ASTM INTERNATIONAL

Designation: F2446 – 04

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

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, & 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 and health practices and determine the applicability of regulatory requirements prior to use.*

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]

3. Terminology

3.1 *Definitions:*

3.1.1 *boundary*—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*—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

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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*—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*—any item that has properties and functions.

3.1.5 *product identification*—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 code for the manufacturer's country of origin.

3.1.6 *property*—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*—any list of ACSII characters with variable length.

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

3.1.9 *unique component identification*—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*—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*—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*—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*—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 Reliability, Availability, and Maintainability (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
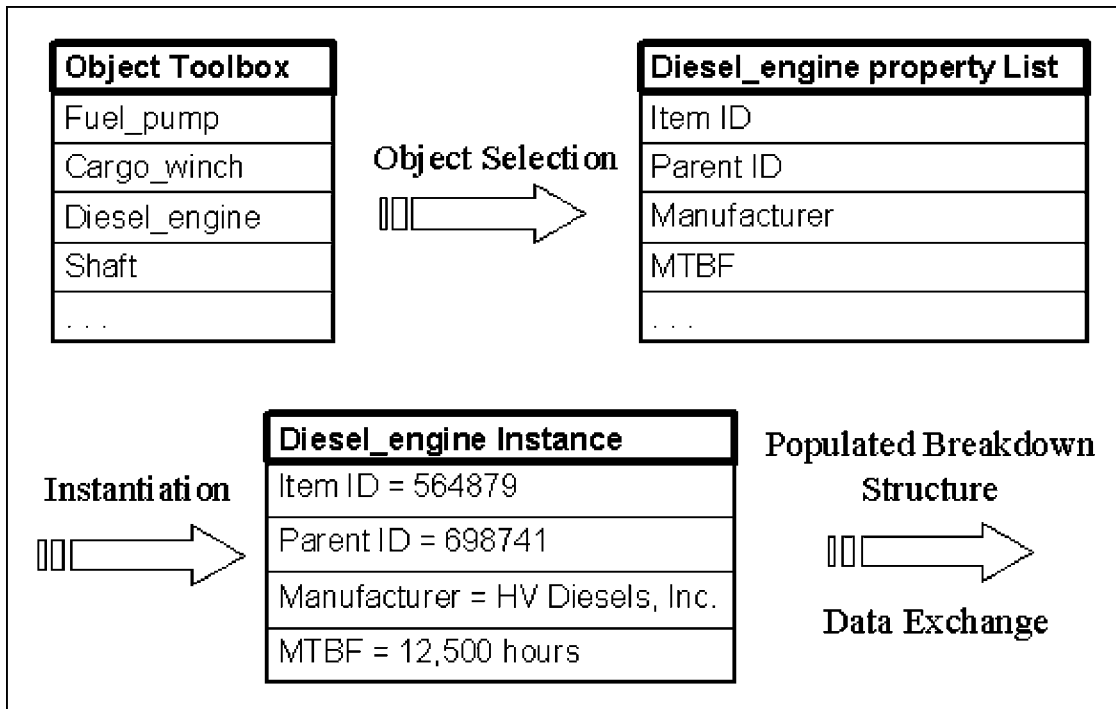
FIG. 1 Object Instantiation Process for Population and Data Exchange

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

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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 black 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	piping_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 via 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

TABLE A1.2 *Continued*

Class Code	Class Name	Class Description
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
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	demineralizer_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 via a mechanical transmission system
22502	mechanical_propulsion_system	a system where the propulsor is driven by a prime mover via 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 via its internal processes
22901	electric_starting_system	a system used to electrically set the machinery into motion, until it can sustain its motion via its internal processes
22902	manual_starting_system	a system used to manually set the machinery into motion, until it can sustain its motion via 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 via 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

TABLE A1.2 *Continued*

Class Code	Class Name	Class Description
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
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 potatos 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	proofer	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

TABLE A1.2 *Continued*

Class Code	Class Name	Class Description
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
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 maker 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

TABLE A1.2 *Continued*

Class Code	Class Name	Class Description
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
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

TABLE A1.2 *Continued*

Class Code	Class Name	Class Description
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
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