

Manual of Petroleum Measurement Standards Chapter 1—Vocabulary

SECOND EDITION, JULY 1994

American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005



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Measurement Coordination

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FOREWORD

The definitions included in this document are derived from standards published as of December 31, 1992. New definitions or revised definitions as a result of standards developed and published after this date will appear in the next edition.

The definitions presented in this document support the petroleum industry's terminology requirements associated with the custody transfer, loss control, and environmental measurement activities addressed within API's *Manual of Petroleum Measurement Standards*. Some of the definitions will be specific to these applications and may conflict with usage of the terms in other contexts, while others may be applied more broadly.

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Suggested revisions are invited and should be submitted to Measurement Coordination, Industry Services Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

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Chapter 1—Vocabulary

1.0 Scope

The words and terms contained in this vocabulary are defined and described to assist in understanding their use throughout the entire *API Manual of Petroleum Measurement Standards* (MPMS).

Additional sections have been included that are based on the definitions found in the vocabulary. Useful facts and information not found elsewhere in the *API Manual of Petroleum Measurement Standards* are also included.

1.1 Vocabulary

A

Absolute temperature: (See temperature, absolute.)

Absolute viscosity: (See viscosity, absolute.)

Accessory equipment: Any device that enhances the utility of a measurement system, including readouts, registers, monitors, and liquid- or flow-conditioning equipment.

Accuracy: The ability of a measuring instrument to indicate values closely approximating the true value of the quantity measured.

Accuracy curve of a volume meter: A plot of meter factor or K factor or error as a function of flow rate used to evaluate the meter's performance.

Adjustment (of meter registration): The operation of bringing a measuring instrument (meter) into a satisfactory state of performance and accuracy.

Air (gas) vapor eliminator (separator): A device used to separate and remove gases (air, gas, or vapor) from a liquid to be measured to prevent an error in liquid measurement from having gas included in the measurement as liquid.

Air-jacketed thermometer: A glass stem thermometer totally encased in a glass sheath that provides air space between the thermometer and the liquid in which the unit is immersed.

All-levels sample: A sample obtained by submerging a stoppered beaker or bottle to a point as near as possible to the draw-off level, then opening the sampler and raising it at a rate such that it is approximately three-fourths full as it emerges from the liquid. An all-levels sample is not necessarily a representative sample because the tank volume may not be proportional to the depth and because the operator may not be able to raise the sampler at the variable rate required for proportional filling. The rate of filling is proportional to the square root of the depth of immersion.

Allowable: The amount of crude oil that can be taken from an oil field as set by regulation, having the effect of law.

Ambient conditions: The conditions (pressure, temperature, humidity, etc.) of the medium surrounding an object such as the case of a meter, instrument, transducer, etc.

Amplifier: A device for increasing the magnitude of a quantity such as an electrical measurement signal. An amplifier use includes increasing a transmitted or received measurement signal for purposes that include operation of indicating, counting, recording, and controlling devices or other instrument that receives the transmitted signal; (also see preamplifier).

Analog output: Transducer output that is a continuous function of the measurand.

Analog signal: A signal that varies continuously in amplitude rather than in discrete steps.

Anchor weight: A weight installed in a tank to which the guide wires or cables for an automatic tank gauge float are attached to hold them taut and plumb.

Angle-stem thermometer: A glass stem thermometer in which the tail is bent at an angle to the stem so that the tail can be mounted in a horizontally disposed thermowell, leaving the scale vertical for greater ease of reading.

API gravity: A term used by the petroleum industry to express the relative density of petroleum liquids (also see density, relative). API gravity is measured by a hydrometer instrument having a scale graduated in degrees API. The relationship between API gravity and relative density (formerly called specific gravity) is as follows:

$$\text{API Gravity at } 60^{\circ}\text{F} = \frac{141.5}{\text{Relative density } 60/60^{\circ}\text{F}} - 131.5$$

See 1.7 for the relationship between API gravity, relative density 60/60°F, and density at 15°C.

Apparent compressibility: (See compressibility, apparent.)

Argument, mathematic: The independent variable X for a function $F(X)$ and also the values of the independent variable in a numerical table, such as for angles in a table of trigonometric functions or the numbers in a table of logarithms; (also see function).

Armored case (thermometer): A sturdy metal case in which a glass stem thermometer can be placed in order to minimize the risk of breakage of the thermometer in use.

Atmosphere; abbreviated atm: A standard unit of pressure equivalent to a column of mercury 760 millimeters high at 0°C under a gravitational acceleration of 980.665 centimeter-gram-second (cgs) units. The pressure exerted by 101.325 kilopascals of 0°C (32°F) mercury (equivalent to 14.696 pounds per square inch absolute).

Atmospheric pressure: (See pressure, atmospheric.)

Automatic gauging tape: The flexible measuring or connecting element that is used to measure the liquid level in tanks by the automatic gauge method.

Automatic sampler: A device used to extract a representative sample from the liquid flowing in a pipe. The automatic sampler generally consists of a probe, a sample extractor, an associated controller, a flow measuring device, and a sample receiver.

Automatic sampling system: A system that consists of stream conditioning, an automatic sampler, and sample mixing and handling.

Automatic tank gauge: An instrument that automatically measures and displays liquid levels or ullages in one or more tanks either continuously, periodically, or on demand.

Automatic temperature compensator: A meter accessory device enabling a meter that is measuring volume at stream temperature to register the equivalent volume at a reference or base temperature.

Automatic vessel tank gauging system: A system that automatically measures and displays liquid levels or ullage in one or more vessel tanks on a continuous, periodic, or on-demand basis.

Auxiliary meter equipment: Equipment (such as a strainer, air separator, or flow conditioner) installed in conjunction with a meter to protect or improve the performance of the meter. Auxiliary equipment does not include instrumentation and accessories driven by the meter's output rotation or pulses.

B

Back pressure: The operating pressure level measured downstream from a measuring device.

Back pressure valve: (See valve, back pressure.)

Ballast: Water taken on when a vessel is empty or partially loaded to increase draft so that the propeller is properly submerged and stability and trim are maintained.

Barrel; abbreviated **bbl:** A unit of quantity for oil equal to 42 U.S. gallons or 9702.0 cubic inches.

Baseline: The fore and aft reference line at the upper surface of the flat plate keel at the centerline for flush shell plate vessels, or the thickness of the garboard strake above that level for vessels having lap seam shell plating.

Basic sediment and water; abbreviated **BS&W:** (Archaic, see sediment and water.)

Batch: A parcel of a single petroleum liquid consigned separately in a pipeline; (see tender and delivery, meter).

Battery or bank of meters: An installation of meters having two or more meters connected in parallel.

Bellows: A pressure sensing element of cylindrical shape whose walls contain deep convolutions that cause the length of the bellows to change when pressure is applied.

Bias: Any influence on a result that produces an incorrect approximation of the true value of the variable being measured. Bias is the result of a predictable systematic error.

Bi-directional meter: A meter that can measure flow from either direction.

Bilge radius: The radius of the rounded portion of the vessel's shell that connects the bottom to the sides.

Bill of lading; abbreviated **BOL:** A document by which a carrier acknowledges having received in good order and condition (or the reverse) certain specified goods consigned to him by some particular shipper and binds himself to deliver those goods in similar condition, unless the perils of the sea, fire, or enemies prevent him, to the consignees of the shippers at the point of destination on their paying him the stipulated freight.

Blind (blanking device): A circular metal disc that is installed in a pipeline by fastening it between flanges to prevent flow in the pipeline.

Boring sample: A sample of the material contained in a barrel, case, bag, or cake that is obtained from the chips created by boring holes into the material with a ship auger.

Bottom guide wire anchor: A bar welded to the bottom of a tank to which guide wires or cables for the float of an automatic tank gauge are attached.

Bottom sample: A spot sample collected from the material at the bottom of the tank, container, or line at its lowest point. In practice, the term has a variety of meanings. As a result, it is recommended that the specific sampling location [for example, 6 inches (15 centimeters) from the bottom] should be specified when using this term.

Bottom water sample: A spot sample of free water taken from beneath the petroleum contained in a ship or barge compartment or a storage tank.

Bourdon tube: A pressure sensing element consisting of a twisted or curved tube of non-circular cross section that tends to be straightened by the application of internal pressure.

Breadth, extreme: The maximum breadth of the hull measured to the outside surfaces of the side shell plating or to the outside of the guards, if fitted.

Bubble point: When the pressure is lowered on a liquid held at a constant temperature, the pressure at which the first bubble of vapor forms is the bubble point. Bubble point pressures are higher at high temperatures.

Bulb: The temperature sensing (detecting) element of a temperature measuring device.

Bulkhead: The vertical partition walls that subdivide the interior of a vessel into compartments or rooms.

C

Calibration (of a container): The process or procedure of determining the exact volume capacity or partial capacities of a standard capacity measure, a tank prover, or a pipe prover.

Calibration (of an instrument): The process or procedure of adjusting an instrument, such as a meter, so that its indication or registration is in satisfactorily close agreement with a reference standard. Meter proving data may be used either to calibrate the meter or to calculate a meter factor.

Calibration (of a prover): The procedure for determining the volume of a prover.

Calibration adjuster (meter): (See meter calibration adjuster.)

Calibration curve (meter): A curve or graph that expresses the relationship between the true values of the quantity measured and corresponding values indicated by the meter.

Calibration table (tank): (See capacity table.)

Calibration, tank: Bottom calibration of a tank is either:

- a. The determination of the tank volume below the strike plate, which is considered to be zero on the tank gauge table.
- b. The quantity of liquid contained in a tank below the gauge point.

The following terms are related to tank calibration:

Measurement calibration method, tank: The method of tank calibration in which volume capacities are calculated from external and/or internal measurements of the tank dimensions.

Liquid calibration, tank: The method of tank calibration in which the capacities are determined by filling into (or withdrawing from) the tank accurately determined volumes of liquid.

Over-calibration, tank: A tank is said to be over-calibrated when its actual capacity is less than that shown on its calibration table or by its capacity indicator.

Under-calibration, tank: A tank is said to be under-calibrated when its actual capacity is greater than that shown by its calibration table or capacity indicator.

Camber: The arching or rounding up transversely of the vessel's deck.

Capacitance probe: A device that senses the different dielectric constants of oil and water or oil and air.

Capacity: The volume of a container or tank filled to a specified level.

Capacity indicator (on a proving tank): A device fitted to a proving tank that indicates

the position of the liquid surface in relation to the reference mark corresponding to the nominal capacity of the proving tank, thus enabling the determination of its liquid contents.

Capacity, nominal (of a tank): The nominal capacity is the designated volume of a container.

Capacity table: A table often referred to as a tank capacity table or calibration table, showing the capacities of or volumes in a tank for various liquid levels measured from the reference gauge point.

Capsule: A pressure sensing element consisting of two metallic diaphragms (usually circular) that are joined around their peripheries.

Cargo quantity option certificate: A certificate signed by vessel and shore representatives acknowledging the amount of cargo intended to load. Generally, most product cargoes have a tolerance based on either supplier, receiver, or vessel capabilities. Each party involved with the loading shall agree to the quantity amount to be loaded.

Cavitation: The formation and collapse of vapor cavities (bubbles) in a liquid that result from a sudden decrease and increase of pressure. Collapse of the cavities causes large impulsive pressures in the vicinity of the cavity. Cavitation can occur and cause mechanical damage to adjacent surfaces in meters, valves, pumps, and pipes at locations where flowing liquid encounters a restriction or change in direction.

Check valve: (See valve, check.)

Choke: A device that is placed in a pipe to restrict flow.

Clearance sample: A spot sample taken with the inlet opening of the sampling apparatus 4 inches (10 centimeters) [some regulatory agencies require 6 inches (15 centimeters)] below the bottom of the tank outlet. This term is normally associated with small tanks (100 barrels or less), commonly referred to as lease tanks.

Clingage: The liquid film that adheres to the inside surface of a container after it has been emptied.

Closing gauge: The measurement in a tank after a delivery or receipt.

Coalescer: A device that is used to cause the separation and removal of one fluid from another, such as removal of water from a petroleum liquid.

Coefficient of expansion adjuster (meter): An accessory device for a meter that is used with an automatic temperature compensator. The coefficient of expansion adjuster regulates the magnitude of temperature compensation consistent with the coefficient of thermal expansion of the liquid being metered.

Commercial gauger: Commercial organizations and individuals who measure, gauge, or sample merchandise. "Public Gauger" has been used to denote a type of commercial gauger dealing mainly with petroleum and petroleum products. "Public gaugers" are commercial gaugers and are subject to the regulations in 19 *Code of Federal Regulations* Part 151.

Commercial laboratory: Commercial organizations and individuals who analyze merchandise, i.e., determine its composition and/or characteristics through laboratory analysis.

Compensation: Provision of a supplemental device, circuit, or special materials to counteract known sources of error.

Composite spot sample: A blend of spot samples mixed in proportion to the volumes of material from which the spot samples were obtained.

Compressibility (liquid): The change in volume per unit of volume of a liquid caused by a unit change in pressure at constant temperature.

Compressibility, apparent: The algebraic sum of the actual compressibility of a liquid and the volume change per unit of volume of the confining container caused by a unit change in pressure at constant temperature.

Compressibility factor: The ratio of the actual volume of gas at a given temperature and pressure to the volume of gas when calculated by the ideal gas law.

Condensate reservoir, automatic tank gauge: A device situated at the base of an automatic tank gauge to collect and drain off condensate from within the tape conduit.

Conductor, shielded: Single or multiple conductors surrounded by a flexible metal shield for the purpose of preventing spurious signals from being carried on the shielded conductors.

Contain: A standard capacity measure is calibrated "to contain" by a procedure that begins with the internal surfaces of the vessel dry and free of the calibrating liquid; (see deliver).

Continuous sample: A sample obtained from a pipeline in such a manner as to give a representative average of a moving stream. This sample may be collected on a continuous basis or intermittently and proportional to time or flow.

Control chart: A chart of successive meter factors (or relative meter errors) generally plotted as a function of time. It is used to evaluate meter stability and to determine when meter performance has departed from its normal range.

Conventional tank: A tank of a shape commonly used in the petroleum industry that is not constructed to withstand any appreciable pressure or vacuum in the vapor space.

Core sample: A spot sample of uniform cross sectional area taken at a given height in a tank.

Counter, factoring: An electronic counter (register) capable of expressing metered volume. The counter includes selective means for automatically applying the meter factor.

Counter, meter: A counting device, electrical or mechanical, coupled to the meter measuring element to register the indicated volume passed through the meter.

Counter-printer, computing: A counter-printer with selective means for setting the price per standard unit of measurement and to compute the total price for a quantity of product delivered.

Counterweight: A device that exerts force or tension on the tape or cable to hold connecting elements tight.

Course, tank: One circumferential ring of plates in a tank; (see storage tank).

Crude oil: A mixture of hydrocarbons that existed in liquid phase in underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities.

Crude oil truck driver; abbreviated COTD: Assumes the driver is also the gauger. However, it should be recognized that these duties may be separated between two individuals, such as a person who only drives the tank truck and a gauger who is responsible for measurement and testing.

Crude oil washing; abbreviated COW: (See washing, crude oil.)

Cup case thermometer: A holder for a mercury-in-glass thermometer incorporating a small metal container in which the bulb of the thermometer is inserted and that serves to take a small sample of the liquid.

Custody transfer measurement: Provides quantity and quality information used for the physical and fiscal documentation of a change in ownership and/or a change in responsibility for commodities.

D

Datum plate: A level metal plate located directly under the reference gauge point to provide a fixed contact surface from which liquid depth measurement can be made.

Dead legs: Sections of pipe that, by design, do not allow for the flow of material through them.

Deadrise: The transverse rise of the vessel's bottom from the keel to the bilge.

Deadwood: Any tank fitting, appurtenance, or structural member that affects the capacity of the tank. Deadwood is positive if it increases tank capacity or negative if it decreases capacity.

Degrees of freedom: The number of independent results used in estimating standard deviation.

Deliver: A standard capacity measure is calibrated "to deliver" by a procedure that begins with the internal surfaces of the vessel wetted with the calibrating liquid; (see contain).

Delivery: The volume delivered through a meter during a metering operation or upon completing fluid movement into or out of a tank. A "batch" or tender may also be called a delivery (see batch).

Delivery, meter: A volume of delivered liquid that is measured by a meter.

Delivery, over- or under-: The amount by which the true volume that has passed through the meter exceeds or is less than the indicated volume registered by a meter; (see error, absolute).

Density: The density of a quantity of a homogeneous substance is the ratio of its mass to its volume. The density varies as the temperature changes and is therefore generally expressed as the mass per unit of volume at a specified temperature.

Density, absolute: The density of a solid or liquid substance at a specified temperature is the mass of the substance occupying unit volume at the specified temperature. Density as so defined is sometimes referred to as "true density" or as "density in vacuo." When reporting density, the units of mass and volume used and the temperature of the determination must be stated (for example, grams per milliliter at $t^{\circ}\text{C}$).

Density, relative: The ratio of the mass of given volume of liquid at 15°C (or other standard temperature, such as 60°F) to the mass of an equal volume of pure water at the same temperature. When reporting results, explicitly state the standard reference temperature (for example, relative density $15/15^{\circ}\text{C}$).

Depth, molded: The vertical distance from the baseline to the underside of the deck plating at the side, measured at the mid-length of the vessel.

Detector, prover: A device that indicates the passage of a displacer in a prover; (also see transducer).

Detector signal: A contact closure change, or other signal, that starts or stops a prover counter/timer and defines the calibrated volume of the prover.

Deviation: Any departure from a reference value.

Dial: The part of an indicating device, such as a meter counter, that contains the scale or scales.

Dial indicator: A pointer and fixed number dial reading in calibrated increments.

Diaphragm: A sensing element consisting of a thin, usually circular, plate that is deformed by pressure applied across the plate.

Differential pressure: (See pressure, differential.)

Differential pressure valve: (See valve, differential pressure.)

Digit: A numerical character used to represent one of the integers smaller than the radix or base (for example, in decimal notation, one of the characters 0 to 9).

Digital: Numerical data existing in the form of digits.

Digital signal: A signal that varies in discrete steps rather than continuously.

Dimension: A geometric element in a design, such as length, angle, etc., or the magnitude of such a quantity.

Dip: A term that designates the depth of liquid in a storage tank; [see innage and outage (ullage)].

Dip hatch, tank: (See gauge hatch, tank.)

Dip point, tank: (See gauge point, tank.)

Dip rod, stick: (See gauge rod.)

Dip weight, bob: (See gauge weight, bob.)

Dipper sample: A sample obtained by placing a dipper or other collecting vessel in the path of a free-flowing stream to collect a definite volume from the full cross section of the stream at regular time intervals for a constant time rate or at time intervals varied in proportion to the flow rate.

Dipping reference point, tank: (See gauging reference point, tank.)

Discrimination: The ability to sense and record a value of a parameter to the specified increments.

Displacement meter: A meter in which the measuring element measures a volume of liquid by mechanically separating the liquid into discrete quantities of fixed volume and counting the quantities in volume units.

Displacer, prover: A spherical or cylindrical object that is a component part of a pipe prover that moves through the prover pipe. The displacer has an elastic seal that contacts the inner pipe wall of a prover to prevent leakage. The displacer is caused to move through the prover pipe by the flowing fluid and displaces a known measured volume of fluid between two fixed detecting devices.

Dissolved water: Water in solution in petroleum and petroleum products.

Draft: The depth of a vessel below the waterline measured from the surface of the water to the bottom of the vessel's keel.

Draft, extreme: The depth of the vessel below the waterline measured vertically from the waterline to the lowest projecting portion of the vessel.

Draft, molded: The depth of the vessel below the waterline measured vertically from the baseline to the waterline.

Draft marks: The vertical column of numbers on each side of the vessel at each end and sometimes amidships to indicate the distance from the lower edge of the number to the bottom of the keel.

Drain sample: A sample obtained from the draw-off or discharge valve on a storage tank. Occasionally, a drain sample may be the same as a bottom sample, as in the case of a tank car.

Drainage time for a capacity standard: A fixed time period for completing the draining of a field standard test measure that is calibrated on a “to deliver” basis, as described on the Report of Calibration by the calibrating agency.

Drift: An observed change, usually uncontrolled, in meter performance, meter factor, etc., that occurs over a period of time.

Dual meter counter shifter: An arrangement for connecting two (or more) meter counters to enable shifting the registration from one counter to another.

E

Electromechanical: Refers to equipment comprising both mechanical and electrical components such as electromechanical valves, electromechanical counters, etc.

Eliminator: An air, gas-vapor eliminator device used in a pipeline in conjunction with a meter to separate and remove air or vapor entrained in liquid to prevent its entry into the meter and erroneous measurement as liquid.

Emergent stem correction, thermometer: (See total immersion thermometer.)

Emulsion: An oil/water mixture that does not readily separate.

Entrained water: Water suspended in the oil. Entrained water includes emulsions but does not include dissolved water.

Environmental conditions: External conditions (such as, shock, vibration, and temperature) to which a meter, transducer, instrument, etc., may be exposed during shipping, storage, handling, and operation.

Environmental measurement: Identifies and quantifies releases into the environment by actual testing and modeling.

Equatorial circumference of a spherical tank: The circumference of the horizontal great circle at the equator of a spherical tank.

Equilibrium pressure (saturated vapor pressure): (See pressure, equilibrium.)

Equilibrium vapor pressure: (See pressure, equilibrium.)

Equivalent dip/innage (gauge), tank: The equivalent dip is the depth of liquid in a tank corresponding to a given ullage. It is obtained by subtracting the observed ullage from the height of the ullage reference point above the dip point on the bottom of the tank.

Error: Various terms related to error are as follows:

Error, absolute: The difference between the result of a measurement and the true value of the measured quantity as determined by means of a suitable standard device.

Error curve: A curve or graph that represents the error of a measuring device such as a pressure gauge as a function either of the quantity measured or of any other quantity that has an influence on the error.

Error, measurement: The discrepancy between the result of the measurement and the value of the quantity measured. The value of the quantity measured is a comparison value equal, according to the particular case, to the following:

- a. The true value of the quantity.
- b. The accepted true value.

c. The arithmetic mean of the results of a series measurements.

Error observation: The error committed by the observer when reading the indication of an instrument (meter), graduated scale, etc. It is sometimes called an experimental error.

Error, precision of measurement: The degree of conformity to each other of measurements repeated under specified conditions irrespective of whether they are close or far from the true value.

Error, random: An error that varies in an unpredictable manner in absolute value and in algebraic sign when a large number of measurements of the same value of a quantity are made under effectively identical conditions.

Notes:

1. It is not possible to take account of random error by the application of a correction to the uncorrected result of the measurement; it is only possible to fix limits within which, with a stated probability, this error will lie on completion of a series of measurements made under effectively identical conditions (using the same measuring instrument, with the same observer, and under the same environmental conditions, etc.).
2. The terms "dispersion error" and "statistical error" are also used.

Error, relative: The quotient of the absolute error divided by the true value of the measured quantity. This fraction multiplied by 100 gives the relative error as a percentage.

Error and repeatability of measurements: The closeness of the agreement between the results of successive measurements of the same quantity carried out by the same method, under the same environment, by the same observer, with the same measuring instruments, in the same laboratory, and at short intervals of time.

Error and reproducibility of measurements: The closeness of the agreement between the results of measurements of the same quantity where the individual measurements are made as follows:

- a. By different methods with different measuring instruments.
- b. By different observers in different laboratories.
- c. With the same instruments used under different conditions after intervals of time that are long compared with the duration of a single measurement.

Notes:

1. The term reproducibility is also used when only some of the factors listed above are different in the individual measurements; these factors should be specified in detail in each particular case.
2. Reproducibility of measurement is most frequently estimated on the basis of the uncertainty of measurement. Owing to the larger number of sources of random errors, this uncertainty is, in general, greater than for the repeatability of a measurement; reproducibility is therefore inferior to repeatability.
3. The results of individual measurements should be corrected for systematic errors.

Error, systematic: An error that, in the course of a number of measurements, made under the same conditions, and of the same value of a given quantity, either remains constant in absolute value and sign or varies according to a definite law when the conditions change. Thus, it causes a bias. (See notes that follow.)

Examples:

Constant systematic error: error that results from a weighing by means of a weight whose mass is taken to be equal to its nominal mass of 1 kilogram, whereas its true mass is 1.010 kilogram.

Error that results from using, at an ambient temperature of 20°C, a rule gauged at 0°C without introducing a suitable correction.

Error that results from the use of a thermoelectric thermometer whose circuit suffers from parasitic thermoelectric effects.

Variable systematic error: indication error of a measuring instrument arising from a systematic variation of temperature during a number of consecutive measurements of the same value.

Notes:

1. The causes of systematic errors can be known or unknown.
2. A systematic error that can be determined by calculation or by experiment should be eliminated by an appropriate correction.
3. Systematic errors that cannot be determined but whose values are considered to be small compared with the inaccuracy of measurement are treated as random errors when calculating the uncertainty of measurement.
4. Systematic errors that cannot be determined but whose values are considered to be sufficiently large compared with the inaccuracy of measurement should be valued approximately and taken into consideration when calculating the uncertainty of the measurement.

Excess flow valve: (See valve, excess flow.)

Expansion (expansibility) factor: A multiplying factor used to correct the calculated flow rate for the reduction in fluid density that a compressible fluid experiences when it passes through an orifice as a result of the increased fluid velocity and the decreased static pressure.

Expansion thermometer: A type of thermometer using a known third order coefficient of expansion of either a solid, a liquid, or a gas to provide indication in terms of degrees of temperature.

Expansion trunk (dome): A trunk extending above a space used for the storage of liquid cargo and providing space for the thermal expansion of the liquid without overflowing.

Externally actuated sampler: A device that is operated by a power source other than the fluid being sampled (for example, an electric or pneumatic motor).

Extrapolation: Any process by which the value of a function is estimated for a value of the independent variable outside of the range in which the function has been determined; (also see function, argument).

F

Feature: An individual characteristic of a part, such as screw-thread, taper, slot, etc.

Figure, numerical: An arithmetic value expressed by one or more digits.

Filling density: The percent ratio of the weight of the liquid in a tank to the weight of water that the tank will hold.

Filter: (See strainer.)

Filter, electrical: A circuit used to eliminate or reduce certain waves or frequencies while leaving others relatively unchanged.

Filter, separator: (See coalescer.)

Flange taps: The position of a pair of tapholes. The upstream tap center is located 1 inch (2.54 centimeters) upstream of the nearest plate face, and the downstream tap center is located 1 inch (2.54 centimeters) downstream of the nearest plate face.

Flash: The sudden vaporization of a liquid caused by rapid decrease in pressure and/or increase in temperature.

Flash point: The minimum temperature to which a product must be heated for the vapors emitted to ignite momentarily in the presence of a flame when operating under standardized conditions.

Flashing: The continuing process by which a liquid is caused to flash.

Float, automatic tank gauge: A liquid level detecting element floating at the liquid surface in a tank that moves in a vertical direction to follow the change in liquid level.

Float guide wires, automatic tank gauge: Solid wires or flexible cables used to

guide the travel of an automatic gauge float.

Float well, tank: An enclosure built into the roof of a floating-roof tank to contain and guide the float of an automatic tank gauge.

Floating cover: A lightweight covering of either metal or plastic material designed to float on the surface of the liquid in a tank. Alternatively, a floating cover may be supported by a float system so that it is just above the free-liquid surface. The device is used to minimize the evaporation of volatile products in a container.

Floating-roof sample: A spot sample taken just below the surface to determine the API gravity of the liquid on which the roof is floating.

Floating-roof tank: A tank in which the roof floats freely on the surface of the liquid contents except at low levels when the weight of the roof is transmitted by its supporting legs to the tank bottom.

Floating screen: A lightweight metal or plastic covering that is arranged to float on the surface of a liquid in a container to retard its evaporation.

Flotation level: The depth of submergence of a buoyant automatic gauge float in a liquid of known density or weight.

Flow meter discrimination: A measure of the smallest increment of change in the pulse output of a flow meter as it relates to the actual volume being measured.

Flow proportional sample: A sample taken from a pipe such that the rate of sampling is proportional, throughout the sampling period, to the flow rate of the liquid in the pipe.

Flow range: The range between the maximum and the minimum flow rates of a meter, generally determined by the limits of acceptable error; (see meter flow rate, maximum and minimum).

Flow rate: The quotient of a volume or mass of liquid passing a point in a line per unit of time.

Flow straightener: A length of straight pipe containing straightening vanes or the equivalent that is installed at the inlet of a flow meter to eliminate swirl from the liquid from entering the meter and causing measurement errors.

Fluid: Gas or liquid, or a mixture of gas and liquid.

Free water; abbreviated **FW:** The water that exists as a separate phase.

Frequency: The number of repetitions of a periodic process in a unit of time.

Frequency converter: An electronic instrument for converting frequency (pulse train) to a proportionate analog signal.

Frequency, electrical: The number of repetitions (cycles) of a periodic signal (for example, pulses, alternating voltage, current, etc.) occurring in a time period of one second. The number of repetitions (cycles) that occur in a one-second period is expressed as hertz (for example, 60 Hz).

Frequency output: An output in the form of frequency, which varies as a function of the applied measurand (for example, angular speed and flow rate).

Frequency range: The measured values over which a meter or other measuring instrument is intended to measure. The range is specified by its upper and lower limits.

Function, mathematic: A mathematical expression describing the relationship between variables. The function takes on a definite value or values when special values are assigned to certain other quantities, called the arguments, or independent variables of the function; (also see argument).

G

Gage: An alternate spelling of gauge.

Garboard: The strake or shell plating adjacent to the keel plate on a vessel.

Gas eliminator (separator): (See air eliminator.)

Gas lock (pressure), tank: A device fitted to the gauge hatch on a pressure tank that enables manual gauging and sampling without loss of vapor.

Gathering: The process of transferring the custody of crude oil or gas in the field from one party to another by performing various measurements and quality tests.

Gauge glass: A glass tube or metal housing with a glass window that is connected to a container to indicate the level of the liquid contents.

Gauge hatch, tank: The opening in the top of a container through which gauging and sampling operations are carried out [see dip (gauge) hatch].

Gauge head, automatic tank gauge: The housing of the automatic tank gauge that may include the indicator and transmitter.

Gauge point, tank: The point on the bottom of a container that the gauge weight touches during the gauging and from which the measurements of the oil and water depths are taken. The gauge point usually corresponds with the datum point; but, if not, the difference in level between the datum point and the gauge point must be designated in the capacity table.

Gauge pressure: (See pressure, gauge.)

Gauge rod, stick: A rigid length of wood or metal that is provided with a scale for measurement and usually graduated in units of volume.

Gauge tape: A graduated metal tape used for measuring the depth of liquid in a tank.

Gauge tester (automatic tank gauge): (See operation checker, automatic tank gauge.)

Gauge weight (bob): A weight (plumb bob) that is attached to a metal gauge tape and is of sufficient weight to keep the tape taut and of such shape as to facilitate the penetration of any sludge that might be present on the datum plate of a tank.

Gauging: A process of measuring the height of a liquid in a container.

Gauging (innaging, dipping, sounding): A process to determine the depth of liquid in a tank, which is measured from the surface of the liquid to the tank bottom or to a fixed datum plate.

Gauging (outaging, ullaging): A process to determine the volume of available space in a container unoccupied by contents. Hence, ullaging is a method of gauging the contents of a tank by measuring the distance from the surface of the liquid to the reference gauge point.

Grab: The volume of sample extracted from a pipeline by a single actuation of the sample extractor.

Grab sample: (a) Solid—A sample obtained by collecting equal quantities from parts or packages of a shipment of loose solids so that the sample is representative of the entire shipment. (b) Liquid—A sample collected at a specific location in a tank or from a flowing stream in a pipe at a specific time.

Graduate, laboratory: A glass measuring cylinder, usually graduated in milliliters.

Graduated neck (prover): The section of reduced cross-sectional area at the top and/or bot-

tom of a prover tank having visible graduations to enable measuring small incremental volumes.

Gravity compensator: A double index scale against which a fixed reference pointer may be moved to correct for variations in relative density from a base point computed for water at 60°F (15°C). The compensator is marked in both relative density and API gravity units.

Gravity selector, meter: (See coefficient of expansion adjuster, meter.)

Grease sample: A sample obtained by scooping or dipping a quantity of soft or semiliquid material from a package in a representative manner.

Great circle: The path on the surface of a sphere-type tank defined by the intersection of a plane surface that includes the center of the sphere.

Gross heating value: The number of kilojoules (BTU's) evolved by the complete combustion, at constant pressure, of one standard cubic meter (foot) of gas [the temperature of the gas, air, and products of combustion being at 60°F (15°C)] and all of the water formed by the combustion reaction being condensed to the liquid state.

Gross observed volume; abbreviated **GOV:** (See volume, gross observed.)

Gross standard volume; abbreviated **GSV:** (See volume, gross standard.)

Guards: Heavy round pipes running longitudinally and welded to the outside of the side shell plating of a vessel to act as fenders.

Guide pole: A device, usually in the form of a cylindrical vertical tube, used in floating-roof tanks to prevent rotation of the roof.

Gunwale: The intersection of the deck plating with the side shell plating of a vessel. A gunwale may be a tee connection or a radius connection.

H

Half siding: The flat, horizontal section of the bottom shell plating measured from the centerline of the vessel to the edge of the flat keel plate.

Hatch: An opening in the top of a tank providing access for gauging, cleaning, or other purposes.

Headlog (in river craft of a rectangular shape): The structural member at the extreme end between the rake shell plating and the deck.

High vapor pressure liquid: (See pressure.)

Hog: The distortion of a ship's form due to stresses in which the bow and stern drop below their normal positions relative to the midship portion of the vessel.

Homogenous: When a fluid composition is the same at all points.

Hysteresis: The difference between the indications of a measuring instrument when the same value of the quantity measured is reached by increasing or decreasing the quantity.

I

Identification inscriptions of a measuring instrument: All the words, letters, and marks carried by a measuring instrument indicating its origin, destination, operation, characteristics, method of use, etc.

Impact pressure: (See pressure, impact.)

Independent inspector: A person or organization of persons, acting independently of, but on behalf of, one or more parties involved in the transfer, storage, inventory, or analysis of a commodity or the calibration of land or marine vessels, for purposes of determining the quantity, capacity, and/or the quality of a commodity; (also see commercial gauger).

Independent surveyor: Often synonymous with “independent inspector” but usually implying a person or organization capable of total quantity and quality inspection, in addition to being capable of providing calibration of shore, truck, rail, and marine vessels; meter proving; and physical properties determinations.

Independent tank: A tank whose boundaries are not part of the hull structure of a barge.

Index: A fixed or movable part of a measuring instrument’s indicating device (such as, pointer, liquid surface, recording stylus, etc.) whose position with reference to the scale marks indicates the value of the measured quantity.

Indicated volume: (See volume, indicated.)

Indicating instrument: A measuring instrument in which the value of the measured quantity is visually indicated but is not recorded.

Inert gas: A gas that does not react with the surroundings.

Inerting: (a) The process of pressurizing the vapor space of a vessel with an inert gas blanket (usually exhaust gas) to prevent the formation of an explosive mixture; (b) a procedure used to reduce the oxygen content of a vessel’s cargo spaces to sufficiently low concentrations at which combustion cannot be sustained by contained gases or vapors. For inerting, nitrogen, carbon dioxide, or the ship’s exhaust are often used.

Innage: (See gauging, innage.)

Innage bob: [See gauge weight (bob).]

Input: A signal received by a device.

Integral hull tank: A tank whose boundaries are the bottom, side, deck, or bulkhead of the vessel hull.

Instrument, measuring: An instrument that serves to transform the quantity measured or a related quantity into an indication of equivalent information.

Integrating: Providing an output that is a time integral function of the measurand.

Interface: (a) The contact surface between two boundaries of liquids or the commingling of products adjacent to each other in a pipeline; (b) a means for coupling unlike equipment or functions so that they may communicate and work in unison.

Intermediate container: The vessel into which all or part of the sample from a primary container/receiver is transferred for transport, storage, or ease of handling.

Intermediate gears: A system of gears that transmits rotary motion.

Intermittent sample: A pipeline sample withdrawn by equal increments at a rate of less than one increment per minute.

International System of Units (SI): A coherent system of units of measurement founded on the following seven base units: the metre, unit of length; the kilogram, unit of mass; the second, unit of time; the ampere, unit of electric current; the kelvin, unit of thermodynamic temperature; the candela, unit of luminous intensity; and the mole, amount of substance.

Interpolation: A process by which an appropriate value is placed between tabulated values of a function.

Interpulse spacing: Variations in meter pulse width/space, normally expressed in percent.

Isentropic exponent: A thermodynamic state property that establishes the relationship between an expanding fluid's pressure and density as the fluid flows through an orifice plate bore.

Isokinetic sample: Sampling in such a manner that the linear velocity of the liquid through the opening of the sampling probe is equal to the linear velocity of the liquid in the pipeline at the sampling location and is in the same direction as the bulk of the liquid in the pipeline approaching the sampling probe.

L

Lagging edge: The positive-to-negative transition of an electric signal.

Laminar flow: A smooth flow of fluid in which no cross flow of fluid particles occurs between adjacent stream lines. The transition from smooth uniform laminar flow to turbulent flow generally occurs as the Reynolds number increases from about 2300 to 4000 or more.

Leading edge: The negative-to-positive transition of an electric signal.

Lease automatic custody transfer system; abbreviated LACT: An arrangement of equipment designed for the unattended custody transfer of liquid hydrocarbons from producing leases to the transporting carrier.

Length (of a tank barge): The distance measured on the centerline between the headlog plates at each end of a barge tank.

Length between perpendiculars: The distance on the summer load waterline from the fore side of the stern to the aft side of the rudder post or stern post. On vessels without a rudder or stern post, the length is measured to the centerline of the rudder stock.

Letter of protest (notice of apparent discrepancy): A letter issued by any participant in a custody transfer citing any condition with which issue is taken. This serves as a written record that a particular action or finding was questioned at the time of occurrence.

Line circulation: Petroleum or other liquid delivered through a pipeline system into a receiving vessel or tank to ensure that the section of pipeline from the source tank to the receiving tank is full in order to minimize the amount of air in the pipeline.

Line displacement: An operation to replace previous material in a pipeline.

Line drop: Opening (venting to atmosphere) a vessel's piping system so as to allow, to the extent possible, its drainage into a tank or tanks where the material may be gauged and accounted for.

Line press (pack): The recorded difference in a tank's gauges taken both while the tank's valve or valves are closed (off line) and while they are open (on line) into a closed system. All downstream valves of the line section to be pressed are open while the terminating valves remain closed. The term also refers to the act of performing this operation.

Linear meter range: The flow range over which the meter factor does not deviate from specified limits.

Linearity of a meter: The ideal accuracy curve of a volume meter is a straight line denoting a constant meter factor. Meter linearity is expressed as the total range of deviation of the accuracy curve from such a straight line between the minimum and maximum recommended flow rates.

Liquid: (See fluid.)

Liquefied petroleum gas (LP-gas); abbreviated LPG: Gas that is predominantly butane and propane separated from natural gasoline or natural gas and sold in liquid form as fuel—commonly known as bottled gas, tank gas, or LP-gas.

List (heel): (a) The leaning or inclination of a vessel, expressed in degrees port or degrees starboard; (b) the transverse deviation of a vessel from the upright position, expressed in degrees.

List correction: The correction applied to the volume or gauge observed in a vessel's tank when the vessel is listing, provided that liquid is in contact with all bulkheads in the tank. List correction may be accomplished by referring to the list correction tables for each of the vessel's tanks or by mathematical calculation.

Load on top; abbreviated **LOT:** Defined as both a procedure and a practice as follows:

Procedure: The shipboard procedure of collecting and settling water and oil mixtures resulting from ballasting and tank cleaning operations (usually in a special slop tank or tanks) and subsequently loading cargo on top of and pumping the mixture ashore at the discharge port.

Practice: The act of commingling onboard quantity with cargo being loaded.

Lock-in thermometer: A dial indicating temperature instrument having an automatic locking device for the indicator. This feature ensures that the indication cannot change until the reading has been taken and the instrument reset.

Loss control measurement: The systematic review and analysis of all measurements that provide for inventory control by establishing baseline measurements against which to judge loss control efforts.

Low vapor pressure liquid: (See pressure, low vapor pressure liquid.)

Lower sample: A spot sample from the mid-point of the lower one-third of the tank contents (a distance of five-sixths of the liquid depth below the top surface).

M

Mass: An absolute measure of a particular quantity of matter. Mass is defined in terms of a standard mass, and therefore the mass of an object is simply a multiple of the mass standard. The mass of an object remains constant regardless of its location. The metric unit of mass is the kilogram (kg).

Mass, apparent: The weight of an object in air, compared with a mass standard.

Mass standard: A precise standard whose volume, density, cubical coefficient of thermal expansion, and mass have been determined by the National Institute of Standards and Technology (NIST).

Mass standard, apparent: A precise standard whose density and apparent mass have been determined by a high-precision commercial laboratory, as compared with its primary standards. Apparent mass standards are calibrated by primary mass or primary apparent mass standards, which in turn have been certified by National Institute of Standards and Technology (NIST).

Master meter: A meter that is proved using a certified prover and then used to calibrate other provers or prove other meters.

Maximum loading gauge (stop gauge): The maximum permissible gauge measurement to which a rail tank car shall be loaded [according to Interstate Commerce Commission (ICC) regulations].

Measurand: A physical quantity, property, or condition that has been or is to be measured.

Note: The term measurand is preferred to input, parameter to be measured, physical phenomenon, stimulus, and variable.

Measured variable: The physical quantity, property, or condition that is to be measured. Common measured variables are temperature, pressure, rate of flow, thickness, velocity, etc.

Measurement: The following terms pertain to different categories of measurement:

Measurement, base unit of: A unit of measurement of one of the base quantities (see note).

Example: The metre is the base unit of length in the International System of Units. The derived units of this system, such as units of velocity, force, electric potential, etc., originate from the metre, together with other base units.

Note: The derived units of measurement in a system of measurement originate from the base units of measurement.

Measurement, reference conditions of: The temperature and pressure conditions to which a measured volume is to be corrected. The temperature to which the volume measurements are to be corrected is 60°F or 15°C. The reference pressure should be designated and can be atmospheric pressure, the absolute vapor pressure of the liquid being measured at 60°F or 15°C, or some other pressure that has been agreed upon by parties involved with the measurement.

Measurement, standard condition of: The standard pressure and temperature to which measurements should be referred. These are 1 bar (101.325 kPa)/cm² and 15°C for the SI metric system, and 14.73 lb/in.² and 60°F for the United States' and British systems.

Measurement, standard units of volume: The standard units of volume are the cubic metre, U.S. gallon and the British imperial gallon.

Measurement, system of units of: A set of base and derived units corresponding to a particular group of quantities.

Example: centimetre-gram-second (cgs) system, metre-kilogram-second-ampere (MKSA) system, International System of Units (SI).

Measurement, unit of: The value of a quantity conventionally accepted as having a numerical value of one. The unit of measurement of a quantity is fixed in order to make quantitative comparison possible between different values of this same quantity.

Measurement, unit symbol: A conventional sign designating the unit of measurement.

Examples:

m = symbol of metre
g = symbol of gram
A = symbol of ampere

Measuring chamber: The portion of a displacement meter that contains the measuring element.

Measuring element: (a) The portion of a displacement meter that moves within the measuring chamber so as to divide the liquid into measured segments as the liquid passes through the meter; (b) The rotating member of a turbine meter commonly referred to as the rotor.

Measuring range: The range of values of the quantity to be measured for which the indications of a measuring instrument, obtained under the normal conditions of use and in a single measurement, should not be affected by an error exceeding the maximum permissible error.

Merchantable oil: A term applied to liquid hydrocarbons that are judged to be acceptable for custody transfer to a carrier. The oil is settled and contains no more than a set amount of suspended sediment and water (S&W) and other impurities.

Meter flow: A device used to measure fluid volume under dynamic conditions.

Meter accuracy factor: When applied to volume meter proving results, this term means specifically the number obtained by dividing the volume registered by the meter by the actual proving volume. It is thus the reciprocal of the meter factor.

Meter bank: Fluid meters coupled in parallel, the sum of which represents the total fluid measured.

Meter calibration adjuster: A device to enable adjusting the meter register to indicate true volume within acceptable tolerance.

Meter case: The outer portion of a meter that encloses the measuring chamber and other working parts.

Meter characteristic: An expression of the relationship between the volume of a given liquid indicated by a meter register and the actual volume of that liquid that passed through the meter for the corresponding period.

Meter combinator (accumulator): A device or system for accumulating the registration of two or more meters in order that their total may be shown on a single readout device.

Meter factor: A dimensionless term obtained by dividing the gross standard volume of liquid passed through the meter (as measured by a prover during proving) by the corresponding meter indicated volume at standard conditions. For subsequent metering operations, the throughput or gross measured volume is determined by multiplying the indicated volume registered by the meter times the meter factor.

Meter flow rate, maximum: The maximum rate of flow recommended by the meter manufacturer or authorized by a regulatory body. The maximum rate is determined by considerations of accuracy, durability, pressure drop, repeatability, and linearity.

Meter flow rate, minimum: The minimum rate of flow recommended by the meter manufacturer or authorized by a regulatory body. The minimum rate is determined by considerations of accuracy, repeatability, and linearity.

Meter, nonrotating: Any metering device for which the meter pulse output is not derived from mechanical rotation as driven by the flowing stream.

Meter performance: A general expression for the relationship between the volume registered by a meter and the true volume that passed through the meter. The term may refer to meter error, meter factor, meter accuracy, etc.

Meter proof: (a) The multiple passes or round-trips of the displacer in a prover for purposes of determining a meter factor; (b) to establish a meter factor by comparing meter throughput to a prover of known volume.

Meter proving: The procedure required to determine the relationship between the volume of liquid passing through a meter at one set of conditions and the indicated volume at those same conditions.

Meter pulse continuity: The deviation of the interpulse period of a flow meter, expressed as a percentage of a full pulse period.

Meter readings: The instantaneous display of the number of units of volume or equivalent thereof, read directly from a meter register.

Meter slippage: (See slippage, meter.)

Meter tube: The straight sections of pipe, including all segments that are integral to the orifice plate holder, upstream and downstream of an orifice plate.