
**Ships and marine technology —
Deck machinery — Multifunctional
manipulator**

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ISO 24044:2020

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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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 4, *Outfitting and deck machinery*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Ships and marine technology — Deck machinery — Multifunctional manipulator

1 Scope

This document specifies the classification, requirements, test methods and inspection rules, as well as marking, packaging, shipping and storage requirements for multifunctional manipulators for deck operations (hereinafter referred to as “multifunctional manipulators”).

It is applicable to the design, manufacture and acceptance of double folding multifunctional manipulators for clamping and tidying the anchor chain and ropes in deck operations.

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 780, *Packaging — Distribution packaging — Graphical symbols for handling and storage of packages*

ISO 3828, *Shipbuilding and marine structures — Deck machinery — Vocabulary and symbols*

ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

IEC 60529, *Degrees of Protection Provided By Enclosure (IP Code)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3828 and the following apply.

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

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

3.1

jib

second movable arm of the multifunctional manipulator used to lift and hook tension free ropes

3.2

multifunctional head

operating device of the multifunctional manipulator used to grasp, clamp and tidy the anchor chain and ropes

3.3

multifunctional boom

second movable arm of the multifunctional manipulator used to connect the *multifunctional head* (3.2)

3.4

main boom

first movable arm of multifunctional manipulator used to connect the slewing tower body and the second movable arm of the double folding boom

3.5 luffing

movement made by the *main boom* (3.4), *jib* (3.1) and *multifunctional boom* (3.3) of the multifunctional manipulator in changing the range in a reach direction

3.6 safe working load SWL

maximum static load (kN) that the multifunctional manipulator can hoist or the *multifunctional head* (3.2) operates under design working conditions

3.7 travelling mechanism

mechanism of the travelling multifunctional manipulator used to complete the movement with load along the guide rail, consisting of carrier, roller train, guide pulley set, travel driving unit, cable reel, pay-out stand, rail clamping device, speed control valve, buffer, and lubrication line

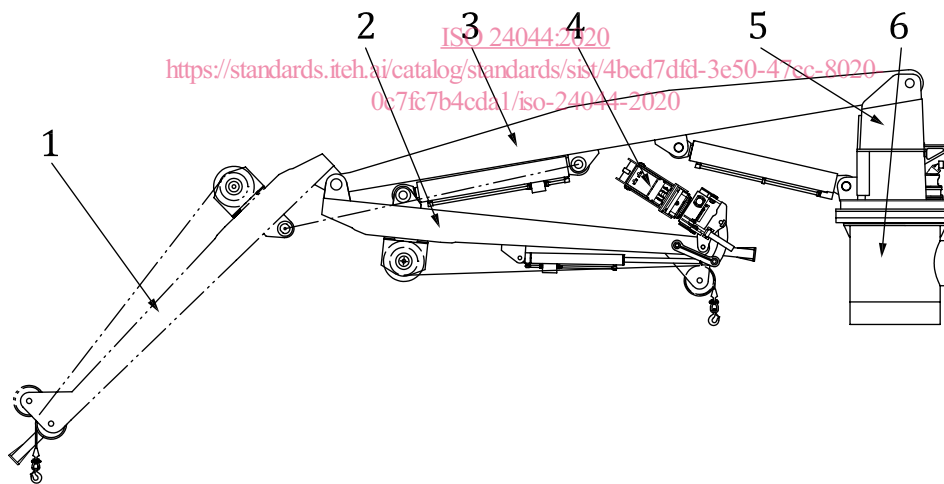
4 Classification

4.1 Structural types

4.1.1 Multifunctional manipulators can be divided into fixed and travelling types, according to their structure (installation) form.

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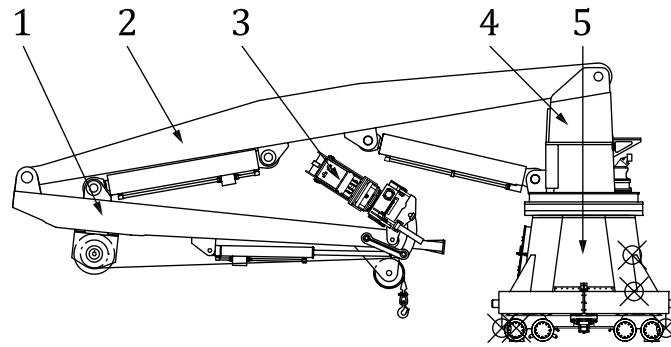
4.1.2 Multifunctional manipulators can be divided into multifunctional boom only and combined multifunctional boom and jib, according to their composition. See [Figure 1](#) and [Figure 2](#).



Key

- | | |
|------------------------|------------------------|
| 1 jib | 4 multifunctional head |
| 2 multifunctional boom | 5 slewing tower body |
| 3 main boom | 6 fixed base |

Figure 1 — Fixed multifunctional manipulator with combined multifunctional boom and jib



Key

- | | | | |
|---|----------------------|---|----------------------|
| 1 | multifunctional boom | 4 | slewing tower body |
| 2 | main boom | 5 | travelling mechanism |
| 3 | multifunctional head | | |

Figure 2 — Travelling multifunctional manipulator with multifunctional boom

4.2 Product designation

The multifunctional manipulator shall be designated as shown in the example in [Figure 3](#).

EXAMPLE Designation of a multifunctional manipulator with lifting SWL of 30 kN and maximum working radius of 12 m, hydraulic-driven, fixed type and double working booms: **Multifunctional manipulator HMF-3012-D**

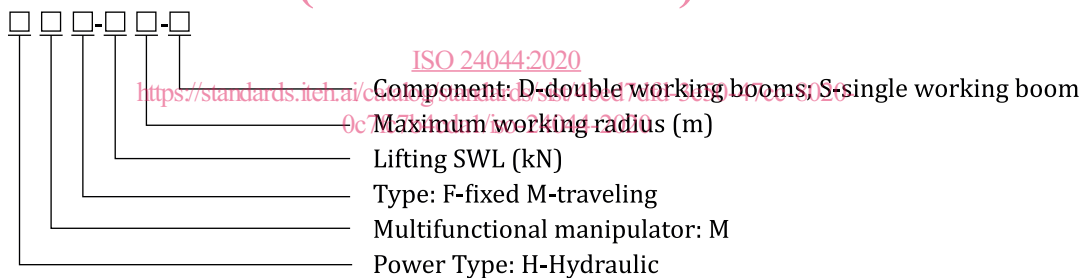


Figure 3 — Product designation example

4.3 Appearance

The colour of the multifunctional manipulator surface shall be uniform, and the outer surface and the coating layer shall be free from scratching, peeling, cracks and rust. The safe working load (SWL) designation shall be clearly visible to the operator.

4.4 Basic parameters

The basic parameters of the multifunctional manipulator shall conform to [Table 1](#).

Table 1 — Basic parameters of multifunctional manipulators

Type		HMF-2010-D	HMF-3012-D	HMR-3012-D	HMR-3014-D	
SWL	Lifting	(kN)	20	30	30	30
	Multifunctional head operation	(kN)	20			

NOTE φ is the diameter of chain or rope.

Table 1 (continued)

Type		HMF-2010-D	HMF-3012-D	HMR-3012-D	HMR-3014-D
Lifting speed	(m/s)	0,46			
Maximum working radius	(m)	10,2	12,2	12,2	14
Minimum working radius	(m)	2,6	2,5	2,5	3,4
Slewing angle	(°)	360° full slewing			
Main boom luffing	(°)	0° to 60°			
Jib luffing	(°)	20° to 150°			
Multifunctional boom luffing	(°)	20° to 150°			
Swinging luffing of the multifunctional head along the boom	(°)	120°			
Self swinging of the multifunctional head	(°)	±40°			
Self slewing luffing of multifunctional head	(°)	360° full slewing			
Size range for multifunctional head clamping anchor chain	(mm)	φ50 to φ120			
Size range for multifunctional head clamping rope	(mm)	φ50 to φ84			
NOTE φ is the diameter of chain or rope.					

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5 Requirements

5.1 Design and structure

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5.1.1 Environmental conditions

The multifunctional manipulator shall be able to work normally in the following environment:

- a) sea state: 4

NOTE According to Pierson - Moskowitz Sea Spectrum and Beaufort Force, sea state 4 means Beaufort wind force 5, under which condition the significant wave is 6 ft., significant range of periods is 2,5~8,5 s, average period is 5 s, and average length of waves is 80 ft.

- b) ambient temperature: -25 °C~45 °C
 c) vibration and shock generated during the normal operation of the ship.
 d) humidity greater than 95 % with oil mist, salt spray, and mildew.

5.1.2 Steel wire rope

The steel wire rope shall be non-rotating steel wire, and the nominal tensile strength of a single steel wire shall be not less than 1 440 MPa and not greater than 2 200 MPa.

5.1.3 Hook

The hook shall be of rotating type and shall reach the lifting capability of lifting SWL in the design sea state.

5.1.4 Pulley

5.1.4.1 There shall be a proper inclined angle, which is usually between 35° and 45°, at the pulley rope groove side and the inclined angle at the pulley rope groove side in Level 4 sea state shall be taken as 40°.

5.1.5 Boom, slewing tower body, base and carrier structure

5.1.5.1 The main boom, jib, and multifunctional boom shall adopt boom structure form with box shaped and variable section. The boom, slewing tower body, base and carrier shall be subjected to stress relief treatment after welding.

5.1.5.2 The slewing tower body shall be subjected to watertight inspection.

5.1.6 Slewing mechanism

5.1.6.1 If there are special requirements for the slewing tower body to limit the slewing angle, the mechanical and electric limits shall be specified.

5.1.6.2 The slewing angle measurement shall be measured using an encoder enclosed inside a hydraulic/electrical adapter.

5.1.6.3 The slewing mechanism has two slewing hydraulic drive mechanisms which are respectively arranged on both sides of the lower plane of the slewing tower body. The slewing hydraulic drive mechanism is composed of a planetary speed reducer, a brake and a gear, and the brake is normally closed. The slewing hydraulic drive mechanism shall leave 1,5 mm eccentricity with the mounting axis to ensure that the slewing support meshes well with the slewing hydraulic drive mechanism gear and compensates for wear during use.

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5.1.7 Fixed base/travelling mechanism

5.1.7.1 The fixed base shall be of sufficient rigidity to prevent the system from shaking due to excessive elastic deformation.

5.1.7.2 For roller trains of the travelling mechanism, the two roller trains mounted on the front and rear ends of the lower portion of the carrier respectively shall be used, each roller train consisting of one mounting shaft, four positive rollers, four return rollers and two swing frames, to accommodate to the vertical plane motion and horizontal yaw of the ship. Travelling drive should adopt the pinion and rack driving mode.

5.1.7.3 The cable length of the cable reel on the travelling mechanism is one-half of the travelling stroke of the travelling multifunctional manipulator plus the safety ring number.

5.1.7.4 The role of the speed control valve of the travelling mechanism is to automatically slow down and stop travelling near the stroke destination. The travelling mechanism of the hydraulic drive shall be equipped with a speed control valve to ensure the system travelling safety and buffers shall be installed at both ends of the travel stroke.

5.1.7.5 The roller of travelling mechanism shall be of curved tread and the guide rail shall be of flat tread.

5.1.7.6 The lubrication for the roller train and guide pulley set shall be carried out with wheel-side manual lubrication.