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Ships and marine technology — Marine cranes — General requirements

National foreword

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**Ships and marine technology —
Marine cranes — General
requirements**

*Navires et technologie maritime — Grues marines — Exigences
générales*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee SC 4, *Outfitting and deck machinery*.

Ships and marine technology — Marine cranes — General requirements

1 Scope

This document specifies the general requirements for marine cranes of metal construction.

This document is applicable to the following types of marine cranes:

- deck cranes mounted on ships for handling cargo or containers in harbour or sheltered water conditions;
- floating cranes or grab cranes mounted on barges or pontoons for operating in harbour conditions;
- engine room cranes and provision cranes, etc. mounted on ships (including floating docks) for handling equipment and stores in harbour conditions.

NOTE Marine cranes in other types can refer to this document.

This document is not applicable to the following:

- minimum ambient operating temperatures below $-20\text{ }^{\circ}\text{C}$;
- maximum ambient operating temperatures above $+45\text{ }^{\circ}\text{C}$;
- loads from accidents or collisions;
- lifting operations below sea level;
- transport, assembly, dismantling and decommissioning of cranes;
- lifting accessories, i.e. any item between the crane and the load;
- lifting operations involving more than one crane;
- hand-powered cranes;
- emergency rescue operations;
- shore-side cargo handling cranes;
- portable cranes on board;
- lifting appliances for lifeboats, liferafts accommodation ladders, and pilot ladders;
- launching appliances for survival craft and rescue boats;
- gangways, accommodation and pilot ladders and their handling appliances.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4301-4, *Cranes and related equipment — Classification — Part 4: Jib cranes*

ISO 4413, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

ISO 8502-3, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)*

ISO 8503-1, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces*

ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

ISO 12944-5, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 5: Protective paint systems*

ISO 16855, *Ships and marine technology — Loose gear of lifting appliances on ships — General requirements*

ISO 16856, *Ships and marine technology — Loose gear of lifting appliances on ships — Hooks*

ISO 16857, *Ships and marine technology — Loose gear of lifting appliances on ships — Shackles*

ISO 16858, *Ships and marine technology — Loose gear of lifting appliances on ships — Pulleys*

ISO 19355, *Ships and marine technology — Marine cranes — Structural requirements*

ISO 19356, *Ships and marine technology — Marine cranes — Test specifications and procedures*

ISO 19359,¹⁾ *Ships and marine technology — Marine cranes — Design methods for drums*

ISO 19360, *Ships and marine technology — Marine cranes — Technical requirements for rigging applications*

IEC 60034 (all parts), *Rotating electrical machines*

IEC 60204-32, *Safety of machinery — electrical equipment of machines — Part 32: Requirements for hoisting machines*

IEC 61892 (all parts), *Mobile and fixed offshore units — Electrical installations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4306-1, ISO 3828, ISO 8431, ISO 19355, ISO 19356, ISO 19359, ISO 19360 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 marine crane

cranes mounted on ships (including floating docks) for handling equipment and stores, and intended for operating in harbour or sheltered water conditions, including deck cranes mounted on ships for handling cargo or containers, floating cranes or grab cranes mounted on barges or pontoons, engine room cranes and provision cranes, etc.

1) To be published.

3.2 deck crane

slewing crane mounted on a ship's deck and intended for loading and unloading the ship; capable of hoisting, luffing and slewing cargo, whose main structural components include pedestals, jibs and houses

Note 1 to entry: The two types of deck crane and their main components are given in [Annex A](#).

3.3 harbour condition

condition where is no significant movement of the ship when handling cargo

4 General requirements

4.1 Overall design

4.1.1 General

4.1.1.1 The overall design of marine cranes is conducted according to generally recognized standards and industrial regulations.

4.1.1.2 The design of marine cranes shall recognize the operational requirements for such cranes and shall also comply with the regulations published by appropriate organizations, such as classification societies.

4.1.1.3 Applicable regulations are those issues by the responsible classification societies and national authorities.

4.1.2 Marine cranes with jibs are assigned classification grades in accordance with ISO 4301-4, as shown in [Table 1](#).

Table 1 — Classification grades for marine cranes

Crane	Operating condition	Classification grade of the whole unit	Classification grade of mechanism			
			Hoisting mechanism	Luffing mechanism	Travelling mechanism	Slewing mechanism
Deck crane	Hooking	A4	M3	M3		M3
	Grabbing	A6	M5	M3		M3
Floating crane	Installation	A4	M4	M3		M3
Grab crane	Barging	A7	M7	M3		M6
Engine room crane	Maintenance	A1	M2		M2	
Provision crane	Handling provision	A2	M2	M2		M2

Classification grades such as A4 and M4 in the table shall be in accordance with ISO 4301-4.

4.1.3 The following forces acting upon marine cranes shall be taken into consideration:

- a) dead load;
- b) the horizontal component of the dead load caused by the ship's inclination (heel and trim);
- c) other unfavourable horizontal forces (e.g. moving inertia force, snow and ice);
- d) the horizontal component of the hoisting load caused by the ship's inclination (heel and trim);

- e) the unfavourable wind load;
- f) other forces induced by the ship's inclination (heel and trim) and movement such as anchoring, locking and binding when cranes are in storage;
- g) unusual loads such as the forces created by the crane crashing into the buffers or the dropping of the test load during testing of the crane.

4.1.4 Design factor

4.1.4.1 Duty factor, Ψ_d , is a factor which makes allowances for the frequency and state of loading for which a lifting appliance is to be considered in design, and shall be considered for the live load and dead load [a) to d) in 4.1.3]. Duty factor, Ψ_d , is determined in accordance with generally recognized standards and regulations, or selected as per Table 2.

Table 2 — Duty factor to be used in marine crane design

Crane type and use	Duty factor, Ψ_d
Provision cranes, engine room cranes	1,00
Deck cranes, floating cranes	1,05
Grab cranes	1,20

4.1.4.2 Dynamic factor, Ψ_h , is a factor which takes account of dynamic effects of the appliance arising from its lifting operation, and shall be considered for the live load [b) in 4.1.3]. Dynamic factor, Ψ_h , is determined in accordance with generally recognized standards and regulations, or is given by Formula (1):

$$\Psi_h = 1 + CV \quad (1)$$

where

V is the hoisting speed, in m/s, but need not be taken as greater than 1,0 m/s;

C is a coefficient depending on the stiffness of the crane concerned, taken as 0,3 for jib type cranes and 0,6 for gantry type cranes.

NOTE In any case, the value Ψ_h is not to be taken as less than 1,10 for jib cranes or 1,15 for gantry cranes.

4.1.5 The marine crane design shall be considered with respect to the loads resulting from the following four operating conditions.

4.1.5.1 Case 1: Crane operations with no wind — the combination of loads to be considered includes a) to d) in 4.1.3. Design factors shall be considered and given by Formula (2):

$$\left[(1) + (2) \times \Psi_h + (3) + (4) \right] \times \Psi_d \quad (2)$$

4.1.5.2 Case 2: Crane operations with wind — the combination of loads to be considered includes loads in 4.1.5.1 and e) in 4.1.3.

4.1.5.3 Case 3: Crane in the stowed position — the combination of loads to be considered includes e) to f) in 4.1.3.

4.1.5.4 Case 4: The crane is subjected to unusual loads — consider the loads in g) in 4.1.3.

4.2 Structural design and requirements

The structure of marine cranes shall be designed according to generally recognized standards and regulations. Requirements for structural design shall comply with ISO 19355.

4.3 Machinery

4.3.1 General

4.3.1.1 The machinery of marine cranes shall be designed according to applicable standards and regulations and be capable of withstanding the static and dynamic loads during the operation.

4.3.1.2 The composition and arrangement of machine structures of marine cranes shall conform to the regulations of appropriate organizations, such as classification societies, in order to ensure their safety and reliability.

4.3.2 Mechanism

4.3.2.1 The hoisting mechanism shall be capable of hoisting and lowering the safe working load (SWL) according to the specified service mode, and necessary means shall be taken to avoid the improper winding of the wire ropes during the hoisting.

4.3.2.2 The slewing mechanism shall be capable of starting up and stopping stably in the allowable operational condition, according to the specified service mode (including the allowable ship inclination and swing), to place the lifted SWL at the due position.

4.3.2.3 The travelling mechanism shall be capable of making the whole unit and cart start up and stop stably according to the specified service mode, and be provided with a device suitable for expected ship's inclination and swing. A crane operating in the open air along a track shall be provided with a reliable wind-proofing device (such as a rail clamping device and other anchors).

4.4 Main components

4.4.1 The bearing components of the marine crane shall be capable of meeting the safety requirements of strength (including fatigue), stiffness and stability after being loaded.

4.4.2 The loose gear of the marine crane shall conform to the requirements of ISO 16855, ISO 16856, ISO 16857 and ISO 16858.

4.4.3 The selection of wire ropes shall conform to the requirements of ISO 19360.

4.4.4 The requirements of drums shall conform to ISO 19359.

4.4.5 The hoisting, luffing and slewing mechanisms of the crane shall be provided with brakes. The brakes for hoisting and luffing mechanisms shall be normally closed. The safety factor of the brake shall be not less than 1,5.

4.4.6 Hydraulic cylinders shall be capable of withstanding the pressure and dynamic force in the working condition or off working condition. Cylinders used in the working conditions of luffing and foldable jib shall be provided with a load control valve, so that even if the pressure of cylinders fails or a hose hydraulic piping breaks, cylinders can also support the jib in position. The load control valve shall be mounted directly on the hydraulic cylinder ports.

4.5 Drive and control systems

4.5.1 General

4.5.1.1 The drive and control systems of the marine crane shall conform to applicable international standards and take possible environmental conditions into account. The drive and control systems shall be designed according to the applicable standards such as ISO/IEC 90003, IEC 61508 and regulations such as classification society rules.

4.5.1.2 The control system shall support the safe operation of the crane and comply with the related requirements of safety protection, alarm, interlock and control.

4.5.1.3 The control system shall effectively control the speed, motion direction and stop of the mechanisms of the crane to ensure the safe operation.

4.5.1.4 The motion direction of the operating handle or hand wheel used for control of the crane operation shall be consistent with that of the hook or crane. When the operating handle is pulled toward the operator or turned upward, the corresponding hook or jib is raised; when the operating handle is turned to the right, the crane turns to the right; when the operating hand wheel is operated along the clockwise direction, the hook or jib is raised or the crane turns to the right, and so on.

4.5.1.5 The operation control position shall be arranged such that an operator can observe the operating area of the crane and the load being lifted.

4.5.1.6 An emergency stop facility shall be provided at each operation control station to stop the motion of the crane in an emergency. Emergency stops shall also be provided at the machinery house and, where necessary, at access routes to the crane. This emergency stop shall be clearly identified and fitted with suitable means to protect the facility from unintentional use.

4.5.1.7 The marine crane equipped with a multi-speed control system shall not be able to continue hoisting when the load suitable for the speed is exceeded. In this case, the crane should only be able to lower the cargo to avoid overload operation.

4.5.1.8 The operation control station shall be provided with an indicator to show the operational condition of the main motor.

4.5.2 Power unit

4.5.2.1 The prime mover of the crane is a complete power unit and shall be sized with the work loads and speeds in compliance with the design operational requirements of the crane in the following conditions:

- a) the diesel engine shall not fall below its required speed (or overspeed) at the SWL and the diesel engine shall not stall;
- b) the electric motor shall not overheat;
- c) the external energy supply is sufficient.

4.5.2.2 The installed power shall meet the operational requirements of the crane taking into account temporary overloads including hoisting motion priority and safety.

4.5.3 Hydraulic system

4.5.3.1 The hydraulic system of a marine hydraulic crane shall comply with the requirements of ISO 4413.

4.5.3.2 The design of the hydraulic system and selection of components shall be suitable for the operational and safe requirements of the marine crane.

4.5.3.3 Safety devices installed in the hydraulic system shall comply with the requirements of applicable regulations (e.g. classification society rules).

4.5.4 Pneumatic system

4.5.4.1 The pneumatic system of a marine pneumatic crane shall comply with ISO 4414.

4.5.4.2 The design of the pneumatic system and selection of components shall be suitable for the operational and safe requirements of the marine crane.

4.5.4.3 The safety devices installed in the pneumatic system shall meet the requirements of applicable regulations (e.g. classification society rules). All filters and dryers shall be installed inside the control area to protect components against pollution.

4.5.5 Electric system

4.5.5.1 The electrical system of a marine crane shall be designed in accordance with IEC 60204-32 and IEC 61892 (all parts).

4.5.5.2 The design of the electric system and selection of components shall be suitable for the operational requirements of the marine crane.

4.5.5.3 The safety devices installed in the electrical system shall meet the requirements of IEC 60034 (all parts) and IEC 60204-32.

4.6 Safety devices

4.6.1 Safety devices for a marine crane shall be designed to meet the requirements of applicable national or international standards and regulations (e.g. classification society rules).

4.6.2 Means shall be provided to automatically hold the crane and load in position. For the electric power control system, resuming of crane operations after power failure shall only be possible after the control lever is returned to its neutral position. The manual emergency lowering device shall be installed to allow the load to be placed in a safe position in case of power failure.

4.6.3 A marine crane shall be provided with a hoisting height limiter, a maximum and minimum luffing angle limiter, a slewing angle limiter (in case the crane is required to have also the slewing angle limited to avoid collisions) and a travelling limiter.

It shall be made clear that it is not required for the whole crane to be disconnected from its power supply, but only that motions in the direction of the motion limitation are prevented (e.g. further hoisting is prevented when the limit switches at the jib head are engaged).

If some motions of the crane need to go beyond the position of limitation (e.g. if required to put the jib down or to move the hook block into the hook block garage, etc.), an override switch may be provided

to prevent the function of the limiter. This switch shall be provided with proper protection to avoid inadvertent use.

4.6.4 A marine crane shall be provided with overload (hoist load limiting) protection or a load indicator. Alarm shall be motivated when marine loaded with more than 95 % of SWL. Motions which increase an overload shall be automatically prevented when marine loaded with 110 % of SWL. The overload protection shall be adjusted according to applicable national or international standards.

4.6.5 Cranes operating outdoors shall be provided with devices to warn against wind, rain, snow and overturning. Cranes operating along a track shall be provided with devices for track cleaning and preventing the cart from falling. The anticollision devices, buffers, end stops and anchoring devices shall be set in accordance with industrial regulations.

4.6.6 Safety installations, such as cabins, passages, ladders and platforms shall conform to applicable national or international standards or regulations.

4.6.7 Disposal of wind speed indicator, horizontal indicator and fire protection devices shall apply to related standards and rules, e.g. class societies' code.

4.7 Coating

4.7.1 The service environment for coated marine cranes shall be subjected to the highest level of anti-corrosive treatment in accordance with C5-M (marine) specified in ISO 12944-2. The coating type shall be suitable for C5-M specified in ISO 12944-5.

4.7.2 Surface treatment level before coating shall be Sa2 1/2 grade in ISO 8501-1, the surface roughness shall be medium in ISO 8503-1 with about 3 mil ~4 mil (75 µm ~100 µm), the surface dust rating shall be "1-2" in ISO 8502-3, the surface soluble salt content shall be no more than 50 mg/m².

4.7.3 Coating shall be applied within 4 hours after the surface treatment.

4.7.4 The environmental test shall be carried out before coating, to inspect the ambient temperature, surface temperature of members, air humidity and dew-point temperature, etc.; the coating environment shall comply with the following requirements:

- the minimum surface temperature of members shall be 5 °C and maximum surface temperature shall be 35 °C;
- substrate temperature at least 3 °C higher than the tested dew point;
- relative humidity 85 % and wind speed ≤0,5 m/s.

The coating inspectors shall be qualified according to ISO 12944-5.

4.7.5 Anti-corrosive treatment, surface treatment, environmental test and coating which is not specified in standards set in [4.7.1](#) to [4.7.4](#) shall be carried out in accordance with generally accepted standards and coating manufacturer's recommendation.

4.8 Test

A marine crane shall be tested according to ISO 19356 and classification rules.

4.9 Marking and label plates

4.9.1 The crane shall be marked with the SWL and corresponding working radius in a visible position in accordance with applicable national or international standards or regulations.

4.9.2 The crane shall have a label plate mounted at its control station, with at least the following information:

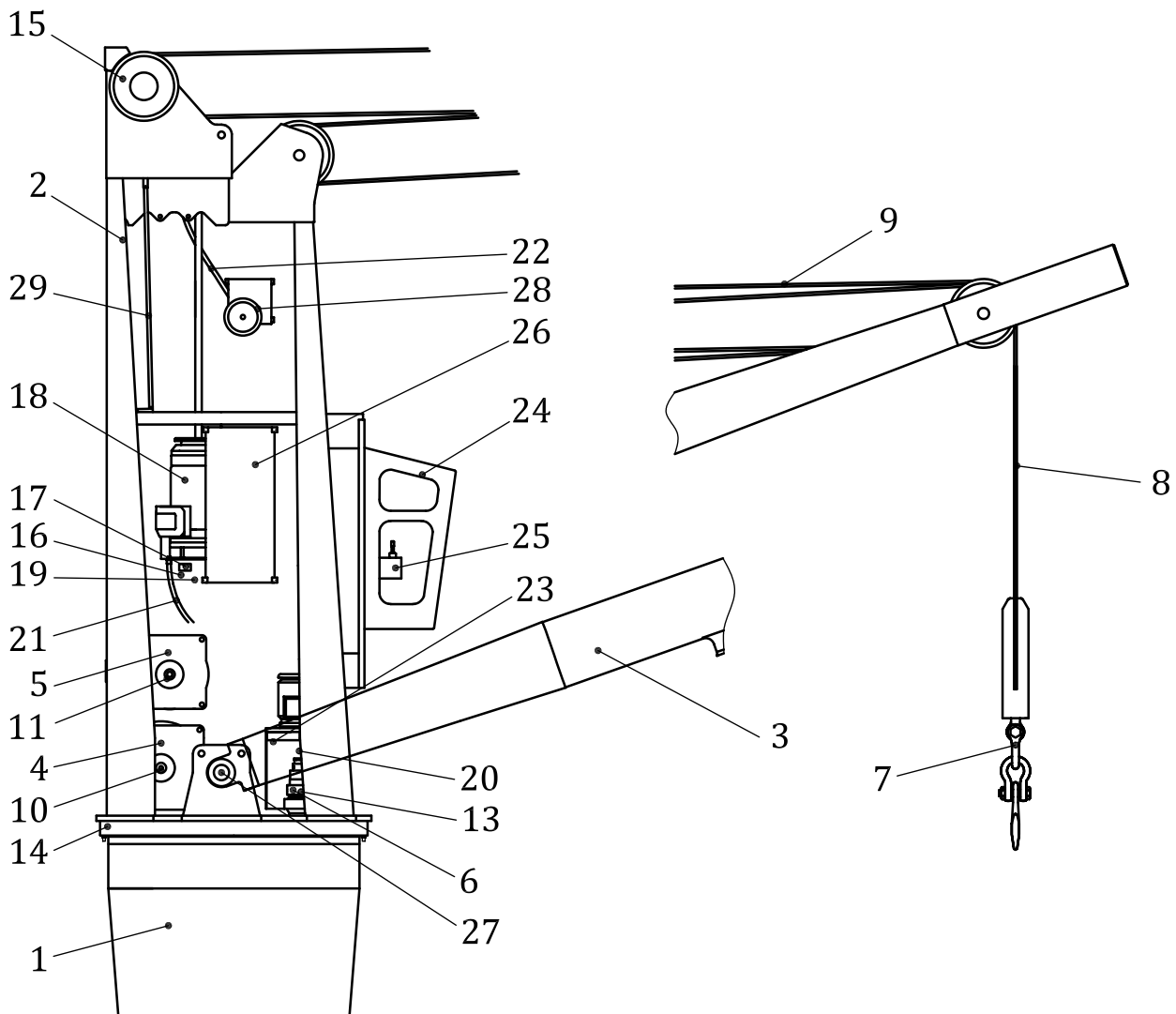
- a) name of manufacturer;
- b) product name and type;
- c) main performance parameters;
- d) serial number;
- e) date of manufacture.

Annex A (informative)

Two types of deck crane and their main components

A.1 Types of deck cranes

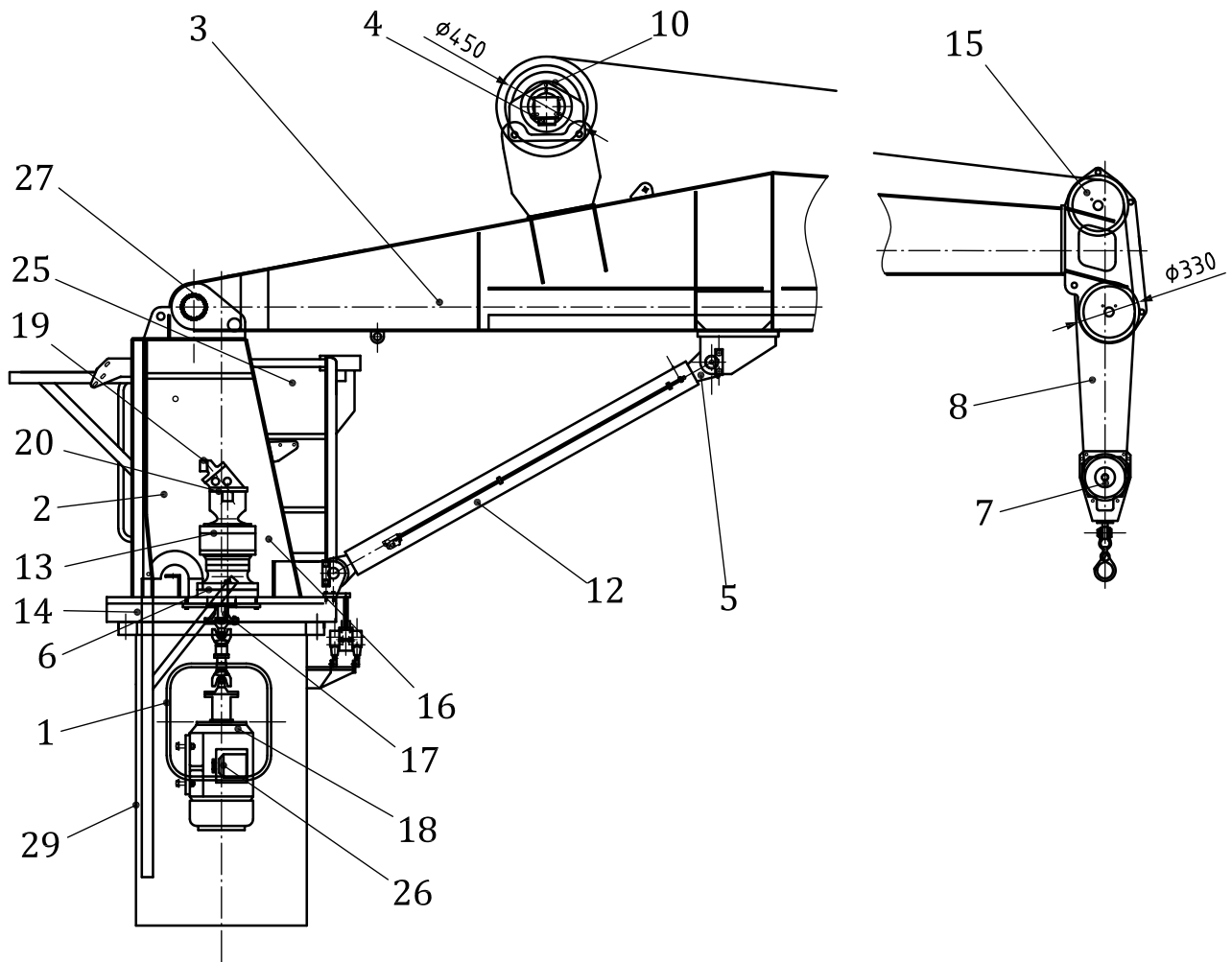
A.1.1 A typical wire rope luffing deck crane is shown in [Figure A.1](#).



NOTE For the main components of wire rope luffing deck marine, see [Table A.1](#).

Figure A.1 — Wire rope luffing deck crane

A.1.2 A typical cylinder luffing deck crane is shown in [Figure A.2](#).



NOTE For the main components of cylinder luffing deck marine, see [Table A.1](#).

Figure A.2 — Cylinder luffing deck crane

A.2 Main components of a deck crane

The main components of a deck crane are given in [Table A.1](#).

Table A.1 — Main components of a deck crane

No.	Name	Description
1	Foundation	Load bearing structure, with welded components, supporting the crane
2	House	Load bearing structure, with welded components, protecting the machinery compartment
3	Jib	Load bearing structure, with welded components, which provides the necessary radius and/or height
4	Hoisting mechanism	Enables a load to be hoisted
5	Luffing mechanism	Enables a load to be luffed
6	Slewing mechanism	Enables a load to be slewed
7	Lifting block	Device by which a load is suspended from the crane
8	Load wire rope	Enables a load to be hoisted

Table A.1 (continued)

No.	Name	Description
9	Luffing wire rope	Enables the jib to be luffed
10	Hoisting winch	Winds the load wire rope
11	Luffing winch	Winds the luffing wire rope
12	Luffing cylinder	Enables the jib to be luffed
13	Slewing gear	Enables the slewing movement
14	Slewing bearing	Bears the weight of the crane and load and enables smooth slewing movement
15	Sheave	Acts as a guide for a wire rope
16	Hydraulic system	Provides hydraulic power to, and control of, the crane
17	Pump unit	Supplies high-pressure oil to the hydraulic system
18	Electric motor	Providing power drive
19	Valve	Enables reversal and control of the hydraulic fluid
20	Hydraulic motor	Provides power to equipment using high-pressure oil
21	High pressure tubing	High-pressure oil transfer
22	Low pressure tubing	Low-pressure oil transfer
23	Assistant pump unit	Refilling oil, etc.
24	Cabin	Enclosed compartment from which the crane is controlled by an operator or 'driver'
25	Driver's desk	Location for the operator's indicators and controls
26	Electrical system	Providing power control
27	Jib axes	Bears the weight of the jib and load and about which the jib rotates
28	Fan	Provides ventilation to the crane machinery and operator's cabin
29	Alleyway	Passage for personnel

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