Designation: F2446 − 04 (Reapproved 2018)

An American National Standard

Standard Classification for Hierarchy of Equipment Identifiers and Boundaries for Reliability, Availability, and Maintainability (RAM) Performance Data Exchange[1]

This standard is issued under the fixed designation F2446; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This classification is to serve as an international standard for marine equipment nomenclature, taxonomy, hierarchical data structure, unique identifiers, and boundary definition for the consistent acquisition and exchange of equipment RAM performance data. The standard addresses the classification of mechanical and software products.

1.2 RAM in an acronym for Reliability, Availability, and Maintainability where:

1.2.1 Reliability is the probability that an item can perform a required function under given conditions for a given time interval (t1, t2). It is generally assumed that the item is in a state to perform this required function at the beginning of the time interval.

1.2.2 Availability is the probability that an item is in a state to perform a required function under given conditions at a given instant of time, assuming that the required external resources are provided.

1.2.3 Maintainability is the probability that a given active maintenance action, for an item under given conditions of use can be carried out within a stated time interval, when the maintenance is performed under stated conditions and using stated procedures and resources.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ISO Standards:*[2]

ISO 3166-1:1997 Codes for the Representation of Names of Countries and Their Subdivisions — Part 1: Country Codes, 1997

ISO 10303 Industrial Automation Systems and Integration — Product Data Representation and Exchange

ISO 13584 Industrial Automation Systems and Integration — Parts Library

ISO/IEC TR 12182 Information Technology — Categorization of Software, Technical Report, 1998

ISO/TC 67/WG 4 ISO/FDIS 14224:1998(E), Petroleum and Natural Gas Industries — Collection and Exchange of Reliability and Maintenance Data for Equipment, 1998

2.2 *Other Standards:*

Center for Chemical Process Safety of the American Institute of Chemical Engineers Guidelines for Improving Plant Reliability through Data Collection and Analysis, 1998[3]

IEC 60050-191 International Electrotechnical Vocabulary, Chapter 191, Dependability and Quality of Service[4]

International Maritime Organization (IMO) Circular letter No. 1886/Rev. 2 Implementation of Resolution A.600(15) — IMO Ship Identification Number Scheme, 2002[5]

Naval Sea Systems Command Expanded Ship Work Breakdown Structure (ESWBS) for All Ships and Ship/Combat Systems, Volumes 1 and 2, 1985[6]

[1] This classification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.05 on Computer Applications.

Current edition approved Dec. 1, 2018. Published December 2018. Originally approved in 2004. Last previous edition approved in 2010 as F2446 – 04 (2010). DOI: 10.1520/F2446-04R18.

[2] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

[3] Available from American Institute of Chemical Engineers (AIChE), 120 Wall Street, FL 23, New York, NY 10005-4020, https://www.aiche.org.

[4] Available from International Electrotechnical Commission (IEC), 3, rue de Varembé, 1st floor, P.O. Box 131, CH-1211, Geneva 20, Switzerland, https://www.iec.ch.

[5] Available from International Maritime Organization (IMO), 4, Albert Embankment, London SE1 7SR, United Kingdom, http://www.imo.org.

[6] Available from Naval Sea Systems Command, 1333 Isaac Hull Avenue, SE, Washington Navy Yard, DC 20376, https://www.navsea.navy.mil.

3. Terminology

3.1 *Definitions:*

3.1.1 *boundary, n*—item boundaries define the subordinate components that are to be included in the item. The purpose of the boundary definition is to ensure a common understanding of which components are to be included within a specific item.

3.1.2 *class, n*—a concept to group objects with similar characteristics, with the purpose of describing common properties.

3.1.2.1 *Discussion*—The ISO 10303 definition of a class is "a concept to group items with similar characteristics, with the purpose of describing the common properties of the class members. Each item belongs to at least one class. A class usually has a criterion for inclusion or exclusion of items." A class is only an abstraction that helps the categorization of objects.

3.1.3 *instance, n*—the physical representation of the member of an object class. For example, the main propulsion diesel engine of vessel XYZ is an instance of the diesel_engine object class.

3.1.4 *object, n*—any item that has properties and functions.

3.1.5 *product identification, n*—this classification proposes that products be uniquely identified using the following combination: Manufacturer Country Code—Manufacturer National Tax ID—Manufacturer Model Number—Manufacturer Model Type. The manufacturer country code must be the ISO 3166-1 code for the manufacturer's country of origin.

3.1.6 *property, n*—an object's attribute whose value characterizes a specific class instance. The process of initializing a set of properties for a specific instance is called instantiation.

3.1.7 *string, n*—any list of ACSII characters with variable length.

3.1.8 *string array, n*—a dimensionless array of string values.

3.1.9 *unique component identification, n*—this classification proposes that components be uniquely identified using the following combination: Site ID—Generic ID—Location ID. The description of the various identifiers is as follows:

3.1.9.1 *site ID, n*—unique vessel identifier. In some cases, shipping organizations manage their inventory at the fleet level in such a way that pieces of equipment are removed from one vessel to be brought back to shore for repairs or overhauls while already serviced pieces of equipment previously installed on board another vessel are used as replacements. This method of managing inventory makes it impractical to associate a specific component with a vessel ID. The following two alternatives are acceptable: *(1)* keeping the ID of the first vessel on which it was installed throughout the component's entire life time, and *(2)* assigning a warehouse ID to components that can potentially be installed on multiple vessels.

3.1.9.2 *generic ID, n*—the name or code of the object class to which the component belong. Standard implementers are free to use either the class name or code, depending on data storage preferences given that class names are string values whereas class codes are numeric values.

3.1.9.3 *location ID, n*—when multiple identical components are located on the same site, the location ID identifies a specific piece of equipment within the site. Examples of location IDs include bolt hole location and deck/port-to-starboard/aft-to-forward sequencing. The method used for setting up location IDs is irrelevant for the standard. It is useful to the standard implementer only and thus it is left to the standard implementer's discretion.

3.1.10 *unique vessel identification, n*—unique equipment identification requires a unique site or vessel identifier. This classification proposes that commercial vessels be identified by their International Maritime Organization (IMO) number. IMO assigns a unique number to every commercial vessel in the world to be used for the vessel tracking. The structure of the IMO number comprises two parts: a variable seven-digit numeric number (the Lloyd's Register number) and a constant alpha prefix "IMO" (for example, IMO 1234567). The constant 3-alpha prefix by definition contributes nothing to the identification of the ship. Therefore, only the variable seven-digit numeric element of the IMO number is used. The seven-digit numeric number is maintained by Lloyd's Register which assigns a number to a ship at any time following the initiation of its construction. This classification also proposes that navy vessels be identified by Navy Specific Identification (Hull) Number preceded by the country code. The structure comprise of two parts: a variable 3-alpha prefix country code followed by five to seven digit alphanumeric hull number (for example, USA LPD17). The five to seven digit alphanumeric hull numbers are maintained by corresponding country navies.

4. Significance and Use

4.1 Capturing high quality RAM performance data requires careful and consistent collection of equipment failure and repair data, operating hours, and repair time. A standard hierarchy of equipment boundaries has been needed for machinery data exchange among the stakeholders in shipbuilding, ship classification, and ship operations.

4.2 Industry and government will use a world standard method for setting the hierarchy of indentures and boundaries required for assigning failure and repair events to equipment for the tracking and calculation of equipment RAM performance.

4.3 Agreed boundaries and equipment identifiers make it possible to share equipment data among organizations, benchmark equipment performance, perform modeling and simulation of current and proposed systems, or use performance data to improve operations of commercial and naval vessels.

4.4 RAM analysis is primarily based on the observation of individual components among which identical items contribute to the same data sample. This classification is designed to be used for the identification of individual (unique) components in such a way that identical components can be identified within a given data sample.

5. Basis of Classification

5.1 The class library constitutes a generic list of objects to be used as a toolbox for the development of specific ship breakdown structures as shown in Fig. 1. Instances of object classes will be created by assigning specific properties, including custom-designed properties serving organization specific functions and required properties aimed at facilitating global identification and RAM assessment.

5.1.1 The class library includes systems, pieces of equipment, elementary items (with some exceptions, elementary items can be seen as parts), and software products. It is that standard implementers use the class library to build specific ship breakdown structures by using a parent/child relationship linking object class instances.

5.1.2 Each item has a parent to which it belongs. The parent of any item can be any other type of items. For example, the parent of a system is likely to be the ship, although in some instances it is another system. The ship is an item of the class library because it is the primary ancestor of all items and the direct parent of most systems. As a primary ancestor, a ship has no parent.

5.1.3 The parent of an elementary item is a system, a piece of equipment or another elementary item. Elementary items do not have children. An item is always defined with respect to its parent. As a result, the identification of the parent is a required property for all items. Within a given ship structure, the combination of an item identifier and its parent identifier is not unique. Indeed, several identical items with identical functions are commonly found on board a specific ship. A location ID (such as the bolt hole location, for example) is thus required to uniquely identify each item. Consequently, an item of a specific ship breakdown structure is fully identified by its own ID, the ID of its parent, and a location ID.

5.2 Equipment RAM data exchange will take place through the exchange of object class instances, that is, objects with populated properties, including the list of required properties for RAM data exchange. Class names are meant to be transparent to end-users once a specific hierarchy is established. They will only facilitate the data exchange. End-users are expected to be presented with customized label names that are dependent on business logic, culture, and language. Label names are optional object properties populated by the standard implementer.

5.3 Existing ship breakdown structures and identification systems will be made compatible by adding a reference to the object class for each component. Standard implementers will be required to collect and store a minimum set of properties, identified as "required properties." The storage structure of the object class properties (for example, manufacturer, model number, Mean Time Between Failures, and so forth) is not imposed by this classification. Standard implementers are free to use their own storage structure. Implementers are also able to create private data exchange for data that is to stay within the organization (see Appendix X1).

5.4 This classification provides a list of generic criteria to be used for the definition of equipment boundaries. Each boundary criterion specifies whether a particular item is included in the definition of pieces of equipment. Excluded items must not be used when compiling the identification and RAM properties to be exchanged.

6. Keywords

6.1 availability; boundary; equipment; hierarchy; maintainability; maintenance; reliability; ship; shipboard; shipboard equipment; ship reliability; vessel

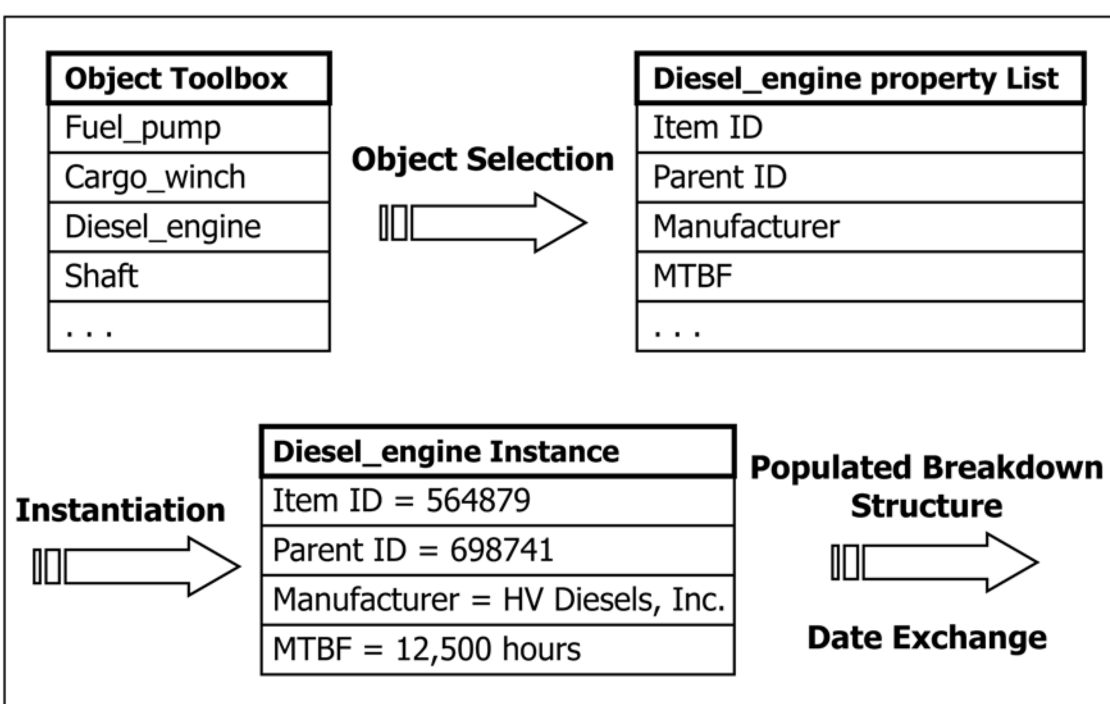

FIG. 1 Object Instantiation Process for Population and Data Exchange