INTERNATIONAL STANDARD

ISO 20662

First edition
2020-01

Ships and marine technology — Hopper dredger supervisory and control systems

Reference number
ISO 20662:2020(E)

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Published in Switzerland

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Foreword

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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.*

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.

Introduction

This document describes the supervisory and control system for a number of components, functions and systems that can, but do not have to, be installed on board of a hopper dredger. It does not prescribe that all described components, functions and systems need to be installed.

Ships and marine technology — Hopper dredger supervisory and control systems

1 Scope

This document specifies the components and structure, general requirements, and functional requirements of trailing suction hopper dredger supervisory and control systems.

It is applicable only to the installed components, functions or systems. It covers design, manufacture and modification.

2 Normative references

The following referenced 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 8384, *Ships and marine technology — Dredgers — Vocabulary*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 8384 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/

3.1.1
hopper dredger supervisory and control system
HD-SCS
system used for supervising and controlling the dredging operations of a hopper dredger

3.1.2
suction tube position monitor
STPM
system used for supervising and controlling the suction tube operation, displaying the movement and position of the suction tube

3.1.3
depth of draghead
distance from the water surface to the lower edge of the draghead

3.1.4
draught and soil loading system
DSLS
system used to display and record the draught and soil load

3.1.5
light ship weight
displacement of the hopper dredger, while the hopper is empty and the bottom doors are closed

Note 1 to entry: It represents the weight of the ship before each dredging.

3.1.6
light mixture overboard
LMO
controller used to discharge the mixture overboard directly when its concentration is too low

3.1.7
suction tube winch controller
STWC
controller used to move the suction tube to the specified position or to hold the position automatically

3.2 Abbreviated terms

DSLS	Draught and soil loading system
HD-SCS	Hopper dredger supervisory and control system
HMI	Human machine interface
LMO	Light mixture overboard
PLC	Programmable logic controller
SCADA	Supervisory control and data acquisition
STPM	Suction tube position monitor
STWC	Suction tube winch controller

4 Components and structure

4.1 Components

A hopper dredger is a self-propelled dredger with its own integrated hopper hold.

An HD-SCS, according to this document, is a basic system for supervising and controlling the dredging operations performed by a hopper dredger utilising sensors, networks, computers, and technologies concerning measurement, communication and automation.

An HD-SCS is an integrated SCADA system that can consist of the following subsystems, based on their functions.

a) STPM/STWC: STPM/STWC monitor excavation process. It should involve the monitoring and control of the suction tube, gantry, draghead, winch, swell compensator and other equipment. The STPM/STWC includes the suction tube vertical/horizontal angle, visor angle, swell compensator position, and valve/gantry state sensors.

b) DSLS: DSLS monitor loading process. It should involve the monitoring and control of overflows, light mixture overboard valve, loading valve and other equipment. The DSLS includes the dredger draught, hopper level, trim/heel, mixture density, mixture flow, overflow position, and valve state sensors.

c) Unloading system: unloading system monitor bottom dumping, rainbow/shore discharging process. It should involve the monitoring and control of the bottom door, split-system pre-dumping

door, hopper emptying valve, bow coupling and winch and other equipment. The unloading system includes the bottom door position, pre-dumping door position, and hopper emptying valve state.

d) Dredge pump system: the dredge pump system should involve the monitoring and control of the dredge pump, including pump vacuum and pressure, pump speed, and pump power.

e) Jet water system: the jet water system should involve the monitoring and control of the jet pump, hopper jet water valve, and draghead jet water valve. The jet water system includes the jet water pressure, jet water flow, jet pump speed, jet pump power, hopper jet water valve state, and draghead jet water valve state sensors.

f) Dredge valve system: dredge valve system construction of mixture channel for dredging operation. It should involve the monitoring and control of the dredge valve.

4.2 Structure

The HD-SCS should adopt a multi-layer network structure, including equipment layer, process monitoring layer, and information management layer, as follows:

a) equipment layer: field instrumentation/sensors;

b) process monitoring layer: PLC, signals collecting and processing units, communication network;

c) information management layer: central monitoring and control station.

5 General requirements

5.1 Operating position and control mode

5.1.1 Operating position

The HD-SCS should have local and remote operating positions.

5.1.2 Control mode

The HD-SCS should have the following control modes:

a) manual: manual operation by handle/button/knob and in graphical user interface;

b) emergency: direct operation through hardwire, only for dredging equipment that affects the safety of the ship.

5.2 External communication

The HD-SCS should have communication with a tide-system.

5.3 Diagnostic

When the equipment start and stop control, operation position transfer, or control mode shift operation fails, the HD-SCS can provide diagnostic information to accommodate a safe dredging.

5.4 HMI graphics

5.4.1 Alarm level

In HMI graphics, the HD-SCS alarm level can be set in two colours.

EXAMPLE Red is the highest level alarm, meaning danger; yellow is the secondary level alarm, meaning warning or abnormal condition.

This principle can be applied to all graphical symbols, function-keys, and digital data.

5.4.2 Conventions on graphic colours

The HMI graphic colours can be specified as follows.

a) For HMI graphics, cold tone colours are recommended, and for non-operating graphical interfaces, warm tone colours can be adopted.

b) The colour matching of the HMI graphics should make the flow chart simple and clear with harmonious and consistent colours. It is advisable that the number of colours adopted not be excessive.

c) Colour adoption of the HMI graphics can be in accordance with the specifications in Table 1.

Table 1 — Convention on graphical adoptions

Colour	General meaning	Meaning of colour in combination with graphical symbol	Meaning of colour in combination with digital data
Red	Danger	Highest level alarm	Highest level alarm
Yellow	Warning	Abnormal condition, secondary alarm	Abnormal condition, secondary alarm
Grey	Static state	Stop, shut down, disconnection	None
Cyan	Special meaning	Remote control, etc.	None
Blue	Secondary importance	Backup equipment	Tag number
White	Safe, program in activation status	None	Measured value or status value, dynamic data
Green	Safe, program in activation status	Normal operation, working, open, shut down, graphic value	None

5.4.3 Brightness of the HMI

The brightness of the HMI graphics should match that of the environment. For screen in bridge, the HMI can have a “night” display mode, and brightness of the screen can be lowered enough not to affect the sailors lookout in the night.

6 Functional requirements

6.1 STPM/STWC

6.1.1 Preset

The configuration of the suction tube and the parameters of the sensors should be set in STPM.

6.1.2 Operation

The STPM/STWC should have the following functions for the equipment operation:

a) hoisting/lowering of the trailing suction tube(s);

b) controlling of gantries;

c) adjusting of the visor angle;

d) stroke and pressure regulation of the swell compensator.

6.1.3 Controller

The STPM should have a STWC, which makes winches and gantries of the suction tube and swell compensators to work together to move the suction tube to a specified position or to hold the position, especially to ensure a constant dredging depth of the draghead.

6.1.4 Display

The STPM should display the following information:

a) top view, side view, and back view of the suction tube with relation to the dredgers position;

b) depth of draghead, and horizontal distance between draghead and hull;

c) status of the suction tube in seated position;

d) stroke of swell compensator;

e) position of the gantry.

6.1.5 Alarm

The STPM should give the alarm under the following circumstances:

a) the draghead position is below the maximum depth setpoint;

b) the suction tube is too close to the hull;

c) the suction tube is too close under the ship;

d) the suction tube is at the highest or lowest position;

e) the pivot vertical and horizontal angles are greater than the pre-set values.

6.1.6 Calibration

The depth of the draghead can be calibrated in the STPM.

6.2 DSLS

6.2.1 Preset

The following information can be set in the DSLS:

a) ship displacement table and hopper capacity table;

b) parameters of draught and hopper level sensor;

c) water density and undisturbed soil density at the construction site.

6.2.2 Operation

The DSLS should have the following functions for the equipment operation:

a) open/close of the light mixture overboard valve;

b) open/close of the loading valve;

c) adjusting of the overflows position.

6.2.3 Controller

The DSLS should have a LMO, which makes some dredge valves to work together to achieve the right mixture to flow overboard or to flow into the hopper according to the velocity and density of the mixture.

6.2.4 Display

The DSLS should display the following information:

a) draught, displacement, light weight, loading, trim;

b) loading mixture density, loading mixture flow;

c) hopper level, mixture volume in hopper, load;

d) position of adjustable overflow;

e) curve of hopper level, mixture volume in hopper, load.

6.2.5 Alarm

The DSLS should give the alarm when draught is over the pre-set value.

6.2.6 Calibration

The actual light ship weight can be calibrated in the DSLS.

6.3 Unloading system

6.3.1 Preset

The following information can be set in the unloading system:

a) individual or grouping-bottom doors;

b) selection of shallow water dump and direct dump modes;

c) shallow water dump depth setpoint;

d) hopper self-emptying valve operation.

6.3.2 Operation

The unloading system should have the following functions for the equipment operation:

a) individual or group operation of the bottom door;

b) open/close, position regulation of the bottom door;

c) open/close of the pre-dumping door;