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Ships and marine technology — Standard data for shipboard machinery and equipment

Navires et technologie maritime — Données normalisées pour les machines et équipements à bord des navires

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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 document 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 6, *Navigation and ship operations*.

This second edition cancels and replaces the first edition (ISO 19848:2018), which has been technically revised.

The main changes are as follows:

— Annex A has been updated to define JSON as an equivalent implementation alternative to XML for DataChannelLists and TimeSeriesData. JSON schemas have been introduced to ensure precise definition and validation.

— The example of the codebook in B.2 has been extended to include navigational information, voyage information, weather information around the ship, oil property information and ship motion information.

— In B.3, a full set of standard data names has been added as references, to improve usability.

— In Annex C, the naming scheme has been changed from from “dnvgl-vis” to “dnv-v2”, as well as various updates to the rules for constructing the LocalID.

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

On-board computer applications for safety and energy-efficient operations have become increasingly popular. These applications require access to the data of shipboard machinery and equipment.

To access data of navigational equipment, the IEC 61162 series, which covers data exchange, can be used. However, there are no existing standards covering the access of data from other on-board components and systems (e.g. machinery, safety equipment, and hull).

Exchanging nonstandardized data between and/or among applications requires name-based aggregation and format mapping. However, this involves a large amount of labour, which hinders the use of such data.

To improve such situations, this document defines unified requirements and guidelines for developing machine and human-readable identifiers and data structures for shipboard machinery and equipment, with the objective of facilitating the exchange and processing of sensor data from ships.

This document defines two concepts and their models for data exchange: one is Data Channel, and the other is Time Series Data. This document thus defines two distinct data structures and file formats: A Data Channel List, which contains the necessary meta-data, and a Time Series Data format for measurements. The time-series format is designed to be lightweight and therefore contains minimal meta-data information, only in the form of a reference to the channel list.

Data Channel is a concept that represents virtual data transmission channels, and defines time-invariant properties. Data Channel can be viewed as a static description for the different sensor data streams. Data Channel is composed of Data Channel ID and Data Channel Property. Data Channel ID uniquely identifies the logical data channels. Data Channel Property defines attributes of Data Channel.

The purpose of this document is to provide guidance and requirements on exchanging data on board a ship. However, in the future, it is possible that shipboard machinery and equipment will be connected directly to the Internet.

Therefore, considering the compatibility between Data Channel ID and URLs, which are used to identify data on the Internet, Data Channel ID has a hierarchical structure with slashes as delimiters. To represent a hierarchy, Data Channel is categorized in accordance with the standardized naming scheme, called Naming Rule, and named by concatenating these category names with slashes.

Annexes B and C provide two types of naming scheme, an example of a codebook and lists of standardized category names given according to these schemes.

These naming schemes provided in Annexes B and C are not designed to unify Data Channel ID, but it is assumed that some entities will develop, maintain and manage codebooks and that these codebooks will be disclosed widely.

Data Channel Property is assumed to be used to automate data processing and help understanding of data. Data Channel Property should be used because it is considered to be essential to both computer applications and humans for the reasons mentioned above.

Time Series Data is a concept that represents collection of time-stamped data. Time Series Data is assumed to be used for sharing latest data and for analysing trends made over time-stamped data.

For reliable data exchange, this document recommends the use of Extensible Markup Language (XML) and XML Schema for data encoding and data structure definition. Using XML and XML schemas makes it possible to define data structures precisely and validate data according to such definitions. As a result, data can be exchanged more reliably between and/or among computer applications.

Furthermore, for convenience and efficiency, this document also defines data structures in JavaScript Object Notation (JSON) and Comma Separated Values (CSV) format.

Ships and marine technology — Standard data for shipboard machinery and equipment

1 Scope

This document provides requirements and guidance on the capture and processing of data from sensors monitoring:

— the structure of the ship;

— shipboard machinery and equipment on board the ship;

— ship operational information.

It is intended for implementers of software used to capture and process such data.

This document describes how to name the sensor and required data item, as well as how to describe the data for shipboard machinery and equipment.

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 8601-1, *Data elements and interchange formats — Information interchange — Representation of dates and times*

ISO 80000 (all parts), *Quantities and units*

IEC 80000 (all parts), *Quantities and units*

IEC 62923-1:2018, *Maritime navigation and radiocommunication equipment and systems — Bridge alert management — Part 1: Operational and performance requirements, methods of testing and required test results*

W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes, W3C Recommendation

RFC 4180, *Common Format and MIME Type for Comma-Separated Values (CSV) Files*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
alert data
information that represents abnormal conditions of shipboard machinery and equipment

3.2
analogue data
numerical information obtained from sensors such as temperature sensors and pressure sensors

Note 1 to entry: Analogue data are a physical value converted from raw electric signals, such as 4 mA –20 mA or 0 V –5 V.

3.3
codebook
list of standardized names

3.4
data
measurement value from shipboard machinery and equipment to which a time stamp is added

3.5
Data Channel
virtual channel for data transmission from shipboard machinery and equipment to shipboard data server, defining static properties of data

3.6
Data Channel ID
identifier for a *Data Channel* (3.5) that identifies Data Channel universally and on-board a ship

Note 1 to entry: There are three types of Data Channel ID: Universal ID, Local ID and Short ID.

3.7
Data Channel List
list of definitions for *Data Channel* (3.5) that define *Data Channel ID* (3.6) and *Data Channel Property* (3.8), and is shared through the shipboard data server

3.8
Data Channel Property
attributes of *Data Channel* (3.5), such as units and ranges

3.9
Data Set
set of *data* (3.4) having the same time stamp

3.10
Extensible Markup Language
XML
text-based data description language used for exchanging data on the Internet

3.11
Hyper Text Transfer Protocol
HTTP
communication protocol used to exchange Hyper Text Markup Language (HTML) or other content on the Internet

3.12
IMO Number
unique reference number for ships that is given by the International Maritime Organization (IMO)

3.13
logical structure
structure of *data* (3.4) that is independent of physical implementation

3.14
measurement value
numeric value or a status symbol, produced as a result of measuring, calculating or estimating the state of various objects

3.15
metadata
data that describes information about other data

3.16
Name Object
building block of *Data Channel ID* (3.6) used to define the hierarchical structure of Data Channel ID

3.17
namespace
set of names that is used in order to avoid conflicting names

3.18
shipboard data server
information hub of the ship that stores data from *shipboard machinery and equipment* (3.19), shares data at sea including machine data, and sends stored data outboard

Note 1 to entry: See ISO 19847[1)] for details.

3.19
shipboard machinery and equipment
various systems located in ships, such as main engine, generator, pumps, fans, valves, pipelines and electric control systems

3.20
Time Series Data
collection of a *Data Set* (3.9)

3.21
XML Schema
data definition language used for *Extensible Markup Language (XML)* (3.10)

4 Abbreviated terms

ABNF	augmented Backus-Naur form
AMS	alarm monitoring system
BNF	Backus-Naur form
CSV	Comma Separated Values
IAS	integrated automation system
IMO	International Maritime Organization
HIN	hull identification number
HTML	Hyper Text Markup Language
HTTP	Hypertext Transfer Protocol
JSON	JavaScript Object Notation

1) Under preparation. Stage at the time of publication: ISO/FDIS 19847:2023.

RDBMS	Relatinal Data Base Management System
RFC	Request for Comments
SI	the International System of Units
URI	Uniform Resource Identifier
UTC	Coordinated Universal Time
UTF-8	UCS Transformation Format 8
XML	Extensible Markup Language

5 Data Channel

5.1 Data Channel ID

5.1.1 General

There are three types of Data Channel ID:

— Universal ID

— Local ID

— Short ID

Universal ID is intended for identifying an on-board Data Channel universally.

Local ID, meanwhile, is intended for identifying an on-board Data Channel locally. For instance, on-board computer systems, such as the integrated automation system (IAS) and the alarm monitoring system (AMS), have their own Data Channel List, which is composed of a unique Channel ID. This Channel ID can correspond to a Local ID.

Short ID is an optional short alternative identifier of Local ID for usability and data compression. This short identifier, for instance, can be used as a Data Channel identifier in the Time Series Data format.

Universal ID shall be universally unique, while Local ID and Short ID shall be unique for a ship.

These IDs shall be case-insensitive to avoid mistyping.

NOTE Data channels representing the same type of sensor data on different ships are expected to have the same Local ID. Conversely, even if the Data Channel has the same meaning, the Short ID can be different for each ship.

5.1.2 Universal ID

Universal ID is an URI conforming to the requirements in this subclause, in addition to the requirement of the URI specified in RFC 3986. The URI definition allows for many different compositions, but the Universal ID is a subset of these and shall be in the following format.

The format is defined by using Augmented BNF (ABNF), which is defined in RFC 5234, as follows.

UniversalID = [protocol] "//" NamingEntity ShipID LocalID

NamingEntity = authority

ShipID = path-element

path-element = "/" unreserved

path-elements = path-element | path-element path-elements

The definition of the "Local ID" element is mentioned in 5.1.3.

The "authority" and "unreserved" element is defined in the URI definition specified in RFC 3986. The "protocol" element is optional.

NOTE Although the path element of URI that is defined in RFC 3986 accepts many more characters, such as RFC 3986 "sub-delimiters", "":, "@", etc., this document only accepts RFC 3986 "unreserved" characters since these characters can be used as control character in ISO 19847. The terms sub-delimiters and unreserved are defined in RFC 3986.

The slash ("/") is a reserved character for describing hierarchies.

The definition of each element of the Universal ID is as follows.

a) Naming Entity

The Naming Entity element shall be domain owned or controlled by the entity producing the Local ID.

EXAMPLE 1

— data.shipdatacenter.jp

— data.dnv.com

b) Ship ID

Ship ID is for identifying ships universally.

Usually, an IMO number or HIN should be used for the Ship ID.

If ships have no IMO number or HIN, an identifier provided by countries or regions, or other means may be used instead.

EXAMPLE 2

— /IMO1234567

— /JP-HXAB7A33G293

5.1.3 Local ID

Local ID consists of the Naming Rule and Local Data Name.

Local ID composition is defined by using ABNF as follows.

LocalID	= NamingRule LocalDataName
NamingRule	= path-element
LocalDataName	= path-elements
path-element	= “/” unreserved
path-elements	= path-element | path-element path-elements

The definition of each element of the Local ID is as follows.

a) Naming Rule

The Naming Rule shall be the designated name for a naming scheme used to name the Data Channel.

This name can be set freely under the supervision of the Naming Entity and shall have a symbol that represents the Naming Entity in front to eliminate duplications.

The naming scheme is a set of requirements that define an identification scheme for components and systems on board the ship. The naming scheme shall define how identification strings are composed, and the method of developing an identification string.

EXAMPLE 1

— /jsmea_mac

— /dnv-v2

The Naming Entity is responsible for defining a methodology for changing the naming scheme and its codebooks.

Impacts on existing users such as backwards compatibility shall be considered.

Therefore, the Naming Entity shall provide version information and change histories of the naming scheme and its codebook for each version, e.g. in a Naming Rule or on a website.

b) Local Data Name

The Local Data Name is an identifier for the Data Channel that is named in accordance with the Naming Rule.

The syntax of the identification string shall be disclosed and precisely defined using ABNF.

EXAMPLE 2

— /MainEngine/Cylinder1/ExhaustGas/Temp

— /vis-3–4a/ 511.11-3/C101/meta/qty-rotational.frequency

5.1.4 Short ID

Short ID is an optional short alternative to Local ID. There shall be a one-to-one correspondence between Data Channel and Short ID; Short ID shall therefore be unique for a ship.

The definition of Short ID is as follows.

ShortID = unreserved

Short ID shall be as short as practical and represented as machine-friendly symbols, human-friendly short words, or a combination of those symbols and short words.

EXAMPLE

— 0001

— TAH001

— ME_RPM

5.1.5 Example of Data Channel ID

In the following example, Ship ID, Naming Rule and Local Data Name are understood as the definitions in 5.1.2(b), 5.1.3(a) and 5.1.3(b), respectively, but without the leading slash.

Universal ID	http://data.shipdatacenter.jp/imo1234567/jsmea_mac/MainEngine/Cylinder1/ExhaustGas/Outlet/Temp
Local ID	/jsmea_mac/MainEngine/Cylinder1/ExhaustGas/Outlet/Temp
Short ID	0001
Ship ID	imo1234567
Naming Entity	data.shipdatacenter.jp
Naming Rule	jsmea_mac
Local Data Name	MainEngine/Cylinder1/ExhaustGas/Outlet/Temp

Universal ID	http://data.dnv.com/imo1234567/dnv-v2/vis-3-4a/ 511.11-3/C101/meta/qty-rotational.frequency
Local ID	/dnv-v2/vis-3–4a/411.1/ 511.11-3/C101/meta/qty-rotational.frequency
Short ID	0001
Ship ID	imo1234567
Naming Entity	data.dnv.com
Naming Rule	dnv-v2
Local Data Name (coded)	vis-3–4a/511.11–3/C101/meta/qty-rotational.frequency
Local Data Name (verbose)	vis-3–4a/511.11–3/C101/~main.generator.engine.3/meta/qty-rotational.frequency

NOTE It is not a requirement that the Universal ID is a resolvable URI; i.e. the URI is not necessarily a valid URL.

A detailed description of the above two naming schemes are described in Annexes B and C.

5.2 Data Channel Property

Data Channel Property shall be defined to provide the attributes of the Data Channel.

The reserved property types are as follows.

— Data Channel Type

— Format

— Range

— Unit

— Quality Coding

— Name

— Remarks

The properties above shall be described in accordance with the requirements in this subclause.

Properties that are not listed above may be used if these are clearly distinguished from the properties defined in this document.

Details of each property are as follows.

a) Data Channel Type

Data Channel Type is used to identify the types of Data Channel, such as raw numeric value, average value, alarms and status. Data Channel Type is composed of the following sub-properties.

— Type

— Update Cycle

— Calculation Period

Type sub-property defines the type of Data Channel and the value of the sub-property shall follow Table 1.

Table 1 — Type name of Data Channel Type

Type	Description
Inst	Measuring value at a certain point in time
Average	Average of the value within a certain time period; "Average" does not mean average of values from multiple sensors at the same time but average of time-series values from a single sensor.
Max	Maximum value within a certain time period; "Maximum" does not mean maximum of values from multiple sensors at the same time but maximum of time-series values from a single sensor.
Min	Minimum value within a certain time period; "Minimum" does not mean minimum of values from multiple sensors at the same time but minimum of time-series values from a single sensor.
Median	Median value within a certain time period; "Median" does not mean median of values from multiple sensors at the same time but median of time-series values from a single sensor.
Mode	Mode value (a value that appears most often in a set of data values) within a certain time period; "Mode" does not mean mode of values from multiple sensors at the same time but mode of time-series values from a single sensor.
StandardDeviation	Standard deviation of the value within a certain time period; "StandardDeviation" does not mean standard deviation of values from multiple sensors at the same time but standard deviation of time-series values from a single sensor.
Calculated	Value obtained from calculation or estimation instead of measurement
SetPoint	Target value for automatic control

Table 1 *(continued)*

Type	Description
Command	Control order to equipment; e.g. slowdown signal to the engine, run/stop order to the pump, opening to the position valve
Alert	Alarm values that can be obtained are also described.
Status	Status values that can be obtained are also described.
ManualInput	Value input by crew. Value assumed here is a reading of the indicator.

Update Cycle represents the cycle of updating measurement value. This sub-property shall be used when the measurement value is updated periodically.

When a value of Data Channel is a result of a calculation that uses a measurement value of specific time periods, the Calculation Period shall be used to describe the said period.

The Update Cycle and Calculation Period shall be described with a decimal number that is larger than zero. The unit of Update Cycle and Calculation Period shall be the “second”.

Type sub-property is mandatory and the others are optional.

EXAMPLE 1

— Type Average

— Calculation Period 60

— Update Cycle 1

b) Format

Format is used for describing data formats and defined by the following sub-properties.

— Type

— Restriction

Type sub-property is mandatory and Restriction sub-property is optional. More than one Restriction sub-property can exist under the Format property.

Available Types are as shown in Table 2. Definitions of these data types shall comply with W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatype.

Table 2 — Available Datatype for format property

Type	Description
Decimal	Decimal represents a subset of the real numbers, which can be represented by decimal numerals. The value space of decimal is the set of numbers that can be obtained by dividing an integer by a non-negative power of 10, i.e. expressible as $i / 10^n$ where i and n are integers and $n \geq 0$. Precision is not reflected in this value space; the number 2,0 is not distinct from the number 2,00. The order relation on decimal is the order relation on real numbers, restricted to this subset.
Integer	Integer is derived from the decimal by fixing the value of fraction digits to be 0 and disallowing the trailing decimal point. This results in the standard mathematical concept of the integer numbers. The value space of integer is the infinite set {...,-2,-1,0,1,2,...}. The base type of integer is decimal.
Boolean	Boolean represents the values of two-valued logic.
String	The string datatype represents character strings in XML.