



# Standard Classification for Hierarchy of Equipment Identifiers and Boundaries for Reliability, Availability, and Maintainability (RAM) Performance Data Exchange<sup>1</sup>

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 ( $\epsilon$ ) 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 is 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 ( $t_1$ ,  $t_2$ ). 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 Recom-*

*mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ISO Standards:<sup>2</sup>

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<sup>3</sup>

IEC 60050-191 International Electrotechnical Vocabulary, Chapter 191, Dependability and Quality of Service<sup>4</sup>

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

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

<sup>2</sup> 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>.

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

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

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

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

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### 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

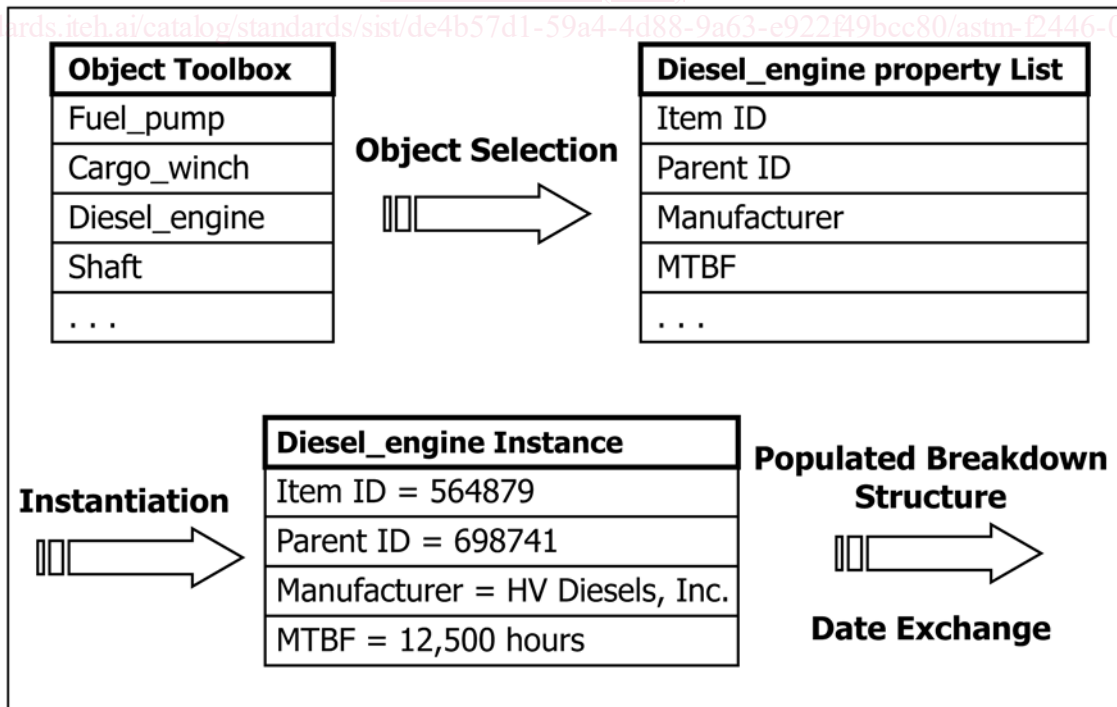


FIG. 1 Object Instantiation Process for Population and Data Exchange

**ANNEX**
**(Mandatory Information)**
**A1. MECHANICAL AND SOFTWARE PRODUCT CLASS LIBRARY**

A1.1 See [Table A1.1](#), [Table A1.2](#), [Table A1.3](#), [Table A1.4](#), and [Table A1.5](#).

**TABLE A1.1 Boundary Criteria**

| Boundary Code | Boundary Element                     | Included in Parent?                                 | Element Description   |
|---------------|--------------------------------------|---|---|
| b_00001       | associated valves                    | yes   | a valve that is required for the proper operation of the product  |
| b_00002       | attached indicating instruments      | yes   | an integrated part of the product used for measuring and displaying a variable  |
| b_00003       | built-in tanks                       | yes   | an integrated part of the product that is a container used for holding a liquid or gas                                    |
| b_00004       | coils                                | yes   | one or more turns of wire through which an electric current travels   |
| b_00005       | cooling device                       | yes   | a device used to lower or maintain the temperature of the product or one of its components                                |
| b_00006       | electric motors                      | yes   | a motor that is powered by electricity  |
| b_00007       | electrical hull fittings             | yes   | any hull-attached element that is electrical in nature and used for the product (for example, a plug)                     |
| b_00008       | electronic signal cabling            | dedicated branch circuit only                       | a set of cables used to transport an electronic signal  |
| b_00009       | filters                              | yes   | a device through which a gas or liquid is passed in order to remove solids or impurities                                  |
| b_00010       | flex connections                     | yes   | a bendable device that joins two internal components of the product or the product with its environment                   |
| b_00011       | handwheels                           | yes   | a circular object that is turned to control a quantity  |
| b_00012       | hull fasteners                       | yes   | a structural connection between the product and the hull  |
| b_00013       | hull structural foundations          | no  | a hull structure that is used as the product's foundation   |
| b_00014       | hydraulic control valves             | yes   | a valve that controls the flow of a fluid within an hydraulic device  |
| b_00015       | hydraulic cylinders                  | yes   | the cylindrical chamber of a device that produces hydraulic energy  |
| b_00016       | hydraulic pumps and motors           | yes   | a pump and motor assembly used to provide a source of hydraulic energy  |
| b_00017       | inserts into structural members      | yes   | an integrated part of the product that is inserted into the ship's structural elements                                    |
| b_00018       | integrated foundations               | yes   | the foundation elements that come with the product (for example, support legs)  |
| b_00019       | label plates                         | yes   | a piece of paper, metal, or other material that is attached to the product to provide information on it                   |
| b_00020       | mechanical hull fittings             | yes   | any hull-attached element that is mechanical in nature and used for the product (for example, a hinge)                    |
| b_00021       | motor controllers                    | yes when not mounted on a group control switchboard | a device that governs an electric motor in some predetermined manner  |
| b_00022       | motor foundations                    | yes   | the foundation elements of a motor  |
| b_00023       | non-built in tanks                   | no  | a liquid or gas container that is required by the product and that is not an integrated part of the product               |
| b_00024       | penetrations into structural members | yes   | an integrated part of the product that penetrates the ship's structural elements  |
| b_00025       | pipe hangers                         | yes   | a device which lends support to a pipe  |
| b_00026       | pipe markings                        | yes   | a mark or series of marks on the surface of a pipe  |
| b_00027       | piping                               | up to the flanged integral part of the unit only    | a system of pipes used to carry a fluid   |
| b_00028       | power supply                         | dedicated branch circuit only                       | a source of electrical energy   |
| b_00029       | remote indicating instruments        | no  | a separate device remotely connected to the product used for measuring and displaying a variable                          |
| b_00030       | resilient and sound mounts           | yes   | a device which lends flexible support to a product in order to reduce vibration and minimize noise                        |
| b_00031       | strainers                            | yes   | a porous or screen medium used ahead of the product to filter out harmful solid objects and particles from a fluid stream |
| b_00032       | valve actuators                      | yes   | a device used to control the rate of a fluid flow by opening or closing a valve   |
| b_00033       | wiring                               | dedicated branch circuit only                       | a system of wires used to carry electricity   |

**TABLE A1.2 Mechanical and Software Product Class Library**

| Class Code | Class Name                         | Class Description  |
|------------|------------------------------------|--|
| 1          | ship                               | a large vessel which travels over the seas, rivers, or lakes   |
| 2          | system                             | an assembly of one or more items, with functional and physical relationships between them, which performs or can perform a clearly identified function as a whole. A system has both physical and functional properties. |
| 201        | accommodation_system               | a group of interacting components designed for the crew and passenger living quarters  |
| 202        | alarm_system                       | a means of warning to the operator if abnormal operating conditions are detected in the equipment  |
| 203        | anchoring_and_mooring_system       | a system designed for securing a ship by attaching it to a fixed object or a mooring buoy with chains or lines, or with anchors or other devices.  |
| 204        | azimuth_thruster                   | a propulsor consisting of a propeller driven from a vertical shaft, which rotates about its vertical axis  |
| 205        | ballast_system                     | a system designed to ensure stability by adjusting the list, trim, and draft of a ship   |
| 206        | brake_system                       | a system that applies friction to a moving surface to slow it down or bring it to rest   |
| 207        | cargo_system                       | a system designed to process cargo   |
| 208        | condition_and_monitoring_system    | a system that records and processes salient operating data from equipment so that trends in its performance characteristics can be assessed for appropriate action to avoid failures                                     |
| 209        | control_and_monitoring_system      | a device for controlling a process or activity   |
| 210        | data_logging_system                | a system used to measure and record a set of data over time  |
| 211        | electric_power_distribution_system | a system used to provide a block box representation of all ship machinery electrical transmission systems with limited internal details of such systems  |
| 212        | electric_power_generation_system   | a group of interacting components that generate electric power   |
| 21201      | combined_cycle_plant               | a plant comprised of a mix of diesel engines, gas turbines, and steam turbines   |
| 21202      | diesel_electric_plant              | an electric power plant which uses only a diesel engine as a prime mover   |
| 21203      | gas_turbine_plant                  | an electric power plant that uses only gas turbine engines as prime movers   |
| 21204      | shaft_generator_system             | a marine electric generator that uses part of the ship main engines as its prime mover   |
| 21205      | steam_power_plant                  | a power plant that uses a steam turbine for generating electrical energy   |
| 213        | electrical_system                  | a group of interacting electrical components   |
| 214        | fire_fighting_system               | a system designed for extinguishing fires  |
| 21401      | carbon_dioxide_system              | a fire extinguishing system in which the extinguishing agent is carbon dioxide   |
| 21402      | halon_system                       | a fire extinguishing system in which the extinguishing agent is halon  |
| 21403      | nitrogen_system                    | a fire extinguishing system in which the extinguishing agent is nitrogen   |
| 21404      | sprinkling_system                  | a system in which water flows through a nozzle that transforms water into a spray pattern of fine droplets   |
| 215        | garbage_and_solid_waste_system     | a system designed to process garbage and solid waste material  |
| 216        | gland_seal_system                  | a system that provides steam to the labyrinth packing glands located at turbine casing penetrations  |
| 217        | hydraulic_system                   | a system composed of machinery and auxiliary components which function to generate, transmit, control, and utilize hydraulic energy  |
| 218        | lifting_system                     | a system designed to carry objects from a lower position to a higher position  |
| 219        | maneuvering_system                 | a system used to perform planned movement or change from the straight steady course and speed of a ship  |
| 220        | mechanical_transmission_system     | a system used to transmit torque at fixed or variable speed between prime movers and energy absorbers  |
| 221        | oil_mist_detection_system          | a system used in the diesel engines to prevent crankcase explosions  |
| 222        | pipng_system                       | a group of interacting piping components   |
| 22201      | air_system                         | a system designed to process air   |
| 22202      | bilge_water_system                 | a system used to drain liquid from machinery-space bilges, tank tops, shaft alleys, and watertight compartments located throughout a vessel  |
| 22203      | bleed_air_system                   | a system designed to let air escape under controlled conditions from a pipe, tank, or the like through a valve or outlet   |
| 22204      | compressed_air_system              | a system used to supply compressed air to locations throughout a vessel  |
| 22205      | drainage_system                    | a piping system designed to remove water from surfaces or structures by mean of gravity or pumps   |
| 22206      | exhaust_system                     | a system designed for the escape of gases, fumes, combustion products, and odors from a mechanical device or an enclosure  |
| 22207      | feed_water_system                  | a system used to regulate the flow of water into the steam drum of a boiler  |
| 22208      | flush_system                       | a system designed to remove lodged deposits of rock fragments and other debris by water flow at high velocity  |
| 22209      | fresh_water_system                 | a group of interacting mechanical and electrical components that control fresh water   |
| 22210      | fuel_injection_system              | a group of interacting piping components that control fuel injection   |
| 22211      | fueling_system                     | a group of interacting piping components that control fuel oil   |
| 22212      | fuel_supply_system                 | a system used to purify, store, and deliver fuel to ship prime movers and auxiliary machinery  |
| 22213      | inert_gas_system                   | a system used to handle inert gas  |
| 22214      | lubrication_system                 | a system used to provide a film of lubricant in order to control friction and wear   |
| 22215      | potable_water_system               | a group of interacting mechanical and electrical components that produces, distributes, and control potable water  |
| 22216      | sea_water_system                   | a system that provides sea water to another system   |

TABLE A1.2 *Continued*

| Class Code | Class Name                   | Class Description   |
|------------|------------------------------|---|
| 22217      | sewage_treatment_system      | a system used to separate, modify, remove, and destroy objectionable, hazardous, and pathogenic substances carried by wastewater in solution or suspension  |
| 22218      | vacuum_system                | a system used to remove air or gas from an enclosed space   |
| 22219      | ventilation_system           | a system that provides movement, circulation, and quality control of air in an enclosed space   |
| 223        | process_system               | a system that is involved in part of a process  |
| 22301      | air_conditioning_system      | a system designed for the maintenance of certain aspects of the environment within a defined space to facilitate the function of that space; aspects controlled include air temperature and motion, radiant heat level, moisture, and concentration of pollutants such as dust, microorganisms, and gases |
| 22303      | chemical_treatment_system    | a system used to treat a fluid by the addition of chemicals   |
| 22304      | combustion_air_system        | a system used to provide air to a combustion process  |
| 22305      | condensate_system            | a system designed to transform a gas to a liquid  |
| 22306      | cooling_system               | a heat transfer system that is used for cooling processed fluids  |
| 2230601    | air_cooling_system           | a heat transfer system that is used for processing cooled air   |
| 2230602    | water_cooling_system         | a heat transfer system that is used for reducing the water temperature  |
| 22307      | deminerlizer_system          | a system designed to remove mineral constituents from water   |
| 22308      | distilling_system            | a system that distills fresh water from sea water   |
| 22309      | exhaust_gas_treatment_system | a system used to treat exhaust gas by capturing or reducing undesirable emissions   |
| 22310      | filtration_system            | a system used to filter a gas or liquid in order to remove solids or other impurities   |
| 22311      | heating_system               | a system used to increase the temperature of a fluid  |
| 22312      | refrigeration_system         | a system designed for the cooling of a space or substance below the environmental temperature   |
| 224        | propeller_system             | a system that creates the required thrust for ship movements using a screw propeller  |
| 225        | propulsion_system            | a system that produces the required thrust for ship movement using fuel as the primary energy source  |
| 22501      | electrical_propulsion_system | a system where the propulsor is driven by an electric motor by mean of a mechanical transmission system   |
| 22502      | mechanical_propulsion_system | a system where the propulsor is driven by a prime mover by mean of a mechanical transmissions system  |
| 226        | pump_jet_propulsor           | a propulsor that accelerates a large volume of water, drawn in from beneath the ship, and expels it as a high speed horizontal jet, setting up a sufficient reaction force to propel the vessel   |
| 227        | rudder_system                | a system comprised of the rudder, shaft, bearings, and associated components that are part of the ship maneuvering system   |
| 228        | safety_system                | a means for automatically altering the operating conditions of piece of equipment in order to prevent damage to it  |
| 229        | starting_system              | a system used to set a piece of machinery into motion, until it can sustain its motion by mean of its internal processes  |
| 22901      | electric_starting_system     | a system used to electrically set the machinery into motion, until it can sustain its motion by mean of its internal processes  |
| 22902      | manual_starting_system       | a system used to manually set the machinery into motion, until it can sustain its motion by mean of its internal processes  |
| 22903      | pneumatic_starting_system    | a system that uses pneumatic pressure to set the machinery into motion, until it can sustain its motion by mean of its internal processes   |
| 230        | steam_generation_system      | a group of interacting components that generate steam   |
| 231        | steering_control_mechanism   | a mechanism used to control the steering of a ship  |
| 232        | steering_system              | a means for altering the direction of propulsor thrust to control ship direction of movement  |
| 233        | water_jet_propulsor          | a machine which takes in water by means of a suitable inlet and ducting system and accelerates the mass of water using an impeller and nozzle   |
| 234        | workshop_system              | a group of interacting components used for manufacturing and repairing using machines and tools   |
| 3          | equipment                    | a mechanical product that carries out a generally self contained function and to a large extent is treated as a single mechanical product for the purpose of design, acquisition, or operation. A piece of equipment has both physical and functional properties  |
| 301        | control_equipment            | a piece of equipment that directs a function of the mechanical product  |
| 30101      | actuator                     | a mechanical control device used to move or control another mechanical device   |
| 3010101    | electric_actuator            | a control device that is electrically operated  |
| 3010102    | hydraulic_actuator           | a control device that is hydraulically operated   |
| 3010103    | manual_actuator              | a control device that is manually operated  |
| 3010104    | pneumatic_actuator           | a control device that is pneumatically operated   |
| 30102      | analyzer                     | an instrument that is used for making electronic measurements   |
| 30103      | flame_controller             | A device that governs the condition of a flame in some predetermined manner   |
| 30104      | regulator                    | a control device designed to maintain the value of some quantity at a relatively constant value   |
| 30105      | signal_conditioner           | used in control and measurement systems to improve or transform measured signals for later use  |
| 302        | electrical_equipment         | a piece of equipment that is electrically operated  |

**TABLE A1.2** *Continued*

| Class Code | Class Name                         | Class Description   |
|------------|------------------------------------|---|
| 30201      | motor_starter                      | a piece of equipment used for driving an engine from standstill in order to initiate the engine combustion process and attain its self-sustained rotation   |
| 30202      | switch_board                       | a large panel of assembled switches, circuit breakers, meters, fuses and terminals that are primary to the operation of electric or electronic equipment  |
| 30203      | transformer                        | a device that reduces or increases the voltage and current of the input electricity, while keeping the same frequency   |
| 303        | galley_equipment                   | a piece of equipment used in the galley for the storage, processing and distribution of food and beverages  |
| 30301      | batter_breader_machine             | a machine designed to apply coating to food items before deep frying  |
| 30302      | beverage_and_food_dispenser        | a device that automatically dispenses food and beverage   |
| 30303      | blender                            | an electric machine used for breaking down foods or making smooth liquid substances from soft foods and liquids   |
| 30304      | broiler                            | an open metal container, often with a frame of metal bars inside, on which food is cooked under a heat source   |
| 30305      | can_opener                         | a tool for opening cans of food   |
| 30306      | coffee_maker                       | an apparatus that brews coffee  |
| 30307      | deep_fryer                         | a device used to fry food in which it is completely covered by oil  |
| 30308      | dishwasher                         | a machine that washes and cleans dirty plates, glasses and flatware   |
| 30309      | food_cutter                        | a device used to cut food into pieces   |
| 30310      | food_processor                     | a machine that cuts, slices and mixes food quickly  |
| 30311      | food_warmer                        | a device that brings and maintains food to a certain temperature through a heating process  |
| 30312      | freezer                            | an insulated unit or compartment in which perishable foods are maintained at or below freezing temperatures   |
| 30313      | french_fry_extruder                | a device that forms French fries from potatoes by forcing or pushing them through a grid  |
| 30314      | galley_saw                         | a tool with a blade and a row of sharp points along one edge, which is used for cutting food  |
| 30315      | griddle                            | a piece of metal used for cooking over a fire or cooker   |
| 30316      | grill                              | a metallic surface which can be heated to very high temperatures and on which food is put in order to be cooked   |
| 30317      | grinder                            | a device used for breaking food into smaller particles  |
| 30318      | hot_food_table                     | a table equipped with heater wells designed to keep food hot  |
| 30319      | hotplate                           | a small movable cooker on which pans of food are heated   |
| 30320      | ice_making_machine                 | a device that produces ice cubes using water  |
| 30321      | kettle                             | a covered container used for boiling water  |
| 30322      | microwave                          | a device used to heat food by means of electromagnetic waves  |
| 30323      | mixer                              | a device that mixes food and liquids  |
| 30324      | oven                               | an enclosed space with a door which is used to cook food or heat other substances   |
| 30325      | peeler                             | a device used to remove the skin of fruit and vegetables  |
| 30326      | pressure_cooker                    | a cooking pan with a tightly fitting lid which allows food to cook quickly in steam under pressure  |
| 30327      | proofing                           | a device used for the proofing (raising) of breads and baked goods  |
| 30328      | refrigerator                       | an insulated unit or compartment in which perishable foods are maintained at cool temperatures  |
| 30329      | salad_bar                          | a type of table where different prepared salads are served  |
| 30330      | slicer                             | a machine used for cutting food into flat, thin pieces  |
| 30331      | steam_table                        | a table that uses steam to maintain the temperature of food items   |
| 30332      | steamer                            | a container, with holes in its bottom, which can be placed over boiling water in order to allow steam to cook food  |
| 30333      | tenderizer                         | a device used to make food easy to cut or chew  |
| 30334      | toaster                            | a device that makes sliced bread warm, crisp and brown by putting it near a high heat   |
| 30335      | vaccum_cleaning_equipment          | a piece of equipment used for sucking dirt from floors and other surfaces   |
| 30336      | ventilator                         | a device that causes fresh air to enter and move around an enclosed space   |
| 30337      | waffle_iron                        | a device used to cook waffles   |
| 304        | laundry_and_dry_cleaning_equipment | a piece of equipment involved in the process of washing and dry cleaning laundry  |
| 30401      | dry_cleaner                        | a machine used for dry cleaning clothes   |
| 30402      | dryer                              | a machine used for drying clothes   |
| 30403      | ironer                             | a device used for making clothes smooth   |
| 30404      | laundry_dispenser                  | a device that dispenses laundry   |
| 30405      | laundry_press                      | a device used for making or keeping clothes smooth by pressing them between two boards  |
| 30406      | sleever                            | a machine used to finish shirt sleeves  |
| 30407      | washer                             | a machine used for washing clothes  |
| 30408      | washer_and_dryer                   | a machine used for washing and drying clothes   |
| 305        | lifting_equipment                  | an equipment that carries objects from a lower position to a higher position  |
| 30501      | cargo_handling_equipment           | a device designed to move cargo   |
| 30502      | conveyor                           | a materials-handling device designed to move individual articles such as solids or free-flowing bulk materials over a horizontal, inclined, declined, or vertical path of travel with continuous motion |
| 30503      | crane                              | a power-oriented hoisting machine with lifting and pivoted boom that allows movement of loads horizontally as well as vertically  |

**TABLE A1.2** *Continued*

| Class Code | Class Name                  | Class Description  |
|------------|-----------------------------|--|
| 3050301    | deck_crane                  | a crane that is located on the deck of a ship  |
| 30504      | elevator                    | a platform or enclosure that is raised and lowered in a vertical hoistway to transport freight or people   |
| 30505      | hoist                       | a device designed to lift from a position directly above the load  |
| 30506      | lift_machinery              | a unit assembly used to operate a lift   |
| 306        | machine_shop_equipment      | a machine used in workshops for manufacturing and repairing items  |
| 30601      | bending_machine             | a machine used to bend metals  |
| 30602      | cutting_machine             | a machine designed to cut pieces of material   |
| 30603      | drill_machine               | a machine which makes holes  |
| 30604      | electric_hammer             | a hammer in which electricity is utilized for producing the impacting blow   |
| 30605      | electrode_oven              | a machine designed to dry and store electrodes   |
| 30606      | forming_machine             | a machine used to form or shape pieces of metal  |
| 30607      | grinding_machine            | a machine used to make something into small pieces or a powder by pressing between hard surfaces   |
| 30608      | hydraulic_intensifier       | a device which increases the power of a signal in a hydraulic servomechanism or other system through the use of fixed and variable orifices  |
| 30609      | hydraulic_press             | a combination of a large and a small cylinder connected by a pipe and filled with a fluid so that the fluid pressure created by a small force acting on the small-cylinder piston will result in a large force on the large piston |
| 30610      | lathe                       | a machine for shaping a workpiece by turning it while a sharp tool is pressed against it   |
| 30611      | milling_machine             | a machine used for the removal of metal by feeding a workpiece through the periphery of a rotating circular cutter   |
| 30612      | painting_machine            | a machine used to paint  |
| 30613      | pneumatic_hammer            | a hammer in which compressed air is utilized for producing the impacting blow  |
| 30614      | power_saw                   | a power-operated saw   |
| 30615      | press_machine               | a machine used to make something firm and flat or to put weight on something to push it down   |
| 30616      | reeling_machine             | a machine used to pull in, take, or give out by turning something round and round  |
| 30617      | sanding_machine             | a machine that uses a moving sheet or disc of rough paper to abrade other surfaces in order to make them smoother  |
| 30618      | sewing_machine              | a mechanism that stitches cloth, leather, or other material by means of a double-pointed or eye-pointed needle   |
| 30619      | shearing_machine            | a machine for cutting cloth or bars, sheets, or plates of metal or other material  |
| 30620      | sheet_metal_working_machine | a machine used to process sheet metal  |
| 30621      | thermal_drying_oven         | a closed chamber for drying an object by heating at relatively low temperatures  |
| 30622      | threading_machine           | a machine used to cut or form threads inside or outside a cylinder or cone   |
| 30623      | welding_machine             | a machine used to join two pieces of metal together permanently by melting the parts that are in contact with one another  |
| 307        | machinery                   | a reciprocating or rotating equipment that performs some sort of energy conversion as its underlying function  |
| 30701      | electrical_machinery        | a working electrical part of a machine   |
| 3070101    | electric_generator          | a machine that generates electricity by transforming mechanical energy   |
| 307010101  | electric_generator_AC       | an electric generator that produces alternating current  |
| 307010102  | electric_generator_DC       | an electric generator that produces direct current   |
| 3070102    | electric_motor              | a motor that is powered by electricity   |
| 307010201  | electric_motor_AC           | an electric motor that uses alternating current  |
| 307010202  | electric_motor_DC           | an electric motor that uses direct current   |
| 30702      | mechanical_machinery        | a piece of machinery that is primarily used in mechanical systems  |
| 3070201    | inboard_motor               | a unit assembly of engine, propeller, and vertical drive shaft used to propel a boat and located inside the hull perimeter   |
| 3070202    | outboard_motor              | a unit assembly of engine, propeller, and vertical drive shaft used to propel a boat and usually clamped to the boat transom   |
| 3070203    | reciprocating_machinery     | a working part of a machine that works complementary to the machine  |
| 307020301  | diesel_engine               | an internal combustion engine operating on the compression ignition principle  |
| 3070204    | rotating_machinery          | a non-electrical working part of a machine that moves in a circular motion   |
| 307020401  | air_charger                 | a device in the intake system of an internal combustion engine used to increase the air-charge weight and therefore boost the amount of fuel that can be burned in the cylinder  |
| 307020402  | anchor_windlass             | a machine designed to raise or lower an anchor and generally consisted of a horizontal barrel that is fitted with gearlike projections that engage the links of the anchor chain   |
| 307020403  | compressor                  | a device used to increase the pressure of a gas  |
| 307020404  | garbage_grinder             | a machine designed for grinding garbage material   |
| 307020405  | gas_turbine_engine          | a device that expands a compressed gas through nozzles thereby changing its pressure to velocity and directing the gas into the turbine blades in order to convert the energy to rotational work                                   |
| 307020406  | gear_assembly               | an assembly of toothed cylinders that are used to transmit torque from one shaft to another  |
| 307020407  | gear_box                    | a housing for gears that are used to transmit power between shafts rotating at different speeds  |
| 307020408  | propulsion_shafting         | a group of interacting shafts and shaft components that are used for the propulsion of a ship  |
| 307020409  | pump                        | a device used to add energy to liquids to produce flow or increase pressure  |



**TABLE A1.2** *Continued*

| Class Code  | Class Name                | Class Description  |
|-------------|---------------------------|--|
| 30702040901 | ballast_pump              | a pump used to transfer seawater into and out of a vessel's ballast tanks in order to adjust list, trim, and draft   |
| 30702040902 | bilge/ballast_pump        | a pump which is used to discharge water ballast and remove water that collects in the bottom of a ship   |
| 30702040903 | bilge_pump                | a pump used to drain liquid from machinery-space bilges, tank tops, shaft alleys, and other watertight compartments  |
| 30702040904 | booster_pump              | a pump used to increase pressure in a water or compressed-air pipe   |
| 30702040905 | brine_pump                | a pump used for a ship brine system  |
| 30702040906 | cargo_pump                | a pump used to load and discharge liquid cargo   |
| 30702040907 | circulating_pump          | a pump used to circulate a fluid   |
| 30702040908 | cleaning_pump             | a pump used to move a cleaning fluid   |
| 30702040909 | condensate_pump           | a pump used to move condensate   |
| 30702040910 | cooling_pump              | a pump used to move a cooling fluid  |
| 30702040911 | discharge_pump            | a pump used to discharge a fluid   |
| 30702040912 | distillate_pump           | a pump used to move distillate   |
| 30702040913 | distilled_water_pump      | a pump used to move distilled water  |
| 30702040914 | dosage_pump               | a pump used to move a specified dosage of fluid  |
| 30702040915 | drinking_water_pump       | a pump used to circulate drinking water  |
| 30702040916 | ejector_pump              | a pump with no internal moving parts that moves a fluid  |
| 30702040917 | engine_fuel_pump          | a pump used to supply fuel to an engine  |
| 30702040918 | feed_pump                 | a pump used to supply water to a steam boiler  |
| 30702040919 | fire_pump                 | a pump used to supply water to shipboard fire-fighting systems   |
| 30702040920 | fire/bilge/ballast_pump   | a pump used to supply fire-fighting water, to remove water from bilges, and to discharge water ballast   |
| 30702040921 | fire/general_service_pump | a pump used to supply fire-fighting water and general service water  |
| 30702040922 | fresh_water_pump          | a pump used to circulate fresh water   |
| 30702040923 | fuel_oil_pump             | a pump used to circulate fuel oil  |
| 30702040924 | fuel_oil_transfer_pump    | a pump user to transfer fuel oil   |
| 30702040925 | gear_oil_pump             | an oil pump that uses gears to move oil  |
| 30702040926 | general_service_pump      | a pump used for general service  |
| 30702040927 | generic_pump              | a pump that is not specific to any area  |
| 30702040928 | hydraulic_oil_pump        | a pump used to circulate hydraulic oil   |
| 30702040929 | lube_oil_pump             | a pump used to circulate lube oil  |
| 30702040930 | lube_oil_transfer_pump    | a pump user to transfer lube oil   |
| 30702040931 | priming_pump              | a pump used to provide priming to a system   |
| 30702040932 | process_pump              | a pump involved in a specific process  |
| 30702040933 | return_pump               | a pump used to return a fluid  |
| 30702040934 | sea_water_pump            | a pump used to circulate sea water   |
| 30702040935 | scavenging_air_pump       | a pump used to supply scavenging air to a diesel engine  |
| 30702040936 | sewage_pump               | a pump used for a sewage system  |
| 30702040937 | sludge_pump               | a pump capable of handling sand- and gravel-laden liquids without clogging or wearing unduly used to extract mud and cuttings from a borehole  |
| 30702040938 | stripping_pump            | a pump used to perform stripping operations on tanks   |
| 30702040939 | supply_pump               | a pump used to supply a fluid  |
| 30702040940 | trimming_pump             | a pump involved in a trimming process  |
| 30702040941 | vacuum_pump               | a pump used to remove air or gas from an enclosed space  |
| 307020410   | screw_propeller           | a device that creates the required thrust for ship movements while rotating in the water   |
| 307020411   | turbine                   | a device for generating rotary mechanical power from the energy in a stream of fluid.  |
| 307020412   | steam_turbine_engine      | a machine used to convert the energy of high-pressure steam into the mechanical energy of a rotating shaft that performs work  |
| 307020413   | steering_unit             | a unit used for directional control  |
| 307020414   | winch                     | a device having a drum on which to coil a rope, cable, or chain for hauling, pulling, or hoisting  |
| 30702041401 | anchor_winch              | a winch designed to raise or lower an anchor   |
| 30702041402 | cargo_winch               | a winch designed to move cargo   |
| 30702041403 | crane_winch               | a winch utilized as part of a crane machinery  |
| 30702041404 | hoisting_winch            | a winch that is part of a hoisting machine for raising and lowering material with intermittent motion while holding the material freely suspended. Hoisting machines are capable of picking up loads at one location and depositing them at another anywhere within a limited area |
| 30702041405 | lifeboat_winch            | a winch designed to raise or lower a lifeboat  |
| 30702041406 | mooring_winch             | a winch used for the mooring system of a ship  |
| 30702041407 | portable_winch            | a winch capable of being easily and conveniently transported   |
| 30702041408 | slewing_winch             | a winch which permits rapid traverse or change in elevation  |
| 30702041409 | topping_winch             | a winch with a topping mechanism   |
| 30702041410 | topping/slewing_winch     | a winch that performs the functions of both a topping winch and a slewing winch  |
| 30702041411 | towing_winch              | a winch used by a towing system  |
| 30702041412 | windlass_winch            | a winch used by a windlass system  |
| 30702041413 | windlass/mooring_winch    | a winch used by a windlass/mooring system  |
| 30703       | process_machinery         | a machinery that is involved in part of a process  |
| 3070301     | agitator                  | a mechanical device used to maintain fluidity, plasticity, and prevent segregation of liquids and liquid solutions   |

**TABLE A1.2** *Continued*

| Class Code | Class Name                   | Class Description   |
|------------|------------------------------|---|
| 3070302    | centrifuge                   | a rotating device that uses centrifugal force to separate substances of different densities   |
| 3070303    | clarifier                    | a device that clears liquid from suspended particles through filtration or centrifugation   |
| 3070304    | homogenizer                  | a device in which substances are emulsified by being forced through an energetic shear field  |
| 3070305    | purifier                     | a device that clears an area or object of all undesirable matter  |
| 3070306    | separator                    | a pressure vessel used to separate the gaseous and liquid components of reservoir fluids into gas, oil, and water   |
| 308        | mechanical_equipment         | a non-machinery equipment that is primarily used in mechanical systems  |
| 30801      | blower                       | a device used to supply a relatively large volume of a gas at a low pressure  |
| 30802      | clutch                       | a device for engagement and disengagement of mechanical power   |
| 3080201    | electro_magnetic_clutch      | a clutch that uses electromagnetic forces to engage and disengage   |
| 3080202    | hydraulic_clutch             | a clutch that uses hydraulic power to engage and disengage  |
| 3080203    | pneumatic_clutch             | a clutch that uses pneumatic pressure to engage and disengage   |
| 30803      | damper                       | a device used to lessen torsional or axial vibrations in a shaft line   |
| 30804      | dryer                        | a device whose primary function is to accomplish drying   |
| 3080401    | air_dryer                    | a device for drying an air flow   |
| 3080402    | gas_dryer                    | a device for drying a gas flow  |
| 30805      | hydraulic_accumulator        | a pressure vessel which operates as a fluid source device or shock absorber   |
| 30806      | hydraulic_power_unit         | a power transmission unit comprising machinery and auxiliary components which function to generate, transmit, control, and utilize hydraulic energy   |
| 30807      | lifeboat_launching_equipment | a unit assembly used to launch a lifeboat   |
| 30809      | mechanical_transmission      | a device by which motive power from a prime mover is made available at a load   |
| 30810      | pneumatic_positioner         | a pneumatic servomechanism used to improve operating characteristics of valves by reducing hysteresis   |
| 30811      | reducer                      | a device designed to reduce a quantity  |
| 3081101    | reduction_gear               | a train of gears designed to reduce the speed with which power is transmitted   |
| 3081102    | speed_reducer                | a train of gears placed between a motor and the machinery which it will drive, to reduce the speed with which power is transmitted  |
| 30812      | scrubber                     | a device for the removal, or washing out, of entrained liquid droplets or dust, or for the removal of an undesired gas component from process gas streams   |
| 30813      | shaft_coupling               | a device used to connect coaxial shafts for power transmission from one to the other  |
| 3081301    | flexible_coupling            | a coupling used to connect two shafts with a certain amount of flexibility and allowance in their axial or radial alignment. It usually contains a resilient member such as a metal spring or rubber disk   |
| 3081302    | fluid_coupling               | a device in which a fluid transmits torque from input shaft to output shaft   |
| 3081303    | solid_coupling               | a rigid connection between two shafts   |
| 308130301  | flanged_solid_coupling       | a coupling in which two flanged ends are connected directly together by bolting   |
| 308130302  | muff_solid_coupling          | a coupling in which there is a sleeve type connection without any flange  |
| 30814      | silencer                     | a device used to reduce or eliminate the sound made by exhaust gas that is discharged from the engine, by reducing the exhaust gas pressure waves   |
| 30815      | thruster_unit                | a unit that produces a driving force  |
| 30816      | trash_compactor              | a machine that compresses solid waste material for convenience in disposal  |
| 308708     | mechanical_governor          | a device that automatically regulates the speed of an engine or machine by varying the supply of fuel or steam according to the power demand  |
| 309        | pipng_equipment              | a piping supply that is needed to complete a certain function   |
| 30901      | drainage_unit                | a unit designed to remove water from surfaces or structures by gravity or pumping   |
| 30902      | pressure_vessel              | a container for fluids that can withstand pressure above or below atmospheric pressure  |
| 30903      | sprinkler                    | a device used for delivering a fire extinguishing liquid or gas   |
| 30904      | tank                         | a large vessel used for holding a fluid such as water, low pressure gas, gasoline, or other fuel  |
| 30905      | valve                        | a device used to start, stop, divert, or regulate the flow rate of a fluid  |
| 3090501    | ball_valve                   | a valve that uses a spherically shaped plug, or ball, with a round hole passing through it that can be moved from fully open to fully closed position by rotating the valve stem 90 degrees   |
| 3090502    | butterfly_valve              | a valve that uses an internal disk is rotated from a fully closed position to a fully open position with a quarter turn of the attached stem  |
| 3090503    | check_valve                  | a valve used to prevent reverse flow  |
| 3090504    | diaphragm_valve              | a valve that uses a flexible diaphragm to form the upper pressure boundary of the valve's body  |
| 3090505    | gate_valve                   | a valve that uses a flat or wedge-shaped gate that is lowered or raised to control the straight-through flow of a fluid   |
| 3090506    | globe_valve                  | a valve that uses a disk that is mounted on the end of a threaded stem  |
| 3090507    | plug_valve                   | a valve that uses a stem-mounted plug resembling a cylinder   |
| 3090508    | solenoid_valve               | a valve that is actuated by a magnetic field that is produced in a solenoid   |
| 310        | process_equipment            | a piece of equipment that is used in a part of a process  |
| 31001      | afterburner                  | a device used for burning additional fuel   |
| 31002      | air_conditioning_unit        | a unit designed for the maintenance of certain aspects of the environment within a defined space to facilitate the function of that space; aspects controlled include air temperature and motion, radiant heat level, moisture, and concentration of pollutants such as dust, microorganisms, and gases |