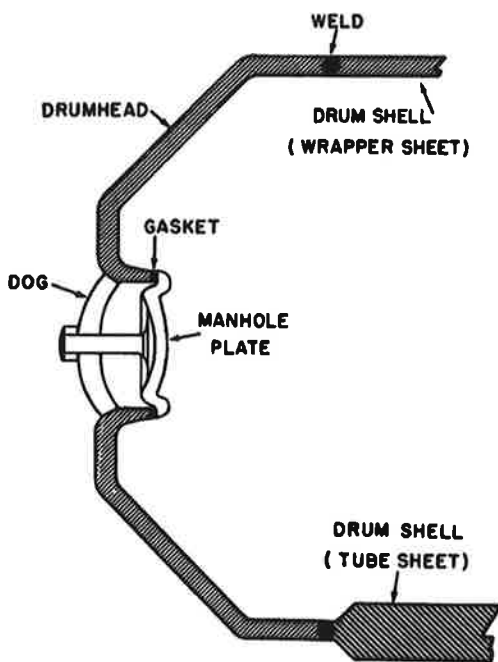


Figure 4-1.—Boiler steam drum.

38.19



38.20

Figure 4-2.—Drumhead secured to steam drum.

provide a place for the accumulation of loose scale and other solid matter that may be present in the boiler water. In drum-type boilers with natural circulation, the water drums and water headers are at the bottom of the boiler. Water drums are usually round. Headers may be round, oval, or square. Headers are provided with access openings, called handholes, of the type shown in figure 4-3. Water drums are usually provided with manholes similar to the manholes in steam drums.

GENERATING AND CIRCULATING TUBES

Most of the tubes in a boiler are generating and circulating tubes. There are four main kinds of generating and circulating tubes: (1) generating tubes in the main generating tube bank, (2) water wall tubes, (3) water screen tubes, and (4) downcomers. These tubes are made of steel similar to the steel used for the drums and headers. Most tubes in the main generating bank are about 1 inch or 1 1/4 inches in outside diameter. Water

down the transmitter connecting piping; clean pilot valve stems and liners; clean bellows bodies; and perform any other cleaning that is specified.

This chapter has not provided you with the information required to calibrate or maintain the system. However, you should have gained a good basic understanding of the system and what it does. There is much training ahead, but this chapter should give you the background so that one day you will become an expert.

GLOSSARY OF AUTOMATIC CONTROL TERMS

This information sheet is a glossary of common terms used in conjunction with automatic controls. This glossary is designed to aid in a better understanding of automatic control systems technical manuals. It is important to understand these terms.

ACTUATOR—That component part of a final control element that converts energy into a mechanical position change in order to change the operating point of the final control element.

ACTUATING SIGNAL—The difference between the reference input (set point) and the forces representing the controlled variable, which will cause a change (pneumatic or mechanical).

AUTOMATIC BOILER CONTROL (ABC)—Pneumatic components throughout the engineering plant that automatically monitor and control the operation of the main boilers and supporting auxiliaries.

AUTOMATIC COMBUSTION CONTROL (ACC)—Interconnected pneumatic components that automatically monitor and control the flow of air and fuel at the proper ratio for optimum combustion and that maintain steam pressure at a set point value.

AUTOMATIC CONTROL—The operation in which the value of a control condition is compared with a desired value and corrective action, dependent on the difference, is taken without human intervention.

BIAS—Increasing or decreasing a pneumatic signal a set amount while the system is in automatic operation.

CALIBRATION—The procedure for checking of readings and/or adjusting an instrument to conform to an accepted standard.

CONTROL AGENT—Process energy or material used in controlling a controlled variable.

CONTROL POINT—The value of the controlled variable which, under any fixed set of conditions, the automatic controller operates to maintain.

CONTROL PRESSURE—The pneumatic pressure to the final control element.

CONTROLLED MEDIUM—That process material in which a variable is controlled.

CONTROLLED VARIABLE—That process material in which a variable is controlled.

CONTROLLER, AUTOMATIC—A device which operates automatically to regulate a controlled variable in response to a command and a feedback signal.

CYCLING—A periodic change of the controlled variable.

DEAD TIME—The interval of time between initiation of an input change and the start of the resulting response.

DEMAND SIGNAL—A signal generated by one component in a control system at the start of the resulting response.

DEVIATION—The difference between the instantaneous value of the controlled variable and the value of the controlled variable corresponding to the set point.

DIFFERENTIAL—The difference of two or more motions or forces.

ERROR—The difference between a value which results from a measurement and the corresponding true value.

FEEDBACK—Part of a closed loop system which provides information about a given condition for comparison with the desired condition.

FEEDBACK SIGNAL—A signal that is returned to the input of the system and compared with the reference signal to obtain an actuating signal which returns the controlled variable to the desired value.

FEEDWATER CONTROL (FWC)—Interconnected pneumatic components that automatically monitors and regulates the flow of feedwater to the boiler to maintain normal water level.

FINAL CONTROL ELEMENT—That portion of the controlling means which directly changes the value of the manipulated variable.

GAIN—The ratio of the signal change that occurs at the output of a device to the change at the input.

Hg—The symbol for the element mercury; a silvery, poisonous, metallic element, liquid at room temperature.

H₂O—The symbol for water.

HUNTING—The undesirable oscillation of an automatic control system. The controlled variable swings on both sides of set point without seeming to approach it.

INERTIA—The property of any material to resist a change in its state or motion (or rest).

INFERENCE—Deduced or deducible by inference. Measurements made in terms different from those we seek, or measurements inferred or deduced from other measurements.

LAG TIME—The interval of time between the start of a response and its completion.

LINEAR—A linear relationship exists between two quantities when a change in one quantity is proportional to the other quantity.

LOADING PRESSURE—The pneumatic signal between two items of pneumatic control equipment, except to the final control element.

MAIN FEED PUMP CONTROL (MFPC)/RE-CIRCULATION CONTROL—Interconnected pneumatic components that control main feed pump speed recirculation control to maintain a predetermined feedwater discharge pressure under all load conditions and automatically ensures adequate flow of feedwater through the main feed pumps under low load conditions.

MANIPULATED VARIABLE—The quantity or condition which is varied by a controller to affect the value of the controlled variable.

OFFSET—The steady state difference between control point and the value of the controlled variable corresponding to set point (any permanent excursion from set point).

PARAMETER—A controllable or variable characteristic of a system, temporarily regarded as a constant, the respective values of which serve to distinguish the various specific states of the system.

PNEUMATIC—Run by or using compressed air.

POSITIONER—Serves to position the final control element in proportion to loading pressure.

PRIMARY ELEMENT—That part of a measuring device that affects or is affected by the variable being measured in order to produce a signal capable of being sensed by a transmitter or indicator.

PROCESS—The collective functions performed in and by the equipment in which a variable is controlled.

PROPORTIONAL—Being in proportion: relation of one part to another with respect to magnitude, quantity, or degree; ratio.

PROPORTIONAL BAND—The amount of deviation of the controlled variable from set point required to move the final control element through the full range. An expression of gain of an instrument.

RANGE—The difference between the maximum and minimum values of physical output

over which an instrument is designed to operate normally.

RATIO—The relation in degree or number between two similar things.

RELAY—A pneumatic device that receives one or more signals, alters and/or combines the signals in various ways and produces an output signal proportional to input.

RESET—The action of a controller which is proportional to the product of the error at the input and the amount of time the error exists.

SET POINT—The desired value of the controlled variable.

SPAN—The difference between the top and bottom scale values of an instrument. On instruments starting at zero, the span is equal to the range.

TRANSMITTER—A device that measures one of the basic variables in the control process and develops and transmits a pneumatic signal proportional to that measurement.

VARIABLE—A process condition, such as temperature, pressure, level, or flow, which is susceptible to change and which can be measured, altered, and controlled.

VELOCITY—Time rate of linear motion in a given direction.

APPENDIX I

GLOSSARY

- ABATEMENT:** A reduction or diminishing.
- ABT (Automatic bus transfer):** An automatic electrical device that supplies power to vital equipment. This device will shift from the normal power supply to an alternate power supply anytime the normal supply is interrupted.
- AFTERCOOLER:** A terminal heat-transfer unit after the last stage.
- AIR CHAMBER:** A chamber, usually bulb-shaped, on the suction and discharge sides of a pump. Air in the chamber acts as a cushion and prevents sudden shocks to the pump.
- AIR EJECTOR:** A type of jet pump, used to remove air and other gases from the condensers.
- AIR LOCK SYSTEM:** A system of control devices combined to hold all final operating elements in the position existing prior to loss of air supply pressure.
- AIR REGISTER:** A device in the casing of a boiler which regulates the amount of air for combustion and provides a circular motion to the air.
- AISE:** Association of Iron and Steel Engineers.
- ALLOY:** A mixture of two or more metals.
- ALTERNATING CURRENT (a.c.):** Current that is constantly changing in value and direction at regularly recurring intervals.
- AMBIENT TEMPERATURE:** The temperature of the room or shipboard space.
- AMPLIFIER:** An instrument or device whose output is an enlarged reproduction of an input signal.
- AMPLIFY:** To increase the energy of information level of a signal by a proportional factor.
- ANNEALING:** The softening of metal by heating and slow cooling.
- ANNUNCIATOR:** See ENGINE ORDER TELEGRAPH.
- ANTIFRICTION BEARING:** A bearing containing rollers or balls plus an inner and outer race. The bearing is designed to roll, thus minimizing friction.
- ARMORED CABLE:** An electric cable that is protected on the outside by a metal covering.
- ASTM:** American Society for Testing Metals.
- ATMOSPHERE ESCAPE PIPING:** Piping, installed from the machinery spaces, up the outer stack or overhead to the atmosphere, through which steam or air, discharged from safety or large volume relief valves, is piped from the spaces.
- ATMOSPHERIC PRESSURE:** The pressure exerted by the atmosphere in all directions, as indicated by a barometer. Standard atmospheric pressure is considered to be 14.7 pounds per square inch, which is equivalent to 29.92 inches of mercury.
- ATOMIZATION:** The spraying of a liquid through a nozzle so that the liquid is broken into tiny droplets or particles.

AUTOMATIC CONTROLLER: An instrument or device that operates automatically to regulate a controlled variable in response to a setpoint and/or input signal.

AUTOMATIC CONTROL SYSTEMS: A combination of instruments or devices arranged systematically to control a process or operation at a setpoint without assistance from operating personnel.

AUTOMATIC-MANUAL TRANSFER SITUATION: An integral unit of control system components that provides the necessary information and switches to facilitate transfer of a particular control loop or subloop from automatic operation and to enable remote manual control of a subsequent control element.

AUTOMATIC OPERATION: Operation of a control system and the process under control without assistance from the operator.

AUXILIARIES: Propulsion plant equipment not powered by main steam.

AUXILIARY: Systems or components functioning in a secondary capacity to the main boilers, and propulsion turbines (such as pumps, air ejectors, blowers, etc.).

AUXILIARY MACHINERY: Any system or unit of machinery that supports the main propulsion units or helps support the ship and crew. Example: Pump, evaporator, steering engine, air-conditioning, and refrigerator equipment, laundry, and galley equipment, deck winch, etc.

AXIAL: In a direction parallel to the axis. Axial movement is movement parallel to the axis.

BABBITTED: Lined with a babbitt metal (containing tin, copper, and antimony).

BACK PRESSURE: (1) Refers to the resistance to the flow of exhaust fluids through the exhaust system. (2) The pressure exerted on the exhaust side of a pump or engine.

BDC (bottom dead center): The position of a reciprocating piston at its lowest point of travel.

BAFFLE: A plate installed to disperse (scatter) motion and/or change direction of flow of fluids.

BALLASTING: The process of filling empty tanks with saltwater to protect the ship from underwater damage and to increase its stability. See DEBALLASTING.

BIAS OR BIASING: The act of adding to or subtracting from a control system signal.

BIAS SIGNAL: A signal that is either added to or subtracted from a control system signal.

BLOCK DIAGRAM: A drawing of a system using blocks for components to show the relationship of components.

BLOWING OF TUBES: A procedure that uses steam to remove soot and carbon from the tubes of steaming boilers.

BLUEPRINT: Reproduced copy of drawing (usually having white lines on a blue background).

BOILER: A strong metal tank or vessel composed of tubes, drums, and headers, in which water is heated by the gases of combustion to form steam.

BOILER BLOW PIPING: Piping from the individual boiler valves to the overboard connection at the skin of the ship.

BOILER EFFICIENCY: The efficiency of a boiler is the ratio of the Btu per pounds of fuel absorbed by the water and steam to the Btu per pound of fuel fired. In other words, boiler efficiency is output divided by input, or heat utilized divided by heat available. Boiler efficiency is expressed as a percentage.

BOILER FEEDWATER: Deaerated water in the piping system between the deaerating feed tank and the boiler.

BOILER FULL-POWER CAPACITY: The total quantity of design steam flow required to develop specified horsepower of the ship, divided by the number of boilers installed in the ship. Also expressed as the number of pounds of steam generated per hour at a specified pressure and temperature.

BOILER INTERNAL FITTINGS: All parts inside the boiler which control the flow of steam and water.

BOILER LOAD: The steam output demanded from a boiler, generally expressed in pounds per hour (lb/hr).

BOILER MASTER: A steam pressure controller.

BOILER OPERATING PRESSURE: The pressure required to be maintained in a boiler while in service.

BOILER OPERATING STATION: A location from which boilers are operated.

BOILER OVERLOAD CAPACITY: As specified in design of a boiler, usually 120% of boiler full-power capacity, either in steaming or firing rate as specified for the individual installation.

BOILER RECORD SHEET: A NAVSHIPS form maintained for each boiler, which serves as a monthly summary of operation.

BOILER REFRACTORIES: Materials used in the boiler furnace to protect the boiler from heat of combustion.

BOILER ROOM: A compartment containing boilers but not containing a station for operating or firing the boilers. Refers specifically to bulkhead enclosed boiler installations.

BOILER TUBE CLEANER: A cylindrical brush that is used to clean the insides of boiler tubes.

BOILER WATER: The water actually contained in the boiler.

BOURDON TUBE: A C-shaped hollow metal tube that is used in a gage for measuring pressures of 15 psi and above. One end of the C is welded or silver-brazed to a stationary base. Pressure on the hollow section forces the tube to try to straighten. The free end moves a needle on the gage face.

BRAKE HORSEPOWER (BHP): A measurement of the actual power produced by an engine.

BRANCH LINES (OR PIPING): Smaller piping branching off the main piping.

BRAZING: A method of joining two metals at high temperature with a molten alloy.

BRINE: A highly concentrated solution of salt in water, normally associated with the overboard discharge of distilling plants.

BRITISH THERMAL UNIT (Btu): A unit of heat used to measure the efficiency of combustion. It is equal to the quantity of heat required to raise 1 pound of water 1°F.

BRITTLENESS: That property of a material which causes it to break or snap suddenly with little or no prior sign of deformation.

BUCKET WHEEL: The steel wheel or disc, fitted to a turbine shaft, to which the blading is attached.

BULL GEAR: The largest gear in a reduction gear train—the main gear, as in a geared turbine drive.

BURNERMAN: Man in the fireroom who tends the burners in the boilers.

BUS: The common connection between a group of line cutout switches. The bus may be in one single piece or it may be divided; may be free or directly connected to a jack outlet.

BUSHING: A renewable lining for a hole through which a moving part passes.

BUS TRANSFER: A device for selecting either of two available sources of electrical power. It may be accomplished either manually or automatically.

BYPASS: To divert the flow of gas or liquid. Also, the line that diverts the flow.

CALIBRATION: The procedure required to adjust an instrument or device to produce a standardized output with a given input. The amount of deviation from the standard must first be determined in order to ascertain the proper correction requirements.

CANTILEVER: A projecting arm or beam supported only at one end.

CAPILLARY TUBE: A slender, thin-walled, small-bored tube used with remote-reading indicators.

CARBON MONOXIDE: A deadly, colorless, odorless, and tasteless gas formed by incomplete burning of hydrocarbons.

CARBON PACKING: Pressed segments of graphite used to prevent steam leakage around shafts.

CARRYOVER: Boiler water entrained with the steam (by foaming or priming).

CASING: A housing that encloses the rotating element (rotor) of a pump or turbine.

CASING THROAT: An opening in a turbine or pump casing through which the shaft protrudes.

CASUALTY: An event or series of events in progress during which equipment damage and/or personnel injury has already occurred. The nature and speed of these events are such that proper and correct procedural steps will serve only to limit damage and/or personnel injury.

CASUALTY POWER SYSTEM: Portable cables that are rigged to transmit power to vital equipment in an emergency.

CELSIUS: Thermometer scale on which the boiling point of water is 100° and the freezing point is 0°.

CENTIGRADE: See CELSIUS.

CENTRIFUGAL FORCE: The outward force on a rotating body.

CHARACTERIZER: A control system component that acts to alter a signal in a predetermined manner to match a nonlinear parameter in the process under control.

CHECK VALVE: A valve that permits a flow of liquid in one direction only.

CHEMICAL ENERGY: Energy stored in chemicals (Fuel) and released during combustion of the chemicals.

CHILL SHOCKING: A method that uses steam and cold water to remove scale from the tubes of a distilling plant.

CHLORIDE: A compound of the chemical element chlorine with one or more other elements.

CHLORINE: A heavy, greenish-yellow gas used in water purification, sewage disposal, and in the preparation of bleaching solutions. Poisonous in concentrated form.

CIRCUIT BREAKER: An electrical switching device that provides circuit overload protection.

CIRCULATING WATER: Water circulated through a heat exchanger (condenser or cooler) to transfer heat away from an operating component.

CLARIFIER: A water tank containing baffles that slow the rate of water flow sufficiently to allow heavy particles to settle to the bottom and light particles to rise to the surface. This separation permits easy removal, thus leaving the "clarified" water. The clarifier is sometimes referred to as a settling tank or sedimentation basin.

CLASSIFICATION AND/OR TYPE: A method of identifying and sorting various equipment and materials. For example:

- a. Check valve-swing, stop, etc.
- b. Valve-solenoid, manual, etc.

CLUTCH: A form of coupling that is designed to connect or disconnect a driving or driven member.

COLD IRON CONDITION: An idle plant as in a destroyer when all port services are received from an external source such as shore or tender.

COMBINING TUBES: Short open-ended tubes in which the inner surfaces are paralleled, or nearly so, and used to combine two inlets into a single outlet.

COMBUSTIBLE: A material that can burn.

COMBUSTION: The burning of fuel in a chemical process accompanied by the evolution of light and heat.

COMBUSTION AIR: The air delivered to the boiler furnace to support burning of the atomized fuel oil.

COMBUSTION CONTROL SYSTEM: A system that regulates fuel rate and combustion air flow to a boiler so that steam is produced at a constant pressure and fuel is burned with optimum combustion efficiency.

COMBUSTION EFFICIENCY: The ratio of the energy in the combustion gases, theoretically available for absorption by the boiler under actual operating conditions, to the energy available had the fuel been burned with the minimum theoretical combustion air.

COMPONENT: Individual unit, or part, of a system; also, the major units which, when suitably connected, comprise a system.

COMPONENT PART: The integral parts of a component.

CONDENSATE: Water produced in the cooling system of the steam cycle from steam that has returned from the turbine or from steam that has returned from various heat exchangers. The water is used over again to generate steam in the boiler for an endless repetitive cycle.

CONDENSATE DEPRESSION: The difference between the temperature of condensate in the condenser hotwell and the saturation temperature corresponding to the vacuum maintained in the condenser.

CONDENSER: A heat transfer device in which vapor is condensed to liquid.

CONDUCTANCE: The ability of a substance to pass an electrical current.

CONDUCTION: Heat transfer by actual contact between substances or from molecule to molecule within a substance.

CONDUCTIVITY: The ability of water to conduct an electric current. It is expressed in micromhos/cm. Generally, the dissolved solids are directly proportional to the conductivity.

CONSOLE: A panel equipped with remote manual controls and visual indicators of system performance.

CONSTANT-PRESSURE GOVERNOR: A device that maintains a constant pump discharge pressure under varying loads.

CONTROL ACTION: The nature of the change of the output of a control element or system affected by its input signal.

CONTROL AIR SUPPLY: Clean, dry air at proper pressure for operation of pneumatic control equipment.

CONTROL COMPONENT: An instrument which has been designed to perform a particular control action.

CONTROLLER (AUTOMATIC): A device or group of devices arranged to automatically

regulate a controlled variable in accordance with a command or setpoint signal.

CONTROLLER (ELECTRICAL): A device used to stop, start, and protect motors from overloads while they are running.

CONTROLLER (PNEUMATIC): (1) A control system component or group of components, arranged to sense two or more control system variables, which act to provide a pneumatic (air) output signal, tending to reduce the difference between these signals to some predetermined value. (2) An arrangement of control system computing elements designed to perform a predetermined set of mathematical functions.

CONTROL POWER: Power that controls or operates a component or component part.

CONTROL SIGNAL (ELECTRICAL): A signal that activates control circuitry or indicators; for example: the signal from a pressure switch.

CONTROL SIGNAL (PNEUMATIC): A loading signal applied to a final control element.

CONTROL SYSTEM AUTOMATIC: An arrangement of components interconnected so that the operating point and the desired operating point of the process under control are continuously monitored and acted upon to tend to reduce the difference between these two parameters to some predetermined value.

CONTROL SYSTEM VARIABLE: A measurable property of the control system that is subject to changes according to the process operating condition or according to reaction of the automatic control system.

CONTROL VALVE: A final control element that operates between the open and closed positions in accordance with a signal provided from the control system.

CONVECTION: The transmission of heat by the circulation of a liquid or a gas such as air. Convection may be forced by use of a pump or fan, or it may occur naturally due to heated

air or liquid rising and forcing the colder air or liquid downward.

COOLANT: Liquid in the cooling system.

COOLER: Any device that removes heat. Some devices, such as oil coolers, remove heat to waste in overboard seawater discharge; other devices, such as ejector coolers, conserve heat by heating condensate for boiler feedwater.

COOLING SYSTEM: Heat removal process that uses mechanical means to remove heat to maintain the desired air temperature. The process may also result in dehumidification.

CORROSION: A gradual wearing away or alteration of metal by a chemical or electrochemical process. Essentially, it is an oxidizing process, such as the rusting of iron by the atmosphere.

COUNTERSINK: A cone-shaped tool used to enlarge and bevel one end of a drilled hole.

CREEP-RESISTANT ALLOY: A metal that resists the slow plastic deformation which occurs at high temperatures when the material is under constant stress.

CRITICAL SPEED: The speed at which the centrifugal force of a rotating element tends to overcome the natural weight of the element, causing distortion and vibration.

CROSS-CONNECT: To align piping of systems to provide flow between machinery groups.

CROSS-CONNECTED PLANT: A method of operating two or more plants as one unit from a common steam supply.

CROSS PIPING (OR VALVES): Piping that provides flow between port and starboard systems or between systems having different purposes..

CURTIS STAGE: A velocity-compounded impulse turbine stage having one pressure drop in the nozzles and two velocity drops in the blading.

CUTOUT VALVE: A valve that is intended normally to be fully open or fully closed.

DAMPER: A device for reducing the motion or oscillations of moving parts, air, or liquid.

DAMPING: A characteristic of a system that results in dissipation of energy and causes decay in oscillations. The negative feedback of an output rate of change.

DEAD BAND: The amount by which the input of a device can be changed without affecting the output.

DEAERATE: Process of removing dissolved oxygen.

DEAERATING FEED TANK (DFT): A unit in the steam-water cycle used to (1) free the condensate of dissolved oxygen, (2) heat the feedwater, and (3) act as a reservoir for feedwater.

DEBALLASTING: The process by which saltwater is emptied from tanks.

DEFORMATION: Permanent alteration of form or shape.

DEGREE OF SUPERHEAT: The amount by which the temperature of steam exceeds the saturation temperature.

DEHUMIDIFICATION: The mechanical process of removing water vapor from the air.

DELAY: The interval of time between a change in signal and its exact repetition at a downstream point of the signal path. Also, the time lag encountered before a control element produces a change of the input signal.

DEMAND SIGNAL: A signal that directs a process or control system variable to assume a value that is a function of the demand signal.

DENTAL COUPLING: A flexible coupling assembly, consisting of a set of external/internal gear teeth, that compensates for shaft misalignment between a driver and a driven machinery component.

DESIGN PRESSURE (BOILER): The pressure specified by a manufacturer as a criterion in design. (In a boiler, it is approximately 103% of operating pressure.)

DESIGN TEMPERATURE (BOILER): The intended operating steam temperature at the superheater outlet, at some specified rate of operation. The specified rate of operation is normally full-power capacity.

DESUPERHEATED STEAM: Steam from which some of the superheat has been removed.

DIAL GAGE OR INDICATOR: A precision micrometer-type instrument that indicates the reading via a needle moving across a dial face.

DIAPHRAGM MOTOR: An actuator using a pneumatic diaphragm mechanism to supply the energy and force required to position a final control element.

DIESEL ENGINE: An engine using the diesel cycle of operation; air alone is compressed and diesel fuel is injected at the end of the compression stroke. Heat of compression produces ignition.

DIFFUSER: A device that spreads a fluid out in all directions and increases fluid pressure while decreasing fluid velocity.

DIRECT CURRENT (d.c.): Current that moves in one direction only.

DIRECT DRIVE: One in which the drive mechanism is coupled directly to the driven member.

DIRECT-DRIVEN: Driven at the same speed as the driver (not having reduction gears).

DISTILLATE: The product (freshwater) resulting from the condensation of vapors produced by the evaporation of seawater.

DISTILLATION: The process of evaporating seawater, then cooling and condensing the resulting vapors. Produces freshwater from seawater by separating the salt from the water.

DISTILLING PLANTS: Units commonly called evaporators, used to convert seawater into freshwater.

DOUBLE REDUCTION: A reduction gear assembly that reduces the high input rpm to a lower output rpm in two stages.

DOUBLE SUCTION IMPELLER: An impeller with suction inlet on each side.

DRAWING: Illustrated plans that show fabrication and assembly details.

DRY PIPE: A perforated pipe, at the highest point in a steam drum, that collects dry steam from steam separators.

DUCTILITY: Property of metals that allows them to be drawn or stretched.

DUPLEX STRAINER: A strainer containing two separate elements, independent of each other.

ECONOMIZER: A heat transfer device that uses the gases of combustion to preheat the feed-water in the boiler before it enters the steam drum.

EDUCTOR: A jet-type pump (no moving parts) used to empty flooded spaces.

EFFICIENCY: The ratio of the output to the input. Also, the degree of conversion of heat of steam to usable mechanical power output.

ELASTICITY: The ability of material to return to its original size and shape after deformation.

ELECTRICAL ENERGY: Energy derived from the forced induction of electrons from one atom to another.

ELECTRODE: A metallic rod (welding rod), used in electric welding, that melts when current is passed through it.

ELECTROHYDRAULIC STEERING: A system having a motor-driven hydraulic pump

that creates the force needed to actuate the rams to position the ship's rudder.

ELECTROLYSIS: A chemical action that takes place between unlike metals in systems using saltwater.

ELECTROMOTIVE FORCE (emf): A force that causes electrons to move through a closed circuit; expressed in volts.

ELEMENT: A substance that consists of chemically united atoms of one kind.

EMERGENCY: An event or series of events in progress which will cause damage to equipment unless immediate, timely, and correct procedural steps are taken.

EMULSIFIED OIL: A chemical condition of oil in which the molecules of the oil have been broken up and suspended in a foreign substance (usually water).

ENERGY: The capacity for doing work.

ENGINEERING LOG: A legal record of important events and data concerning the machinery of a ship.

ENGINEER'S BELL BOOK: A legal record, maintained by the throttle watch, of all ordered main engine speed changes.

ENGINE ORDER TELEGRAPH: A device on the ship's bridge to give orders to the engineroom. Also called ANNUNCIATOR.

EPM (EQUIVALENT PER MILLION): A term used to describe the chemical concentration of dissolved material; used in reporting sample test results. It expresses the chemical equivalent unit weight of material dissolved in a million unit weights of solution. (The chemical equivalent weight of chloride is 35.5. If 35.5 pounds of chloride were dissolved in 1,000,000 pounds of water, the water would contain 1.00 epm chloride.)

ERROR: The difference between a setpoint and a feedback signal.

EVAPORATION: The action that takes place when a liquid changes to a vapor gas.

EVAPORATOR: A distilling device to produce freshwater from seawater.

EXCESS FEED: Excess feedwater that is returned to storage tanks.

EXPANSION JOINT: A junction in a piping system which allows for expansion and contraction.

FAHRENHEIT: Thermometer scale on which the boiling point of water is 212°, and the freezing point is 32° above zero.

FAIL: (1) The loss of control signal or power to a component. (2) The breakage or breakdown of a component or component part.

FAIL POSITION: The operating or physical position to which a device will go upon loss of its actuating electrical, electronic, pneumatic, or hydraulic control signal.

FATIGUE: The tendency of a material to break under repeated strain.

FEEDBACK: Information about a process output which is communicated to the process input.

FEEDER: An electrical conductor or group of conductors between different generating or distributing units of a power system.

FEED HEATER: A heat transfer device that heats the feedwater before it goes to the boiler.

FEEDWATER: Water that meets the requirements of *Naval Ships' Technical Manual* Chapter 220 (9560) for use in a boiler.

FEEDWATER CONTROL (THREE-ELEMENT): An automatic control that maintains a balance between the output steam flow of the boiler and the input flow of feedwater, with corrections made for variations in drum water level.

FEEDWATER SYSTEM: A system for storing, heating, and delivering feedwater to boilers.

FERROUS METAL: Metal with a high iron content.

FILTER: A device through which gas or liquid is passed; dirt, dust, and other impurities are removed by the separating action.

FINAL CONTROL ELEMENT: An element of a control system that directly changes a process variable in response to a change in its loading signal.

FIREBOX: The section of a ship's boiler where fuel oil combustion takes place.

FIRELINE: Section of piping and hose on discharge side of a proportioner leading to fire location.

FIRE MAIN: The saltwater line that provides firefighting and flushing water throughout the ship. Raw water is used at Great Lakes in lieu of saltwater.

FIREROOM: A compartment containing boilers and the station for "firing" or operating same.

FIRE TUBE BOILER: Boiler in which the gases of combustion pass through the tubes and heat the water surrounding them.

FLAMMABLE: A combustible material that burns easily, intensely or quickly.

FLAREBACK: A backfire of flame and hot gases into a ship's fireroom from the firebox. Caused by a fuel oil explosion in the firebox.

FLASH POINT OF OIL: The temperature at which oil vapor will flash into fire although the main body of the oil will not ignite.

FLEXIBLE COUPLING: A coupling that transmits rotary motion from one shaft to another while compensating for minor misalignment between the two units.

FLEXIBLE I-BEAM: An I-shaped steel beam on which the forward end of a turbine is mounted; it allows for longitudinal expansion and contraction.

FLOAT ON THE LINE: Proportioner discharging through the fireline with foam liquid pump not picking up foam liquid.

FLOCCULATION: The separation of solids induced by the addition of chemicals in the clarifier.

FLOOR PLATES: The removable deck plating of a fireroom or engineroom aboard ship.

FLOW TRANSMITTER: A transmitter that produces an output signal proportional to flow.

FLUID: A substance capable of flowing or conforming to the shape of its container (a liquid or gas).

FOAMING: Failure of steam bubbles to break, caused by either dissolved solids or light suspended solids in the boiler water, causing small amounts of continuous boiler water carry-over with the steam.

FOAM NOZZLE: A nozzle designed to entrain air and mix it with water and foam liquid to produce a foam blanket.

FORCE: Anything that tends to produce or modify motion.

FORCE-BALANCE: An arrangement of control system components using a mechanical force as the feedback signal. The feedback applied force must "null" the forces acting on a balanced mechanism.

FORCED DRAFT: A term that describes the combustion air supplied under pressure to the burners in a ship's boiler by the forced draft blowers.

FREQUENCY: The number of vibrations, cycles, or changes in direction in a unit of time.

FRESHWATER: Water of relatively low dissolved solids content as compared to seawater. There are two types of shipboard freshwater: feedwater (the low-pressure drains of the steam generator condensate system) and potable water (supplied from either a shore water source or a shipboard distilling plant.)

FRESHWATER DRAINS: A collective term which refers to drainage from steam heating systems and warming-up drainage from other higher pressure steam systems. These drains are of feedwater quality and are returned to the boiler condensate system.

FRESHWATER SYSTEM: A piping system that supplies freshwater throughout the ship.

FUEL OIL: As referred to herein and unless otherwise specified means Navy Distillate Fuel MIL-F-24397, Diesel Fuel Marine MIL-F-16884, JP5-MIL-T-5624, or Navy Special Fuel Oil MIL-F-859.

FUEL OIL MICROMETER VALVE: A valve, installed at the burner manifold, that controls the fuel oil pressure to the burners.

FUEL OIL SERVICE TANKS: Tanks from which the fuel oil service pumps take suction for supplying oil to the burners.

FUNCTION: To perform the normal or characteristic action of anything, or special duty or performance required of a person or thing in the course of work.

FUSE: A protective device that will open a circuit if the current flow exceeds a predetermined value.

GAGE GLASS: A device for indicating the liquid level in a tank.

GAIN: The ratio of the signal change, which occurs at the output of a device, to the change at the input.

GAS FREE: A term that describes a space which has been tested and found safe for hot work (welding and cutting).

GEARED TURBINE: A turbine coupled to its driven unit through a gear assembly.

GEARED-TURBINE DRIVE: A turbine that drives a pump, generator, or other machinery through reduction gears.

GLAND SEAL REGULATOR: A device that automatically regulates the steam flow of the turbine glands to meet the flow requirements for the various operating conditions.

GLAND SEALING: Water piped to a pump casing stuffing box to maintain a seal against air entering the pump casing. Also, low pressure steam piped to the glands of steam turbines to prevent air leakage into turbines.

GRAVITY HEAD: A supply of fluid above the suction level of a pump. Also called "statichead."

GROUNDING PLUG: A three-pronged electrical plug used to ground portable tools to the ship's structure. It is a safety device which always must be checked prior to your using portable tools.

GUARDING VALVE: A valve installed upstream of the throttle valves. This valve permits stopping steam flow to the turbines if the throttle valves are leaking or damaged.

HANDHOLE: An opening large enough for the hand and arm to enter the boiler for making slight repairs and for inspection purposes.

HARDENING: The heating and rapid cooling (quenching) of metal to induce hardness.

HARDNESS: A quality exhibited by water containing various dissolved salts, principally calcium and magnesium. Can result in a heat transfer resistant scale on the steam generating surfaces.

HEADER: A chamber, or tank, located within a boiler, to which tubes are connected so that water or steam may pass freely from one tube to the other(s). Similar to, but smaller than, water drum.

HEAT: A form of energy.

HEAT EXCHANGER: Any device that is designed to allow the transfer of heat from one fluid (liquid or gas) to another.

HEATING SURFACE: The exposed surface of a heating unit in a boiler or a furnace which is directly exposed to the heat of the flue gases.

HEATING SYSTEM: A system for adding heat to maintain the desired air temperature, as distinguished from heat added incidentally or unavoidably.

HELICAL: A spiraling shape such as that made by a coil spring.

HERTZ (Hz): Frequency per second of alternating current. Formerly referred to as "cycles per second."

HORSEPOWER (as applied to boilers): A unit to indicate the time rate of doing work equal to 550 foot-pounds per second or 33,000 foot-pounds per minute. One horsepower equals 745.8 watts. In practice this is considered 746 watts.

HOTWELL: Reservoir attached to the bottom of a condenser for collecting condensate.

HUMIDITY: The vapor content of the atmosphere. Humidity can vary depending on air temperature; the higher the temperature, the more vapor the air can hold.

HUNTING: An undesirable oscillation of frequency and amplitude prolonged after external stimuli disappear.

HYDRAULICS: The study of liquid in motion.

HYDROCARBON: Chemical compound of hydrogen and carbon; all petroleum fuels are composed of hydrocarbons.

HYDROGEN: A highly explosive, light, invisible, nonpoisonous gas used in underwater welding and cutting operations.

HYDROMETER: An instrument used to determine the specific gravity of liquids.

HYDROSTATIC: Static (nonmoving) pressure generated by pressurizing liquid.

HYDROSTATIC TEST: A test using pressurized water to detect leaks in a boiler or other closed systems.

IGNITION, COMPRESSION: When the heat generated by compression in an internal-combustion engine ignites the fuel (as in a diesel engine).

IGNITION, SPARK: When the mixture of air and fuel in an internal-combustion engine is ignited by an electric spark (as in a gasoline engine).

IGNITION TEMPERATURE: The minimum temperature to which a substance (solid, liquid or gas) must be heated to cause self-sustained combustion.

IMPELLER: An encased, rotating element provided with vanes which draw in fluid at the center and expel it at a high velocity at the outer edge.

IMPULSE LINES: Piping that connects a sensing element to the point at which it is desired to sense pressure, flow, temperature, etc.

IMPULSE TURBINE: A turbine in which the major part of the driving force is received from the impulse of incoming steam.

INDICATORS: Panel-mounted pressure gages.

INDIRECT DRIVE: A drive mechanism coupled to the driven member by gears or belts.

INERT: Inactive.

INERTIA: The tendency of a stationary object to remain stationary and of moving objects to remain in motion.

INJECTOR: A device that uses a jet of steam to force water into the boiler. Injectors are also used in a diesel engine to force fuel into the cylinders.

INSULATION: A material that retards heat transfer.

INTERCOOLER: An intermediate heat transfer unit between two successive stages, as in an air compressor.

INTERFACE: Surface or area between two abutting parts usually of different materials.

INTERLOCK: A feature or device in one system or component that affects the operation of another system or component. Generally, a safety device but it may be used to control the operating sequence of components.

JACKBOX: Receptacle, usually secured to a bulkhead, in which telephone jacks are mounted.

JACKING: Mechanically rotating a turbine at very low speed.

JOB ORDER: An order issued by a repair activity to its own subdivision to perform a repair job in response to work request.

JOURNAL: That part of a shaft that is prepared to accept a bearing (connecting rod, main bearing).

JUMPER: Any connecting pipe, hose, or wire, normally used in emergencies aboard ship to bypass damaged sections of a pipe, a hose, or a wire. (See **BYPASS**.)

JURY RIG: Any temporary or makeshift device.

KEY: A parallel-sided piece inserted into a groove cut part way into each of two parts, which prevent slippage between the two parts.

KEYWAY: A slot cut in a shaft, pulley hub, wheel hub, etc. A square key is placed in the slot and engages a similar keyway in the mating

piece. The key prevents slippage between the two parts.

KINETIC ENERGY: Energy in motion, producing work.

LABYRINTH: A system of metal packing in which the inside diameter of a series of rings contacts the rotating surface of the turbine shaft. The passage of air or steam along the shaft is thereby reduced or inhibited.

LABYRINTH PACKING: A soft metal ring installed in the casing throat in such a manner that the lateral teeth of the inside diametrical surface will be presented to the surface of the rotating shaft. The teeth run either in close proximity to the shaft or in grooves machined in the shaft.

LAGGING: A protective and confining cover placed over insulating material.

LATENT HEAT OF CONDENSATION: The amount of heat (energy) required to change the state of a substance from a vapor to a liquid without a change in temperature.

LATENT HEAT OF VAPORIZATION: The amount of heat (energy) required to change the state of a substance from a liquid to vapor without a change in temperature.

LIFT CHECK VALVE: A valve having a guide-mounted, springloaded disc wherein a liquid exerting pressure on the bottom of the disc will lift the disc and pass through. Pressure exerted against the top of the disc shuts the disc and ensures only one direction of flow.

LIGHT OFF: Start. Literally, "to start a fire in," as in "light off a boiler."

LIMIT SWITCH: A switch that is actuated by the mechanical motion of an element.

LINE CUTOFF SWITCH: The device in a switchbox which disconnects an individual line from a group of circuits.

LOAD: Steam production demanded of a boiler by the operation of steam-driven equipment.

LOADING: The act of transferring energy into or out of a system.

LOADING SIGNAL: An input air signal to a control system element.

LOCAL MANUAL OPERATION: Direct manual positioning of a control valve or power operator by means of a handwheel or lever.

LOCKED TRAIN: A gear arrangement that has the high-speed pinions "locked" between the high-speed gears so that the only load on the pinion bearings is that of the weight of the pinion since the tooth loads cancel one another.

LOG BOOK: Any chronological record of events, such as an engineering watch log.

LOG ROOM: Engineer's office aboard ship.

LOOP SEAL: A vertical U-bend in drain piping in which a water level is maintained to create an airtight seal.

LUBRICANT: Any material, usually of a petroleum nature such as grease, oil, etc, that is placed between two moving parts in an effort to reduce friction.

LUBRICATING OIL PURIFIER: A unit that removes water and sediment from lubricating oil by centrifugal force.

MACHINABILITY: The ease with which a metal may be turned, planed, milled, or otherwise shaped.

MACHINERY GROUP: One single self-contained steam plant consisting of one engine-room and one fireroom.

MAIN CONDENSATE: Condensate from the main condenser. Although this is the principal source of feedwater, water from other drains as well as water from reserve makeup tanks and the Ship Service Turbo Generator

(SSTG) condensers are also included in feedwater.

MAIN CONDENSER: A heat exchanger that converts exhaust steam to feedwater.

MAIN DRAIN SYSTEM: System used for pumping bilges; consists of pumps and associated piping.

MAIN INJECTION (SCOOP INJECTION): An opening in the skin of a ship designed to deliver cooling water to the main condenser and main lubricating oil cooler by the forward motion of the ship.

MAIN STEAM: 1200-psi superheated steam.

MAKEUP FEED: Water from reserve feed tanks added to the condensate-feedwater system to make up for water losses from the steam generator system.

MALLEABILITY: That property of a material which enables it to be stamped, hammered, or rolled into thin sheets.

MANIFOLD: A fitting with numerous branches used to convey fluids between a large pipe and several smaller pipes.

MASTER DEMAND SIGNAL: Signal that represents a demand for air flow and oil flow to the boiler.

MAXIMUM OPERATING PRESSURE: The highest pressure that can exist in a system or subsystem under normal operating conditions. This pressure is determined by such influences as pump or compressor shutoff pressures, pressure regulating valve lockup (no-flow) pressure, and maximum chosen pressure at the system source.

MAXIMUM SYSTEM PRESSURE: The highest pressure that can exist in a system or subsystem during any condition. Normal, abnormal, and emergency operation and casualty conditions shall be considered in determining the maximum system pressure. In any system or subsystem with relief valve protection, the nominal setting of the relief valve shall be taken

as the maximum system pressure (relief valve accumulation may be ignored).

MECHANICAL ADVANTAGE (MA): The advantage (leverage) gained by the use of devices such as a wheel to open a large valve, chain falls, and block and tackle to lift heavy weights, and wrenches to tighten nuts on bolts.

MECHANICAL CLEANING: A method of cleaning the firesides of boilers by scraping and wirebrushing.

MECHANICAL ENERGY: Energy derived from mechanical force or impact.

MICROMHO: Electrical unit used with salinity indicators for measuring the conductivity of water. Is equivalent to the quantity of one divided by the resistance of the water to electrical conductivity.

MONITORING POINT: The physical location at which any indicating device displays the value of a parameter at some control station. (See PARAMETER.)

MORPHOLINE: A chemical that prevents sludge in boilers by neutralizing the acidic quality of condensate, thereby reducing corrosion in condensate and feedwater piping.

MOTIVE STEAM: Steam that performs work in the turbine steam path.

MOTOR CONTROLLER: A device or group of devices that governs, in some predetermined manner, the operation of the motor to which it is connected.

MOTOR GENERATOR SET: A machine that consists of a motor mechanically coupled to a generator and usually mounted on the same base.

NAVY BOILER COMPOUND: A powdered chemical mixture used in boiler water treatment to convert scale-forming salts into sludge.

NAVY DISTILLATE FUEL: Navy Distillate (ND) fuel is used in steam-powered ships of

the Navy. ND is a fuel of the middle to higher distillation range. Military specification MIL-F-24397 (ships), NATO Symbol F-76 covers the requirements for Navy Distillate Fuel.

NEEDLE VALVE: Type of valve with rod-shaped, needle-pointed valve body which works into a valve seat so shaped that the needle point fits into it and closes the passage. Suitable for precise control of flow.

NIGHT ORDER BOOK: A notebook containing standing and special instructions from the engineer officer to the night engineering officer of the watch.

NITROGEN: An inert gas which will not support life or combustion. Used in recoil systems and other spaces that require an inert atmosphere.

NOMINAL OPERATING PRESSURE: The approximate pressure at which an essentially constant-pressure system operates when performing its normal function. This pressure is used for the system basic pressure identification.

NONFERROUS METAL: Metals that are composed primarily of some element or elements other than iron.

NOZZLE: That portion of a turbine that converts heat energy of steam into a directed steam and sets the amount of steam flow.

NOZZLE AREA: Smallest opening (area) of a nozzle that is at right angles to the direction of steam flow.

NOZZLE-BLOCK: Turbine part that takes steam from the turbine chest and directs it into the first stage of the turbine.

NOZZLE DIAPHRAGM: A removable metal ring inserted in the casing between the stages of the turbine. This ring contains the nozzles by which steam flows from one stage to another.

OFFICER OF THE WATCH (OOW): Officer on duty in the engineering spaces.

OIL KING: A petty officer who receives, transfers, discharges, and tests fuel oil and maintains fuel oil records.

OIL POLLUTION ACTS: The Oil Pollution Act of 1924 (as amended), the Oil Pollution Act of 1961, and the Water Quality Improvement Act of 1970 prohibit the overboard discharge of oil or water that contains oil, in port, in any sea area within 12 miles of land, and in special prohibited zones.

OIL STRAINER: A strainer placed at the inlet end of the oil pump to prevent dirt and other particles from getting into moving parts.

ONE-LINE SCHEMATIC DIAGRAM: A drawing of a system using only one line to show the tie-in of various components; for example, the three conductors needed to transmit 3-phase power are represented by a single line.

OPERATING CHARACTERISTICS: The combination of a parameter and its setpoints. (See PARAMETER.)

OPERATING PRESSURE: The constant pressure at which a component is designed to operate in service.

OPERATING TEMPERATURE: The actual temperature of a component during operation.

OPERATION (AUTOMATIC): The regulation of a process by a controlling system without manual intervention.

OPERATION (LOCAL-MANUAL): Positioning of a final control element by attending personnel from an element's ManAuto control stations.

OPERATION (SEMI-AUTOMATIC): The regulation of a process in which the setpoint for one process operation is adjusted manually (for instance, at the boiler control station).

ORIFICE: A circular opening in a flow passage which acts as a flow restriction.

ORIFICE PLATE: A plate with an opening fitted between flanges in piping systems to reduce velocity and pressure in steam traps and steam supply to distilling plants.

OVERLOAD RELAY: An electrical protective device which automatically trips when a circuit draws excessive current.

OXIDATION: The process of various elements and compounds combining with oxygen. The corrosion of metals is generally a form of oxidation; rust on iron, for example, is iron oxide, or oxidation.

OXYGEN-FREE FEEDWATER: Water in which dissolved oxygen has been removed.

PANT, PANTING: A series of pulsations caused by minor, recurrent explosions in the firebox of a ship's boiler. Usually caused by a shortage of air.

PARALLEL CIRCUIT: An electrical circuit with two or more resistance units wired to permit current flow through both units at the same time. Unlike the series circuit, the current in the parallel circuit does not have to pass through one unit to reach the other.

PARALLEL OPERATION: Two or more units operating simultaneously and connected so their output forms a common supply, as opposed to series or independent operation.

PARAMETER: A variable such as temperature, pressure, flow rate, voltage, current, frequency, etc, which may be indicated, monitored, checked or sensed in any way during operation or testing.

PARTICULATE: Minute particles or quantities of matter resulting from incomplete combustion. Carbon, sulphur, ash, and various other compounds are all referred to as particulate, either collectively or individually, when discharged into a flue or into the atmosphere.

PERIPHERY: The curved line which forms the boundary of a circle (circumference), ellipse, or similar figure. Also, the outer bounds of

something as distinguished from the center or internal regions.

pH: A chemistry term that denotes the degree of acidity or alkalinity of a solution. The pH of water solution may have any value between 0 and 14. A solution with a pH of 7 is neutral. Above 7, it is alkaline. Below 7, it is acidic.

PILOT VALVE: A small valve disk and seat, usually located within a larger disk, which opens to reduce the steam pressure across, and therefore reduce the effort required to unseat, the main disk.

PINION: A gear that meshes with a larger mating gear.

PIPING: An assembly of pipe or tubing, valves, fittings, and related components that forms a whole or a part of a system for transferring fluids.

PIPING MAIN: The larger or primary piping, extending throughout the boundaries of a system to which components or subsystems are interconnected by smaller branch lines.

PITOMETER LOG: Device that indicates the speed of a ship and the distance traveled by measuring water pressure on a tube projected outside the ship's hull.

PLASTICITY: That property which enables a material to be excessively and permanently deformed without breaking.

PNEUMATIC: Driven, or operated, by air pressure.

PNEUMERCATOR: A type of manometer that measures the volume of liquid in tanks.

POSITIONER: That part of a control drive, loaded by a control signal, which supplies energy to an actuator in such manner that the final control element is positioned in accordance with the control signal.

POTENTIAL ENERGY: Energy at rest; stored energy.

POTABLE WATER: Water that is suitable for drinking. The potable water system supplies scuttlebutts, sinks, showers, sculleries, and galleys and provides makeup water for various freshwater cooling systems.

PPM (PARTS PER MILLION): Concentration of the number of parts of a substance dissolved in a million parts of another substance. Used to measure the salt content of water. If 1 pound of sea salt were dissolved in 1,000,000 pounds of water, the sea salt concentration would be 1.00 ppm.

PREHEATING: The application of heat to the base metal before it is welded or cut.

PRESSURE FEED SYSTEM: A system in which pressure (rather than gravity) is used to maintain flow.

PRESSURE RELIEF VALVE: A valve designed to open when pressure in the system exceeds a certain limit.

PRESSURE-TIME FUEL SYSTEM: A system in which fuel is injected into the cylinders at a specific pressure in separately timed events.

PRIMARY ELEMENT: That part of a measuring device that affects, or is affected by, the quantity being measured in order to produce a signal capable of being sensed by a transmitter or indicator.

PRIMARY SENSING ELEMENT: The control component that transforms energy from the controlled medium to produce a signal which is a function of the value of the controlled variable.

PRIME MOVER: The source of motion, such as a turbine, automobile engine, etc.

PRIMING: Unevaporated boiler water carried out of the steam drum with the steam. It is caused by malfunctioning steam drum internals, high water level, sudden steam demand, or rough weather.

PROPORTIONAL ACTION: A method of control in which departure from the setpoint of a controlled variable results in a proportional change of the setting of the final control element.

PROPORTIONAL BAND: The range of values of the directly controlled variable which corresponds to the full operating range of the final control element. The band is commonly expressed in units of the controlled variable or percentage of the controller scale range.

PROPULSION OR STEAM PLANT: The entire steam propulsion plant, consisting of two enginerooms and two firerooms.

PROTECTED COMPARTMENT: A compartment with a fixed (total flooding) carbon dioxide system installed.

PROTECTIVE FEATURE: A feature of a component or component part designed to protect a component or system from damage.

PULSATION: A rhythmical throbbing or vibrating.

PUMP: A device that raises, transfers, or compresses fluids or gases.

PUMP CAPACITY: The amount of fluid a pump can move in a given period of time, usually stated in gallons per minute (gpm).

PUMP RISER: The section of piping from the pump discharge valve to the piping main.

PUNCHING TUBES: Process for cleaning the interiors of boiler tubes.

PURPLE-K-POWDER (PKP): A purple powder composed of potassium bicarbonate that is used on class B fires. Can be used on class C fires; however, CO₂ is a better agent for such electrical fires because it leaves no residue.

QUILL SHAFT: A reduction gear shaft that connects the first reduction gear to the second reduction pinion.

RABBET: A machined joint that fits a protruding part of one joint into a groove in another joint.

RACE (BEARING): The inner or outer ring that provides a contact surface for the balls or rollers in a bearing.

RADIAL BEARINGS: Bearings designed to carry loads applied in a plane perpendicular to the axis of the shaft and used to prevent movement in a radial direction.

RADIAL THRUST BEARINGS: Bearings designed to carry a combination of radial and thrust loads. The loads are applied both radially and axially with a resultant angular component.

RADIATION: Transfer of heat in the form of waves similar to light and radio waves, without physical contact between the emitting and the receiving regions.

RADIATION, HEAT: Heat emitted in the form of heat waves.

RATE ACTION: That action of a control system component whose output is proportional to the rate of change in its input for slowly changing signals and proportional to the input for rapidly changing signals.

RAW WATER: City water used in lieu of saltwater.

REACH ROD: A length of pipe or back stock used as an extension on valve stems.

REACTION TURBINE: A turbine in which the major part of the driving force is received from the reactive force of steam as it leaves the blading.

RECEIVER INDICATORS: Pressure sensitive instruments indicating the loading pressure signals in percentage.

RECIRCULATION SYSTEM: The process of removing heat and moisture with cooled air by means of mechanical or natural distribution

ductwork. The process may include filtering, heating, and dehumidifying.

RECTIFIER: A device for converting alternating current into direct current.

RECTIFY: To make an alternating current flow in one direction only.

REDUCER: (1) Any coupling or fitting that connects a large opening to a smaller pipe or hose. (2) A device that reduces pressure in a fluid (gas or liquid) system.

REDUCING STATION: An assembly consisting of a reducing valve, isolation valves, and bypass valves for the reducer.

REDUCING VALVES: Automatic valves that provide a steady pressure lower than the supply pressure.

REDUCTION GEAR: A set of gears that transmit the rotation of one shaft to another at a slower speed.

REFRACTORY: Various types of heat-resistant material used to line the insides of boiler furnaces.

REGULATOR (gas): An instrument that controls the flow of gases from compressed gas cylinders.

RELATIVE HUMIDITY: The ratio of the weight of water vapor in a quantity of air to the weight of water vapor which that quantity of air would hold if saturated at the existing temperature. Usually expressed as a percentage; for example, if air is holding half the moisture it is capable of holding at the existing temperature, the RH is 50%.

RELAY: A magnetically operated switch that makes and breaks the flow of current in a circuit. Also called "cutout and circuit breaker."

RELAY SENDER: A control system component that provides a means for manually setting a signal.

REMOTE MANUAL OPERATION: Human operation of a process by manual manipulation of loading signals to the final control elements.

REMOTE OPERATING GEAR: Flexible cables attached to valve wheels so the valves can be operated from another compartment.

RESERVE FEEDWATER: Water stored in tanks for use in the boiler feedwater system as needed.

RESET ACTION: Action of a controller in which the final control element is moved at a speed proportional to the error until the controlled variable returns to the setpoint.

RESET RATE: The number of times that the effect of proportional action is repeated per minute; this is commonly expressed as "repeats per minute." In some instances, rest rate is expressed as "minutes per repeat," i.e., two repeats per minute equals 0.5 minutes per repeat.

RISER: A vertical pipe leading off a large one; for example fire main riser.

ROOT VALVE: A valve located where a branch line comes off the main line.

ROTARY SWITCH: An electrical switch that closes or opens the circuit by a rotating motion.

ROTOR: The rotating element of a motor, pump, or turbine.

SAE: Society of Automotive Engineers.

SAFETY VALVE: An automatic, quick opening and closing valve that has a reset pressure lower than the lift pressure.

SALINE/SALINITY: (1) Constituting, quick opening and closing valve that has a reset pressure lower than the lift pressure.

SALINOMETER: A hydrometer that measures the concentration of salt in a solution.

SATURATED AIR: Air that contains the maximum amount of moisture it can hold at a specified temperature.

SATURATED STEAM: Steam at the saturation temperature.

SATURATION PRESSURE: The pressure corresponding to the saturation temperature.

SATURATION TEMPERATURE: The temperature at which a liquid boils under a given pressure. For a given pressure there is a corresponding saturation temperature.

SAYBOLT VISCOMETER: An instrument that determines the fluidity or viscosity (resistance to flow) of an oil.

SCALE: Undesirable deposit, mostly calcium sulfate, which forms in the tubes of boilers.

SEAWATER: Seawater is an aqueous solution of various minerals and salts (chlorides). In suspension also, but not dissolved in the water, may be various types of vegetable and animal growths, including in many cases bacteria and organisms harmful or actually dangerous to health.

SECURE: (1) To make fast or safe. (2) The order given on completion of a drill or exercise. (3) The procedure followed with any piece of equipment that is to be shut down.

SEDIMENT: An accumulation of matter which settles to the bottom of a liquid.

SELECTOR SWITCH: Usually a rotary-type switch with more than two line connections. The selector switch permits the connection of a permanently connected handset to any other circuit selected—that is, wired in, by means of a jack outlet. In some stations, where only two circuits are involved, a double-throw toggle switch is sufficient.

SENSING POINT: The physical and/or functional point in a system at which a signal may be detected and monitored or may cause some automatic operation to result.

SENTINEL VALVE: A relief valve designed to emit an audible sound; does not have substantial pressure-relieving capacity.

SEQUENTIALLY: In a predesigned sequence, not necessarily in numerical order.

SERIES CIRCUIT: A circuit with two or more resistance units so wired that the current must pass through one unit before reaching the other.

SERIES-PARALLEL CIRCUIT: A circuit of three or more resistance units in which a series and a parallel circuit are combined.

SERVICE TANKS: Tanks in which fluids for use in the service systems are stored.

SETPOINT: The level or value at which a controlled variable is to be maintained.

SHAFT ALLEY: The long compartment of a ship in which the propeller shafts revolve.

SHAFT GLANDS AND PACKING: Used to minimize steam leakage from the turbine casing and/or the entrance of air into the turbine casing.

SHELL INSERT BEARING: A bearing in which the wearing surface is installed on a thin shell. This shell is removable from the bearing body.

SHORE WATER: A broad term for classifying water originating from a source ashore.

SHRINK: (In a boiler) A short-term decrease in drum water level which results from a change in the firing rate or steam flow without any corresponding change in the feeding rate. Since flow of water into the boiler must correspond to the outflow of steam, the feeding rate must be decreased when shrink occurs.

SIGNAL DEMAND: A signal, generated by one component in a control system, which enters a controller and requires that other components respond in order to maintain the system at the desired conditions.

SIGNAL FEEDBACK: In a control system, a signal feedback is the return to the input signal of a part of the output signal, which is either added to or subtracted from the input, to accomplish the purpose of the system.

SIGNAL, INPUT: A signal applied to a system or element.

SIGNAL, OUTPUT: A signal delivered by a system or element.

SIMPLE SKETCH: A simplified pictorial illustration of a system.

SKETCH: A rough drawing indicating major features of an object to be constructed.

SLIDING FEET: A mounting for turbines and boilers to allow for expansion and contraction.

SLUDGE: (1) The sediment in the lower portion of a secured boiler resulting from the settling of suspended solids in the boiler water. The sediment may include, besides the suspended solids, oil and other contaminants. (2) The sediment left in fuel oil tanks.

SOLID COUPLING: A device that joins two shafts rigidly.

SOOT BLOWER: A soot removal device using a steam jet to clean the firesides of a boiler.

SPECIAL FUNCTION: A unique service performed by a system usually above and beyond the intended design of the system. Special functions are usually provided by small modifications to a simple system as opposed to making a separate system to perform a single operation.

SPECIFIC GRAVITY: The relative weight of a given volume of a specific material as compared to the weight of an equal volume of water.

SPECIFIC HEAT: The amount of heat required to raise the temperature of 1 pound of

a substance 1 °F. All substances are compared to water which has a specific heat of 1 Btu/lb/°F.

SPEED-LIMITING GOVERNOR: A device for limiting the rotational speed of a prime mover.

SPEED-REGULATING GOVERNOR: A device that maintains a constant speed on a piece of machinery that is operating under varying load conditions.

SPLIT PLANT: A method of operating propulsion plants so that they are divided into two or more separate and complete units.

SPRING BEARINGS: Bearings positioned at varying intervals along a propulsion shaft to help keep it in alignment and to support its weight.

STANDING CASING: The half of a split casing that is bolted to the foundation, as opposed to the half, or cover, which can be removed with minimum disturbance to other elements of the equipment.

STANDARD PRINT: A standard drawing, schematic, or blueprint produced in the applicable technical manual, or other official technical publication.

STANDBY EQUIPMENT: Two identical auxiliaries that perform one function. When one auxiliary is running, the standby is so connected that it may be started if the first fails.

STATIC: A force exerted by reason of weight alone as related to bodies at rest or in balance.

STATIC FORCE: A balanced force characteristic of bodies at rest.

STATOR: The stationary element of a motor or generator.

STEAM: Vapor of water, invisible, odorless, tasteless, and expansive.

STEAM DRUM: The large tank in which the steam collects in the boiler.

STEAM DRUM PRESSURE: The actual steam pressure in the boiler steam drum.

STEAM LANCE: A device for using low-pressure steam inside boilers to remove soot and carbon from boiler tubes.

STEAMING WATCH: Watches stood when the main engines are in use and the ship is underway.

STEP-TOOTHED LABYRINTH: Labyrinth type packing having each alternate tooth ring installed on the shaft and running in close proximity to the fixed packing ring.

STEERING ENGINE: The machinery that turns the rudder.

STERN TUBE: A watertight enclosure for the propeller shaft.

STERN TUBE FLUSHING WATER: Water circulated through the stern tubes from inboard to prevent accumulation of debris in the stern tube while the ship is at rest or backing down.

STRAIN: The deformation, or change in shape, of a material which results from the weight of the applied load.

STRENGTH: The ability of material to resist strain.

STRESS: A force which produces, or tends to produce, deformation in a metal.

STRIPPING SYSTEM: A system provided to strip all oil tanks and service systems of water and sediment.

STUFFING BOX: A device to prevent fluid leakage between a moving and a fixed part in a steam engineering plant.

STUFFING TUBE: A packed tube that makes a watertight fitting for a cable or small pipe passing through a bulkhead.

SUMP: A container, compartment, or reservoir used as a drain or receptacle for fluids.

SUPERHEAT: Amount of heat applied to steam to raise its temperature above the saturation temperature, while maintaining constant pressure.

SUPERHEATED STEAM: Steam heated to a temperature above the saturated temperature of the given pressure.

SUPERHEATER: That part of the boiler specifically designed to raise the temperature of the steam to a predetermined figure above the saturation point for the design pressure of the boiler.

SUPERHEATER OUTLET PRESSURE: The actual steam pressure measured at the boiler superheater outlet.

SUPERHEAT TEMPERATURE: Temperature of steam heated above the saturated temperature of the given pressure.

SUPPLY AIR: Compressed air required for the proper operation of pneumatic control components.

SWASH PLATES: Metal plates in the lower part of the steam drum that prevent the surging of boiler water with the motion of the ship.

SWELL: A short-term increase in boiler drum water level which results from a change in the firing rate or steam flow without any corresponding change in the feeding rate. Since flow of water into the boiler must correspond to the outflow of steam, the feeding rate must be increased when swell occurs.

SWING CHECK VALVE: A valve having a guide-mounted disc swung from the top by a horizontal pin. A liquid exerting pressure against the disc will cause it to open, allowing a flow. Pressure exerted in the opposite direction will close the valve, ensuring only one direction of flow.

SWITCHBOARD: A panel or group of panels with automatic protective devices, used to distribute the electrical power throughout the ship.

SWITCHGEAR GROUP: Two or more switchboards in close proximity, mechanically independent but electrically connected, to form a designated unit.

SYNCHRO: An electromagnetic device for the transmission of mechanical motions to a remote location.

SYNTHRON SEAL: A rubber strip seal installed on the shaft to prevent seawater from leaking into the ship along the shaft.

SYSTEM: A grouping of components or equipment joined to serve a common purpose.

SYSTEM ALIGNMENT: The operation or adjustment of components within a system to route flow to a designated point.

SYSTEM DESIGN PRESSURE: The pressure used in the calculation of minimum section thickness of piping and piping components.

SYSTEM DESIGN TEMPERATURE: The temperature intended for all equipment in a system or subsystem.

SYSTEM INTERRELATION: Specific individual operations in one system affecting the operation in another system under normal conditions which are not fully described in emergency or casualty procedures or in the functional discussion of the system.

TAKE LEADS: A method of determining bearing clearance.

TANK TOP: Top side of tank section of double bottom of a ship.

TDC (top dead center): The position of a reciprocating piston at its uppermost point of travel.

TEFLON: A plastic with excellent self-lubricating properties.

TEMPERING: The heating and controlled cooling of a metal to produce the desired hardness.

THERMAL CYCLE: The cycle in which the water is formed into steam, back to water and back to steam again by the addition or removal of heat.

THERMAL ENERGY: Energy contained in, or derived from, heat.

THIEF SAMPLE: A sample of oil or water taken from a ship's tank for analysis.

THREE-ELEMENT FEEDWATER CONTROL: An automatic feedwater flow control system which senses steam flow, feedwater flow and drum water level, and acts to maintain boiler drum water level at a constant setpoint.

THROAT: Openings in the cylinder block through which the crankshaft ends are extended.

THROTTLEMAN: Man in the engineroom who operates the throttles to control the main engines.

THROTTLE VALVE: A type of valve especially designed to control rate of flow.

THROTTLING: Operating a valve partially open such as to produce a pressure drop with flow.

THRUST BEARINGS: Bearings that serve to limit the axial (longitudinal) movement of the rotor within the casing and to absorb the thrust imparted to the rotor by the steam.

TIE CUTOUT SWITCH: Normally closed, the tie cutout switch is opened to disconnect a tie line, usually under casualty conditions.

TIE LINES: The connection between the tie and the tie cutout switches.

TIE SWITCH: Connects two circuits when closed.

TOP OFF: To fill up, as a ship tops off, with fuel oil before leaving port.

TOUGHNESS: The property of a material which enables it to withstand shock as well as to be deformed without breaking.

TRANSFER SWITCH: (1) Used to transfer the connections of individual lines from one group of circuits to another group. Used primarily in fire control telephone circuits. (2) When used with a sound-powered telephone amplifier, the transfer switch selects a single line from two or more lines for amplification. Communications on the remaining lines continue at normal level of volume.

TRANSFER VALVE: Manually operated valve used to switch automatic control systems from automatic to manual operation and vice versa.

TRANSFORMER: An electrical device used to step up or step down an a.c. voltage.

TRANSMITTER: A device that produces an output signal proportional to the measured variable.

TUBE EXPANDER: A tool that expands replacement tubes into their seas in boiler drums and headers.

TURBINE: A multibladed rotor, driven by steam, hot gas, or water.

TURBINE AHEAD ELEMENT: Bladed section or turbine that provides torque or power to drive the ship ahead (fwd).

TURBINE ASTERN ELEMENT: Bladed section of turbine that provides torque or power to drive the ship aft (astern).

TURBINE CASING: Shell that houses blading and other internals.

TURBINE JACKING GEAR: A motor-driven gear arrangement that slowly rotates idle propulsion shafts and turbines.

TURBINE STAGE: The term applied to one set of nozzles and the succeeding row or rows of moving blades.

UNBURNABLE OIL: That quantity of oil below the stripping suction in storage tanks and below the service suction in service tanks.

UNSTABLE: That action of an automatic control system and controller process that is characterized by a continuous cycling of one or more system variables to a degree greater than a specified maximum.

UPTAKES (EXHAUST TRUNKS): Large enclosed passages for exhaust gases from boilers to the stacks.

VACUUM: Pressures lower than atmospheric; in steam plant, a mixture of very little air and low density steam.

VALVE: A mechanism that can be opened or closed to control or stop the flow of a liquid, gas, or vapor from one to another place.

VALVE SEAT: The surface, normally curved, against which the valve disc operating face comes to rest to provide a seal against leakage of liquid, gas or vapor.

VALVE SEAT INSERT: Metal ring inserted into valve seat; made of special metal that can withstand operating temperature satisfactorily.

VALVE SPRING: The compression-type spring that closes the valve when the valve-operating cam assumes the closed-valve position.

VANE: A thin plate that is affixed to a rotating unit either to throw off air or liquid or to receive the thrust imparted by moving air or liquid striking the vane. In the first case, it would be acting as a pump and, in the second case, as a turbine.

VAPOR: The gaseous state of a substance that is usually a liquid or solid at atmospheric temperature and pressure.

VELOCITY: Speed in a definite direction.

VENT: A valve in a tank or compartment used primarily to permit air to escape.

VENTILATION SYSTEM: The process of removing heat and stale air and providing fresh air by means of mechanical or natural distribution ductwork. The process may also include filtering and heating.

VENTURI: That part of a tube, channel, pipe, etc. tapered to form a smaller or constricted area. A liquid, or a gas, moving through this constricted area, will speed up and as it passes the narrowest point, a partial vacuum will be formed. The taper facing the flow of air is much steeper than the taper facing away from the flow of air.

VENTURI INJECTOR: A device used to wash the firesides of boilers.

VISCOSIMETER: A device that determines the viscosity of a given sample of oil. The oil is heated to a specific temperature and then allowed to flow through a set orifice. The length of time required for a certain amount to flow determines the oil's viscosity.

VITAL CIRCUITS: Electrical circuits that provide power or lighting to equipment and spaces necessary for propulsion, ship control, and communications.

VOID: A small empty compartment below decks.

VOLTAGE TESTER: A portable instrument that detects electricity.

WATCHSTATION: Duties, assignments or responsibilities that an individual or group of individuals may be called upon to carry out. Not necessarily a normally manned position with a "watchbill" assignment.

WATER DRUM: A tank at the bottom of a boiler, sometimes called MUD DRUM, that equalizes distribution of water to the generating tubes and collects loose scale and other solids in boiler water.

WATER JACKET: Internal passages and cavities cast into the cylinder block of engines or air compressors through which water is

circulated around and adjacent to friction (heat) areas.

WATER LEG: The water that condenses in a dead-end pressure gage line.

WATER TUBE BOILER: Boilers in which the water flows through the tubes where it is heated by the gases of combustion.

WATER WASHING: A method of cleaning the firesides of boilers to remove soot and carbon.

WIPED BEARINGS: A bearing in which the babbitt has melted because of excess heat.

WIRESWAYS: Passageways between decks and on the overheads of compartments that contain electric cables.

WORK REQUEST: Request issued to naval shipyard, tender, or repair ship for repairs.

WYE GATE: A fitting with two separately controlled hose fittings, designed to connect to an outlet.

ZERK FITTING: A small fitting to which a grease gun can be applied to force lubricating grease into bearings or moving parts of machinery.

ZERO SETTING: The output of a device when its input is minimum.

ZINC: A metal placed in saltwater systems to counteract the effects of electrolysis.

