
4	Nut	1040201605	GB/T889.1-2000	M4-8	3
5	Shaft sleeve	000209905A0000013			2
6	Pin	1040500216	GB/T91-2000	6.3×50	1
7	Gear	000209905A0024001			1
8	Drive shaft	000201709CT000810			1
9	Bolt	1040004539	GB/T5783-2000	M5×20-8.8	4
10	Washer	1040300048	GB/T97.1-2002	5-200HV	4
11	Washer	1040300060	GB/T93-1987	5	4