

The following definitions and abbreviations were compiled from the following organizations:

1. **American Petroleum Institute (API)**, 1220 L Street, NW, Washington, DC 20005-4070 *API Glossary of Oilfield Production Terminology (GOT)*, First Edition, January 1, 1988, and includes definitions as seen in **API RP 5C7 Recommended Practice for Coiled Tubing Operations in Oil and Gas Well Services**, First Edition, December, 1996.
2. **American Iron and Steel Institute**, 1000 16th Street NW, Washington, D.C. 20036.
3. **American National Standards Institute (ANSI)**, 1430 Broadway, New York, NY 10018.
4. **American Society for Nondestructive Testing (ASNT)**, 4153 Arlingate Plaza, P. O. Box 28518, Columbus, OH 43228-0518.
5. **American Society for Testing and Materials (ASTM)**, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
6. **American Welding Society (AWS)**, 550 NW LeJeune Road, Miami, FL 33126.

Abandon. To cease efforts to produce fluids from a well in a depleted formation and to plug the well without adversely affecting the environment.

Abnormal BHP. A reservoir is set to have an abnormal bottomhole pressure when its pressure is appreciably greater than that of a saltwater column which height is equivalent to the depth of the reservoir.

Abnormal Operating Condition. A condition which occurs in a process components when an operating variable ranges outside of its normal operating limits.

Absolute Pressure. Pressure measured from absolute zero pressure, ordinarily expressed as gauge pressure (the reading obtained from a pressure measuring instrument) plus atmospheric pressure, denoted in pounds per square inch absolute (psia) or kilopascal (kpa).

Absolute Volume. The volume per unit mass, reciprocal of absolute density.

Accumulator. A pressure vessel typically charged with nitrogen gas used to store hydraulic fluid under pressure for operation of pressure control equipment or other hydraulically operated equipment components.

Accumulator Precharge. An initial charge of gas (typically nitrogen) within an accumulator which is further compressed when the hydraulic fluid is pumped into the accumulator storing potential energy.

Acid. Any chemical compound containing hydrogen capable of being replaced by positive elements or radicals to form salts. In terms of the dissociation theory, it is a compound which, on dissociation in solution, yields excess hydrogen ions. Acids lower the pH.

Acid Brittleness. Brittleness induced in steel, when it is pickled in dilute acid. Commonly attributed to absorption of hydrogen.

Acidizing. A technique used in oil and gas wells to increase permeability immediately around the wellbore by injecting acid through the completion into the formation. Acidizing is also used to clean the walls of the borehole or the completion interval through circulation or injection of the low pH chemical.

Actuation Test. The closing and opening of a pressure sealing component or flow control device to assure mechanical functioning.

Adjustable Choke. A choke equipped with a variable aperture which is used to vary the rate of flow of liquids and/or gas, or to control the back pressure applied to the well, either through manual or automatic adjustment.

Aeration. The technique of injecting air or gas in varying amounts into a fluid for the purpose of reducing hydrostatic head.

Aerosol. Suspension of liquid or solid particles in air or gas.

Aggregate. An essentially inert material of mineral origin having a particle size predominantly greater than 10 mesh. Also a group of two or more individual particles held together by strong forces which are not subject to dispersion by normal mixing or handling.

Alkalinity. The combining power of a base measured by the maximum number of equivalents of an acid with which it can react to form a salt. In water analysis, it represents carbonates, bicarbonates, hydroxides, and occasionally the borates, silicates, and phosphates in the water. It is determined by titration with standard acid to certain datum points. Alkalines increase pH.

Anaerobic. Refers to microbial life or processes that occur in the absence of oxygen.

Anchor. A device for holding, fixing, or fastening an object which may tend to change its position (for example, deadline, wireline or derrick anchor). Also, an anchor may be a length of tubing extending below the working barrel in a pumping well such as a gas anchor or mud anchor.

Angle of Inclination. The angle in (degrees) taken at one or at several points of variation from the vertical revealed by a deviation survey. Sometimes called the inclination or angle of deviation.

Angle of Twist. The azimuth change through which a work string or drill stem must be turned to offset the twist caused by the reactive torque of a downhole motor.

Annealing. A process involving heating and cooling, usually applied to induce softening. The term also refers to treatments intended to alter mechanical or physical properties, produce a definite microstructure or to remove gases.

Annular Preventer. A large bag-type pressure isolation component, usually installed above the ram preventers, which forms a seal in the annular space between the drill pipe or tubing and the wellbore. Compression of a reinforced elastomer packing element by hydraulic pressure effects the seal. Some annular preventers are capable of creating a pressure seal, even if pipe or tubing is not present in the wellbore.

Annular Velocity. The average velocity of a fluid moving within the annulus.

Annulus. The space between the casing and the wall of the wellbore, between two strings of casing, between production tubing and casing or between coiled tubing and tubing or casing.

Anti-Foam. A substance used to prevent foam formation by greatly decreasing the surface tension within the fluid mixture.

API Gravity. The gravity (weight per unit volume) of crude oil or other related liquids as measured by a system recommended by the American Petroleum Institute. API Gravity is expressed in degrees, a specific gravity of 1.00 being equivalent to 10 API. API gravity is related to specific gravity (SG) by the following formula:

$$\text{API Gravity} = (141.5 / \text{Specific Gravity}) - 131.5$$

Apparent Viscosity. The viscosity a fluid appears to demonstrate on a given instrument at a stated rate of shear. It is a function of the plastic viscosity and yield point of the given fluid. The apparent viscosity in centiPoise (cP) as determined by the direct-indicating viscometer is equal to 1/2 of the 600 RPM reading. In a Newtonian fluid, the apparent viscosity is numerically equal to the plastic viscosity.

Approach. The number of degrees temperature difference between the hot fluid inlet and cold fluid outlet, or between the hot fluid outlet and cold fluid inlet, whichever is smaller.

Artificial Lift. Any means of lifting liquid from a wellbore that has ceased to flow due to inadequate reservoir energy. These methods include rod pumps, electric submersible pumps (ESP), gaslift, plunger pumps, and hydraulic jet pumps.

Atmospheric Pressure. The pressure exerted over the surface of the earth by the weight of the atmosphere. At sea level, this pressure is approximately 14.7 psia or 6.8 kpa.

Attapulgitic Clay. A colloidal, viscosity-building clay used principally in saltwater drilling fluids. Attapulgitic, a special fullers earth, is a hydrous magnesium, aluminum silicate.

Austenite. A solid solution of one or more elements in face-centered cubic iron.

Azimuth. Direction of a course measured in a clockwise direction from 0 through 360 degrees, with 0 degrees established as North.

Backoff. To unscrew one threaded piece within a connection (e.g. a section of pipe) from another.

Backoff Joint. The point where the drill pipe, casing, tubing, or rod segment connection is unscrewed above such a point at which it is stuck in the hole.

Back Pressure. The pressure retained in a pipeline, flowline, vessel, or reservoir resulting from restrictions of the outflow of gas or liquids.

Back Tension. The tension developed by the service reel drive system needed to bend the coiled tubing over the tubing guide arch and onto the service reel, maintaining control of the tubing.

Backup. The act of holding one section of tubing near a connection while a separate segment of tubing is screwed into or out of the connection. A backup wrench refers to any wrench being used to hold the pipe securely. Backup tongs are applied to the drill pipe or production tubing and are used to hold the section of pipe while another segment is screwed into through use of other tongs.

Backwashing. The process of cleaning a completion interval by injecting fluids into the formation and permitting the well to backflow.

Bail. To recover bottomhole fluids, samples or drill cuttings by lowering a cylindrical vessel, called a "bailer" to the bottom of the well, filling it, and retrieving it. Also refers to a link of steel attached to pipe elevators used for lifting.

Bailer. A long tubular vessel fitted with a bail at the upper end and a valve at its lower extremity. Bailers are used to remove water, oil and solids from a wellbore. When fitted with a plunger to which a line is attached, a bailer can draw materials into the vessel as it is lifted. This type of bailer is also called a sand pump.

Balance Point. Length of tubing within the wellbore where generates a tubing weight equal to the well pressure acting against the cross-sectional area of the tube. Note that this is a static

condition with the tubing full of fluid and does not include frictional forces of the stripper assembly and/or tubing rams, if engaged.

Ball Valve. A valve whose mechanism consists of a ball with a through-bore hole oriented along the same axis as the direction of fluid flow. Turning the plug 90 degrees opens or closes the valve. The valve may or may not be full-bore opening.

Banding. Layers of oxides or other inclusions inside the steel from which coiled tubing is manufactured.

Barite. Barium sulfate (BaSO_4), a mineral used to increase the weight of drilling fluids. Barite has an approximate specific gravity of 4.2.

Barrel. A common unit of liquid volume measurement in the petroleum industry. One barrel (bbl) is equivalent to 42 gallons (158.97 liters).

Basket Sub. A fishing accessory typically run above the bit to permit recovery of small amounts of metal or junk from the wellbore.

Bauschinger Effect. An effect wherein strain cycling of tubing causes a lowering of the yield strength of the material.

Bell Nipple. A flow-diverting nipple installed above the well control stack. The top end of the nipple is expanded (belled) to guide workstring tools into the hole and usually has side connections for attaching the fill line and the mud returns line.

Bellows. An expandable accordion-shaped device used to impart motion to a recording or controlling element within an instrument or to provide a flexible seal for pump shafts, etc. In gaslift technology, the bellows acts as the pressurized accumulator used to operate the valve.

Bending Cycle. The completion of two bending events whereby the axial strain returns to zero from a loaded condition. A cycle therefore consists of one bending event and one straightening event. The axial strain in coiled tubing is zero when the tubing is straight.

Bending Moment. The moment tending to bend the workstring or bottomhole assembly measured in Lb-ft or Newton-meters.

Bending Strength Ratio (Stiffness Ratio): Ratio of box to pin modulus. Used as a measure of how well "balanced" the mating pin and box rotary connections are in their ability to resist any bending moment.

Bent Sub. A sub used on top of a downhole motor to give a "non-straight" bottom assembly. One of the connecting threads is machined at an angle to the axis of the body of the sub.

Bentonite. A plastic, colloidal clay largely composed of the mineral sodium montmorillonite (a hydrated aluminum silicate) and having the property of swelling when hydrated in an aqueous solution. The generic term "bentonite" is neither an exact mineralogical name nor is the clay of definite mineralogical composition. Bentonite has a specific gravity ranging from 2.4 - 2.7.

Bit. The cutting or boring element used in drilling oil and gas wells. The bit consists of a cutting element and a circulating element. The cutting element may be steel teeth, tungsten carbide buttons, industrial diamonds or polycrystalline diamond compacts (PDCs).

Bit Breaker. A heavy plate which fits within the rotary table and holds the drill bit while it is being made up or broken out of the drill stem.

Blind Rams. The rams in a well control stack which are designed to seal against each other to effectively close the wellbore when there are no tools or tubing through the well control stack. The blind rams are not intended to seal against coiled tubing or any other tubular products.

Blowout. An uncontrolled flow of pressurized wellbore fluids and/or formation fluids out of the wellbore or into lower pressured subsurface zones (underground blowout).

Blowout Preventer. A heavy wellhead control device equipped with opposed rams or an annular device which may be closed around the workstring or completely close off the top of the well control stack if the workstring is withdrawn.

Bottomhole Assembly. An arrangement of downhole tools comprised of the bit, motor (if applicable), stabilizers, reamers, collars, subs, etc., which are installed at the bottom of the workstring or drillstring and used to perform milling or drilling operations.

Bottomhole Flowing Pressure. The flowing pressure at or near the bottom of the wellbore. The bottomhole flowing pressure is usually determined at the face of the producing formation by means of pressure-recording instruments which can be lowered into the well.

Bottomhole Pressure. The static pressure at or near the bottom of the wellbore. Bottomhole pressure (BHP) is usually determined at the face of the formation by means of pressure-recording instruments which can be lowered into the well. BHP may be calculated by adding the surface pressure to the wellbore fluid hydrostatic pressure if the density(s) of the fluid(s) is known.

Braking Systems. Mechanisms operating on the injector and service reel which prevent uncontrolled or undesirable movement of the coiled tubing string. These braking systems may be mechanically or hydraulically operated.

Bridge. An obstruction in the wellbore. A bridge may be formed by sloughing of the borehole into the wellbore or the accumulation of formation solids in sufficient volume to create physical blockage within the wellbore.

Bridge Plug. A downhole flow control device composed primarily of slips, block mandrel, and rubber-sealing element which is run and set into tubing or casing to isolate pressure and fluid in the lower portion of the wellbore.

Brittleness. The tendency of a material to fracture without appreciable deformation.

Buckling. A large deformation of the tube body resulting from a slight increase of an existing load under which the tube had previously exhibited little, if any, deformation before the load was increased. In unsupported tube lengths, the deflection of the lateral axis of the tube body can rapidly become large, resulting in catastrophic failure. In bounded environments where the tube is concentric to tubing or casing, the buckling can take a sinusoidal or helical form, depending upon the applied load and ratio of tubing (or casing) ID and concentric tube OD.

Buckup. To tighten up a threaded connection (such as two joints of tubing).

Build Angle. The act of increasing the inclination of the drilled hole. Also the rate of change represented in degrees per 100 feet (30 meters) of the increasing angle in the hole.

Build-And-Hold Borehole. A borehole configuration where the inclination is increased to some terminal angle of inclination and maintained at that angle to the specified target.

Buildup. The portion of the borehole in which the inclination angle is increased. The rate of buildup is usually expressed as the angular increase in degrees per 100 feet (30 meters) of measured depth.

Bullhead Squeeze. The process by which hydraulic pressure is applied to a well to force fluids such as acids or cement outside the wellbore. Annular flow (returns) is prevented by a packer set in the casing above the perforations and/or in open hole, or by sealing off the returns flow path at the surface.

Butt Welding. See Tube-to-Tube Welding.

Bypass. Usually refers to a plumbing connection around a valve or other flow control mechanism. A bypass is installed in such cases to permit passage of fluid through the diverting line when the maximum flow rate and/or pressure desired downstream is reached.

Caisson. A single-wellhead marine completion structure.

Calcium Carbonate (CaCO₃). An insoluble calcium salt sometimes used as a weighing material (limestone, oyster shell, etc.) in specialized drilling fluids. It is also used as a standard unit for expressing hardness of water.

Calcium Chloride (CaCl₂). A highly soluble salt which imparts special properties to drilling and completion fluids, but primarily for increasing the density of the fluid phase and/or accelerate the hydration reaction of cement and water.

Calibration. Comparison and adjustment of instruments, prior to use, to known basic reference points often traceable to the National Bureau of Standards. When calibrating instruments, often one of the reference points is "zero", thereby providing the means to establish the gain (slope) and the offset (y-intercept).

Caliper Logging. An operation used to determine the diameter of the wellbore or the internal diameter of casing, drill pipe or tubing. In the case of wellbore calipers, the logging operation is used to determine restrictions or enlargement in the wellbore. In the case of tubular goods, the caliper log indicates where internal corrosion or scale accumulation is prevalent.

Capping. The term referring to the method by which uncontrolled flow from a wellbore is halted or placed under control.

Casing. The steel pipe placed in an oil or gas well which prevents the wall of the borehole from caving in, restricts movement of the borehole fluids from one formation to another, and improves the efficiency of extracting petroleum in productive wells.

Casinghead. A heavy flanged steel fitting which is connected to the first string of casing set within the borehole. The casinghead provides a housing for slips and packing assemblies, provides suspension of intermediate and production casing, as well as a means to seal off the annulus.

Casing Point. The depth within a well at which the casing is set, generally the depth at which the casing shoe rests. Also, the objective depth in a drilling contract, either a specified depth or the depth at which a specific zone is to be penetrated.

Casing Pressure. The pressure in the annular space between two casing strings or the casing string and tubing string.

Casing String. The entire length of all joints of casing run into a wellbore.

Cellar. Excavation around the wellhead usually dug prior to drilling a deep well which provides space for items of equipment at the top of the wellbore. Also serves as a pit to collect drainage of water and other liquids.

Cement. A mixture of calcium aluminates and silicates made by combining lime and clay while heating. Slaked cement contains approximately 62.5% calcium hydroxide.

Cement Bond Log. A well log of the vibrations of an ultrasonic acoustical signal as it passes through a four-phase system of fluid, pipe, cement and formation. If the pipe is not acoustically coupled tightly with a dampening material such as cement, very little of the acoustical energy signal is lost. If the cement is bonded or acoustically coupled tight to the pipe, the energy is extremely dampened and the signal nearly disappears, thereby indicating that the casing is well cemented. The log may consist of (1) a collar log, (2) a transit time curve recording the time of the first arrival of the acoustical signal, (3) an amplitude curve which represents the amplitude of a selected portion of the acoustical wave, and (4) a display of the acoustical wave as x-y signatures or a variable density version of the signatures.

Cement Dump Bailer. A cylindrical container with a valve that is used to release small batches of cement downhole in a remedial cementing operation or for other special purposes.

Cement Plug. A portion of cement placed at some point in the wellbore to effect a seal used to isolate pressure or eliminate liquid movement.

Cementing (Conventional). The operation by which a cement slurry is pumped down a string of tubing and displaces the annular space to a predetermined height above the end of the cement string. In drilling and completion operations, cementing is used to secure the casing in place and isolate formations for control of fluids. In remedial operations cementing is used to seal holes in the wellbore for fluid control.

Cementing (Squeeze). The process of forcing cementing material under pressure into a specific portion of a well, such as fractures, openings, perforations or other permeable zones:

Hesitation-Squeeze Cementing - The process of forcing cementing material under pressure into the desired areas with a final pressure equal to or greater than the formation fracture pressure and with a final temperature equal to the bottomhole static temperature.

High Pressure Squeeze Cementing - The forcing of cement slurry into the desired position with a final pressure equal to or greater than the formation fracture pressure.

Low Pressure Squeeze Cementing - The forcing of cement slurry into the desired position with a pressure less than the formation fracture pressure.

CentiPoise (cP). A unit of viscosity equal to 0.01 Poise. A Poise equals 1 gram per meter-second, and a centiPoise equals 1 gram per centimeter-second.

Check Valve. A valve that allows flow through it in one direction only. This device (also called a one-way valve) is installed near the coiled tubing connector and allows fluid to be circulated down the string but prevents backflow. This device may be a ball-and-seat type or flapper type.

Chloride Stress Cracking. The stress corrosion cracking of ferrous-based alloy steels which may result when exposed to well streams containing water and chlorides under certain conditions of concentration and temperature. Other constituents present such as oxygen may contribute to chloride stress cracking.

Choke. A device with a fixed aperture used to control the rate of flow of liquids and/or gas, or to control the back pressure applied to the well.

Choke Line Valve. The valve(s) connected to the well control stack which controls the flow to the choke.

Christmas Tree. A term applied to the combination of valves and fittings assembled above the top of the tubing hanger spool on a completed well to contain well pressure and control the flow of hydrocarbons and other well effluents.

Circulation. The movement of fluid from the surface tank through the pump, coiled tubing, bottomhole assembly, annular space within the wellbore, and back to the surface tank.

Circulation Rate. The volume flow rate of the circulated fluid usually expressed in gallons per minute (gpm), barrels per minute (bpm) or cubic meters per minute (m³/m).

Clay. A term used for particles smaller than 4 microns regardless of mineral composition.

Closing Ratio. The ratio of the wellhead pressure to the hydraulic actuation pressure required to effect the closure of the well control component.

Coating. The process of covering a tube of a specific material with another material, primarily for corrosion resistance, but could also be applied for reduction of pipe/borehole-to-coiled tube friction.

Coefficient of Friction. The ratio of the force required to move one surface over another to the normal force between the two surfaces.

Coiled Tubing. Any continuously-milled tubular product manufactured in lengths which require spooling onto a take-up reel during the primary milling or manufacturing process. Conventional coiled tubing (CT) is constructed of carbon steel using the high-frequency induction welding process. Advanced metallic coiled tubing strings are constructed using corrosion resistant alloys or titanium, with the seam weld formed using the TIG process. Composite coiled tubing strings are constructed using specialized winding machines with continuous-length synthetic fibers fabricated within an epoxy or resin matrix.

Coiled Tubing Unit. The assembly of the major equipment components needed to perform a continuous-length tubing service. These basic equipment components include (as a minimum) an injector, service reel, control console, power supply, and well control stack assembly.

Cold Weld. A metallurgical inexact term generally indicating a lack of adequate weld bonding strength of the abutting edges, due to insufficient heat and/or pressure. A cold weld may or may not have separation in the weld line. Other, more definitive terms, should be used whenever possible to describe this condition.

Cold Working. Deforming a metal plastically at such a temperature and rate that substantial increases occur in the strength and hardness of the metal occurs. Visible structural changes include changes in grain shape and, in some instances, mechanical twinning or banding. The upper limit of temperature for this process is the recrystallization temperature of the material.

Collapse. Flattening of the coiled tubular product due to the application of an external pressure of such magnitude as to exceed the hoop yield stress of the tube. Collapse pressure is measured as the pressure differential of external to internal tube pressure and is significantly reduced when the tube is subjected to tension or bending.

Collar. A coupling device used to join two lengths of threaded pipe, tubing or tool components.

Collar Locator. A logging device that detects casing or tubing collars for depths correlation purposes. The collar locator may be operated mechanically or electrically to produce a log showing the location of each casing or tubing collar within the wellbore. When properly interpreted, this log provides an accurate means for depths measurements in a wellbore.

Colloidal Suspension. A stable, homogenous system of very fine particles of matter dispersed uniformly throughout a liquid medium, having properties which differ both from a true solution and from a suspension of larger particles. True colloidal suspensions have particle size range of 5 to 200 micrometers.

Completion String. A string of tubing placed within a productive well to serve as an exhaust or delivery duct for produced wellbore fluids.

Compressibility Factor. The factor which compensates for the deviation of a giving gas from the ideal gas law when calculating the pressure-volume-temperature relationship.

Compressive Yield Strength. The maximum stress a material can withstand without a predefined amount of permanent deformation when subjected to compression loading.

Concentric Operations. Well servicing operations conducted within the existing production tubing or within tubingless completions. This type of operation is normally performed with the christmas tree in place using a coiled tubing unit, hydraulic workover unit, wireline unit, hoisting unit, or small rig using smaller diameter jointed tubing.

Conductor Casing. Generally, the first string of casing in a wellbore. Its purpose is to prevent soft formations near the surface from caving in and to conduct drilling mud from the bottom of the hole to the surface when drilling commences. Also called conductor pipe and drive pipe.

Connectors (CT). Devices used to connect coiled tubing and equipment components. There are several types of connectors in use as described below:

Dimple Type - Connection which is secured onto the coiled tubing body through the use of numerous blunt-tip screws loaded into dimpled recesses formed in the tube body. As the mechanical blunt-tip screws are loaded onto the tube body, forces exceeding the material yield strength of the tube create "dimples" in the tube body. These dimples serve as mechanical loading recesses for the blunt-tip screws which secure the connection to the CT body.

Roll-On Type - Connection which incorporates a machined insert mandrel designed to fit inside the CT. The mandrel is machined with circular recesses or "furrows" which serve as the force loading shoulders for the connection. The connector is secured to the CT body by means of mechanically yielding the tube into machined groove recesses on the mandrel.

Slip Type - Connection which requires the use of a slip or grapple-type load ferrule placed on the OD of the tube body. The load ferrule is typically constructed with sharp "spiraled" teeth which secure the ferrule onto the CT body. The load ferrule is mechanically wedged onto the coiled tubing OD during connection make-up.

Thread Type - Connection which is secured onto the CT with threads. This connection requires that the end of the CT be threaded to mate with the connector threads.

Weld Type - Connection secured to the CT through welding. This connection may be a Figure 1502 union used to connect the CT string to the service reel fluid manifold, or a threaded union located on the outboard end of the tubing string for use in installing downhole tools.

Continuously-Milled Tubing. Carbon steel coiled tubular products manufactured using high frequency induction welding processes in milled length segments greater than 500 feet.

Continuously Tapered Skelp. Skelp material having a variable wall thickness. This skelp is milled having a specified wall thickness at the lead end of the steel strip, progressively increasing in wall thickness along the length of the strip to a second specified wall thickness at the tail end of the skelp strip.

Control Console. An enclosure displaying an array of switches, push buttons, lights, valves, various pressure gauges, and/or meters to control or monitor coiled tubing operating functions.

Conventional Operations. Well operations conducted using a rig equipped with fluid pumps, rotary table, and other equipment designed to perform well workovers, recompletions, and other work which requires removal of the christmas tree and pulling or manipulation of the tubing.

Corrosion. Gradual chemical or electro-chemical attack on a metal by the atmosphere, moisture or other agents.

Crack. A stress-induced separation of the metal which, without any other influence, is insufficient in extent to cause complete rupture of the material.

Creep. Time-dependent increase in strain during a state of constant stress.

Critical Flow. The rate of a compressible fluid flow through an orifice or small opening in which the velocity of the fluid reaches a maximum and remains constant. The rate of the fluid flow is directly proportional to upstream pressure and changes only with upstream pressure. Changes in downstream pressure have a negligible effect on flow rate when critical velocity is obtained.

Crossover Flange. A double or single studded adapter flange with a restricted area sealing means and with a top connection pressure rating above that of the lower connection.

Crowd the Bit. Term used to indicate that more weight is applied to the bit than is needed for efficient drilling. A crowded bit will usually increase the inclination or cause an azimuth change.

Crown Block Assembly. The stationary sheave or block assembly mounted at the top of the derrick or mast and over which the drilling line is reeved.

Crude Oil. A mixture of hydrocarbons that exists in the liquid phase in the underground reservoir and remains liquid at atmospheric pressure after passing through surface separating facilities.

Crystallization. The formation of a crystal by the atoms assuming definite positions in the crystal lattice.

Cumulative Fatigue Damage. The total of fatigue damage caused by repeated cyclic stresses.

Darcy. A unit of permeability. A porous medium has a permeability of 1 Darcy when a pressure of one (1) atmosphere is applied to force a liquid of one (1) cP viscosity through a sample one (1) cm long and one (1) cm² in cross section at a rate of one (1) cm³ per second.

Darcy's Law. The rate of flow of a homogenous fluid through a porous medium is proportional to the pressure or hydraulic gradient and to the cross-sectional area normal to the direction of fluid and inversely proportional to the viscosity of the fluid.

Dead Oil. Crude containing essentially no dissolved gas when it is produced.

Dead Well. A well that has ceased to produce oil or gas either temporarily or permanently. Ultimately, a well that has suffered a kick or a blowout and has been killed.

Defect. An imperfection whose size, shape, orientation, location or other properties make it detrimental to the useful service of the tube or exceed the accept/reject level of the applicable specification.

Density (Absolute). Mass per unit volume. Absolute density considers only the actual volume occupied by the material expressed in pounds per gallon (ppg) or pounds per cubic foot (lb/cu.ft.). The typical SI expression for density is in kilograms per cubic meter (kg/m³). Absolute density is also commonly referred to as "weight".

Density (Bulk). Mass per unit volume. Bulk density is a mass per unit bulk volume which includes the actual volume of the material plus the volume of trapped air.

Dent. A local change in surface contour caused by a mechanical impact, but not accompanied by the loss of metal.

Departure. Horizontal displacement of one station from another in an east or west direction.

Derrick. A large load-bearing structure, usually of bolted construction. This semi-permanent structure of square or rectangular cross-section having members that are latticed or trussed on all four sides must be assembled in the vertical or operation position as it includes no erection mechanism, this derrick may or may not be guyed.

Design Load. That force or combination of forces which a structure or mechanical component is designed to withstand without exceeding the allowable stress within any member.

Design Pressure. Maximum allowable working pressure at the design temperature and operating conditions.

Design Verification. The process of proving design by testing.

Designated Representative. Individual selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.

Development Well. A well drilled in proven territory in a field for the purpose of completing the desired spacing pattern for production optimization.

Deviation Bit. A bit specifically designed to reduce the tendency to drill a crooked hole.

Deviation Control Techniques. The techniques typically used to control the deviation of the borehole when performing steered-drilling operations are shown below:

Fulcrum - Utilizes the bending moment principle to create a force on the bit which counteracts the reaction forces which tend to push the bit in a given direction.

Mechanical - Utilizes bottomhole orienting equipment which is not normally part of the conventional drill string to aid deviation control. This equipment acts to force the bit to turn the borehole in inclination.

Packed-Hole - Utilizes the hole wall to minimize bending of the bottomhole assembly.

Pendulum - The basic principle involved is gravity or the "plumb-bob effect".

Diameter Tape. A measuring device consisting of a thin flexible metallic tape which can be wrapped around the circumference of a pipe, and is graduated such that diameter can be read directly from its scale. Also called a "Pi Tape".

Diametral Growth. The increase in the outer diameter of the tube which occurs as a consequence of performing repeated bend cycles of the tube with an internal pressure greater than the external pressure acting on the tube.

Differential Pressure. The difference between two fluid pressures. This difference in pressure may be between points in a fluid pumping system, may represent the loss in pressure within the fluid when pumped through a specific length of tubing, or when fluid flows between two systems (e.g., the difference between the pressure in a reservoir and the pressure in a wellbore).

Diluent. Liquid which is added to dilute or thin a solution.

Direction. See azimuth. Direction of vertical projection of the wellbore onto a horizontal plane.

Direction of Inclination. The direction of the course.

Directional Drilling. The planned drilling of an off-vertical wellbore at a controlled, pre-determined angle and direction using special equipment and orienting devices.

Discontinuity. Any interruption in the normal physical structure or configuration of a tube such as cracks, laps, seams, pits and laminations. A discontinuity may or may not affect the usefulness of a pipe or exceed critical flaw size. Also called a flaw or imperfection.

Discovery Well. An well that encounters a new and previously untapped petroleum deposit.

Dispersant. A chemical agent used to break up or disperse concentrations of various liquid or solid materials.

Displacement. The lateral distance from the surface location to the primary target.

Distillate. The condensed hydrocarbons which are produced with gas from a single or two-phase reservoir. Condensation occurs as pressure is reduced below specific critical pressures.

Diverter. A device attached to the wellhead or marine riser to close the vertical access and direct any flow into a line away from the rig. Diversers differ from blowout preventers in that flow is not stopped, but rather the flow path is redirected away from the rig.

Dog Leg. The total curvature in the wellbore consisting of a change of inclination and/or direction between two points.

Dog Leg Severity. A measure of the amount of change in the inclination and/or direction of a borehole, usually expressed in degrees per 100 feet (30 meters) of course length.

Dolomite. A type of sedimentary rock similar to limestone but rich in magnesium carbonate. Sometimes dolomite is found as the reservoir rock for petroleum-bearing zones.

Dope. A viscous material used on casing or tubing threads as a lubricant and to prevent corrosion.

Double-Wall Drill Pipe. A two-tube concentric drill pipe assembled with the inner pipe in compression and the outer pipe in tension. Used to replace drill collars in directional holes.

Downhole Motor. A power source located just above the bit which is used to rotate the bit while the drill string remains fixed.

Drag. The algebraic sum of the resistance due to (1) the friction between the coiled tubing and the well control equipment, (2) the friction between the coiled tubing and the wall of the

wellbore, (3) the friction due to the coiled tubing passing through fluid, and (4) the friction due to the flow of fluids either inside or outside of the coiled tubing.

Drawdown. The differential pressure in a constant-rate producing well between the static (shut-in) bottomhole pressure and the flowing bottomhole pressure. The location of this pressure condition is generally found within the wellbore directly across the completion interval.

Drawworks. The hoisting mechanism on a drilling rig which is essentially comprised of a large winch which spools off or takes in the drilling line. This action raises or lowers the drillstem and bit.

Drill. To bore a hole within the earth, usually to find and remove subsurface formation fluids such as oil and gas.

Drill Collar. A heavy, thick-walled tube, usually constructed of steel, placed between the drill pipe and the bit in the drill stem which provides stiffness and concentration of weight at the bit.

Drill Collar Sub. A sub made up between the drill string and the drill collars that is used to ensure that the drill pipe and the collar may be joined together properly.

Drill Pipe. The tubular member of the drill string which transmits power to the bit to which tool joints are attached.

Drill Stem. The entire drilling assembly, from the swivel to the bit, composed of the kelly, drill string, subs, drill collars, and other downhole tools such as stabilizers and reamers. This assembly is used to rotate the bit and carry the drilling fluid to the bit.

Drill Stem Test. The conventional method of formation testing. The basic drill stem test tool consists of a packer or packers, valves or ports that may be opened or closed from the surface, and two or more pressure-recording devices.

Drilling Fluid. A fluid circulated through the bit which serves to carry cuttings from the bit to the surface. Hole conditions may dictate other necessary functions for this fluid, such as cooling the bit and to counteract downhole formation pressure. The most common drilling fluid is a mixture of clay and other minerals with water, but can also be air, gas, water or foam systems.

Drop-Off Rate. The rate of change of the inclination in the part of the wellbore where the inclination angle is purposely returned to the vertical orientation and usually expressed in degrees per 100 feet (30 meters) of course length.

Dry Gas. Natural gas that is produced without liquid hydrocarbons. Also gas that has been dehydrated to remove water.

Ductility. The property that permits permanent deformation before fracture by stress in tension occurs.

Dynamic Loading. Loads introduced into any mechanical component which is required to operate in the presence of accelerating or decelerating forces. Dynamic loading can be experienced in the tubing string, tube handling equipment, or in any component which may experience rapid force loading or unloading.

Dynamic Positioning. A method by which a floating vessel is maintained in position (on station) over an offshore well location without the use of mooring anchors. Generally, several propulsion units called thrusters are located on the hulls of these structures and are actuated by a sensing system which is directed by computer.

Dynamic Stress. Varying or fluctuating stress occurring in a structural member as a result of dynamic loading.

Eccentricity (Tube Mill). A condition of tubing geometry in which the OD and ID axes are not coincident, resulting in wall thickness variation around the circumference at a given section plane.

Eccentricity (Fluid Flow). The degree to which a concentric tubing string is decentralized within an annulus with consideration for calculating the effects of frictional pressure loss. An eccentricity value of 0.0 indicates perfectly centralized tubing within the annulus. An eccentricity value of 1.0 indicates perfectly decentralized tubing within the annulus.

Eddy Current. A circulating current caused to flow in the tubing by varying magnetic fields.

Eddy Current Inspection. Performing a nondestructive inspection using the eddy current method.

Effective Permeability. The permeability of a rock to a specified fluid when the rock is not 100 percent saturated with the fluid.

Effective Porosity. The percentage of the bulk volume of a rock sample that is composed of interconnected pore spaces, allowing the passage of fluids through the sample.

Effective Size. A term used in specifying sand size. It is the sieve size in millimeters that permits 10 percent (by weight) of the filter sand to pass.

Effective Thread Length. Connector threads having fully-formed roots but not necessarily finished crests.

Elastic Aftereffect. A slight contraction that occurs slowly while metal is standing with no load, subsequent to plastic tensile flow and immediate elastic recovery. Microscopic stresses acting in compression are responsible for this condition as well as for the Bauschinger effect.

Elastic Buckling Stress. The buckling stress of a cylinder based upon elastic behavior.

Elastic Deformation. Temporary changes in tube dimensions caused by stress. The material returns to the original dimensions after removal of the stress.

Elastic Hysteresis. Energy absorbed by reversed deformation, represented by the closed loop of stress-strain curves in the elastic range, formed by curves for loading and unloading.

Elastic Limits. The maximum stress which a material is capable of sustaining without any measurable permanent extension remaining after complete release of the applied force.

Elastomer. Any of the class of materials, including natural rubber and synthetic compounds, which return to their original shape after being subjected to large deformations.

Electric Logging. An instrument measurement of resistivity and self-potential of formations immediately adjacent to the wellbore. These measurements are obtained by passing electrodes across the formations of interest within the wellbore. Electric logs are typically run on wireline to obtain information concerning the porosity, permeability, fluid content of the formations drilled, etc. Data is then transmitted up the wireline conductors which is recorded at surface.

Elevation. Measurement of a well location or a plane on a drilling well above a specified datum, usually sea level.

Elevators. Mechanical device attached to the traveling block which latches around and supports the pipe during hoisting or lowering operations.

Elongation. The amount of permanent extension in the vicinity of the fracture in a tension test specimen, with the increase in length expressed as a percentage of the original gage length.

Emulsion. A substantially permanent heterogeneous mixture of two or more liquids which do not dissolve in each other but are held in suspension or dispersion (one in the other) by mechanical agitation or, more frequently, by adding small amounts of substances known as emulsifiers. Emulsions may be mechanical, chemical or a combination of the two (commonly oil and water).

Encircling Coil. A coil surrounding the tube under test, used in eddy current testing.

Endurance Limit. The maximum stress that a metal will withstand without failure during a specified large number of cycles of stress. If the term is employed without qualification, the cycles of stress are usually such as to produce complete reversal of flexural stress.

Endurance Ratio. The ratio of the endurance limit for cycles of reversed flexural stress to the tensile strength.

Entrained Gas. Gas suspended in bubbles in a stream of liquid such as water or oil.

Entrained Liquids. Mist-size liquid droplets transported in a gas stream.

Equivalent Circulating Density. For a circulating fluid, the equivalent circulating density in lbs/gallon is equal to the hydrostatic head of the annular fluid (psig) plus the total annular frictional pressure loss (in psig) caused by the fluids circulating in the annulus, divided by the depth (feet) and a conversion factor of 0.052.

Erosion. The abrasion of metal or other material by liquid or gas usually accelerated by pressure of solid particles of matter in suspension and sometimes by corrosion.

Evaluation. Process of determining the severity of the flaw which leads to determining whether the tube is acceptable or rejectable under the appropriate specification.

Excessive Reinforcement. Also referred to as excessive over-fill. The outside weld beads which extend above the prolongation of the original surface of the tube.

Exfoliation. A type of corrosion that progresses parallel to the outer surface of the metal, causing layers of the metal to be elevated by the formation of the corrosion product.

False Indication. An indication that may be interpreted erroneously as an imperfection or defect. An irrelevant indication, sometimes called an artifact.

Fatigue. The process of progressive localized permanent structural change occurring in a material subjected to conditions which produce fluctuating stresses that may culminate in cracks or complete failure after a sufficient number of fluctuations.

Fatigue Classification. Fatigue is often identified within the following classes:

High Cycle Fatigue - Loading is primarily elastic and material failure occurs in excess of 10,000 stress cycles.

Low Cycle Fatigue - Loading is mostly elastic and material failure occurs in 1,000 to 10,000 stress cycles.

Ultra-Low Cycle Fatigue - Loading is plastic and material failure typically occurs in less than 1,000 stress cycles.

Fatigue Crack or Failure. A fracture starting from a nucleus where there is an abnormal concentration of cyclic stress and propagating through the metal. The surface is smooth and frequently shows concentric (sea shell) type markings with a nucleus as a center. Fatigue cracks which penetrate the OD surface of the tube body are incorrectly referred to as "pinholes".

Fatigue Life. Number of cycles a material (typically metal) can endure at a given stress level before failure will occur.

Fatigue Limit. The maximum stress that a material (typically metal) will withstand without failure for a specified number of stress cycles.

Filler Material. A material added to a cement or cement slurry for the primary purpose of increasing the yield for the slurry.

Filler Metal. The metal added in making a welded, brazed or soldered joint.

Filter Cake. The accumulation of suspended solids deposited on a porous medium during the process of filtration.

Filtrate. The liquid that is forced through a porous medium during the filtration process.

Fish. Any object left in the wellbore during drilling or workover operations which must be recovered before work below the object can proceed.

Fishing. Operations within a wellbore which focus on retrieving objects (fish) left in the borehole.

Flange. A protruding rim extending completely around the tube or pipe with holes positioned to accept bolts and having a sealing mechanism used to join pressure-containing equipment.

Flare Test. An expansion of the tube body when forced over a cone-shaped mandrel having a given tapered angle and a given cone length. The specimen lengths of coiled tubing (approximately 4" in length) are flared over a mandrel having a 60 included angle. For CT-90 Grade and lower, the ID at the mouth of the tube is flared until it is expanded to at least 21% of original ID without cracking. For CT-100 Grade, the ID of the mouth of the tube must expand to at least 16% of original ID without cracking. The ID flash may be ground flush prior to testing.

Flash (OD/ID). A thin fin or web of metal formed at the joining edges of a weld when a small portion of metal is extruded during the high frequency induction seam-forming process. This flash extends above the plane of the OD surface as well as the plane of the ID surface.

Flash Free CT. Coiled tubing from which the inside longitudinal weld flash has been removed.

Flattening Test. A weld integrity test procedure which customarily uses a ring or crop end section from the tube, positioning the weld either 0 or 90 degrees to the applied force, and flattening between parallel plates without cracking or showing flaws.

Flaw. A discontinuity or irregularity in the tubular product.

Fleet Angle. The maximum lateral bending angle imposed onto the coiled tubing as seen at the entrance to the tubing guide arch. After the injector and service reel are properly positioned, a reference line is run from the center of the tubing guide arch through a point on the service reel located midway between the reel flanges. The fleet angle is represented as the angle between

the reference line and a second line run from the entrance to the tubing guide arch to the wall of either the reel flange, as measured along the same plane.

Flow Coupling. A heavy-walled nipple incorporated within the production tubing string designed to resist erosion that may result from turbulence created by a restriction within the flow string.

Flow Cross. A pressure fitting with a minimum of four openings. Usually all four openings are oriented at 90 degrees to each other in the same plane. Crosses may be threaded, studded or flanged. The flow cross may be used in the well control stack to provide the returns fluid outlet.

Flow Tee. A pressure fitting with the straight (run) segment sized to be full bore and the side outlet (branch) sized to connect a high-pressure line. The flow tee is a well control stack component typically used to provide the returns fluid outlet.

Flowing Bottomhole Pressure. The pressure existing at the depth of the producing formation in a wellbore flowing with a constant rate of fluid production.

Flowing Wellhead Pressure. The pressure existing at the wellhead of a flowing well.

Fluid. A form of matter which cannot permanently resist a shearing force which causes flow. Also a generic term meaning a gas, vapor, liquid or combinations thereof.

Elastic - A gas, e.g., a condition of matter in which the molecules flow apparently without resistance.

Inelastic - A liquid, e.g., a condition of matter in which the molecules move freely but are restricted by gravitation.

Fluid Analysis. Examination and testing of fluids to determine physical and chemical properties and condition.

Fluorescent Magnetic Particle Inspection. The magnetic particle inspection process employing a finely divided fluorescent ferromagnetic inspection medium that fluoresces when activated by ultraviolet light and is used for the detection of two-dimensional surface imperfections.

Foam. A two phase fluid system similar to an emulsion where the dispersed phase is a gas.

Foaming Agent. A substance that produces fairly stable bubbles at the gas-liquid interface due to agitation, aeration, or ebullition. In air or gas drilling, foaming agents are added to turn water influx into aerated foam, commonly called mist drilling.

Formation Damage. The reduction of permeability in the reservoir at the completion interval arising from invasion of drilling fluids, treating fluids, or any fluid incompatibility with the native reservoir condition.

Formation Pressure. The pressure exerted by fluids within a formation, recorded in the borehole at the true vertical depth of the formation with the well shut-in. Formation pressure may also be referred to as "reservoir pressure" or "shut-in bottomhole pressure".

Fracturing. Application of hydraulic pressure to the reservoir formation to create fractures within the rock through which oil and gas may flow into the wellbore.

Free Point Indicator. A tool designed to measure the amount of stretch in a string of stuck tubing or pipe. The free point indicator is lowered into the stuck string of tubing or pipe on a

conducting cable and is run to determine the deepest point at which the tubing or pipe string is free.

Function. Operation of a well control component, choke or kill valve, or any other component in one direction. For example, closing the blind rams is one function and opening the blind rams is a separate function.

Function Pressure Test. The pressure test which requires the well control component or flow control device to undergo actuation to demonstrate its ability to effect a seal.

Fusible Plug. A plug or portion of the sub-surface safety valve (SSSV) surface control system which is designed to melt in case of a fire, allowing the SSSV system failsafe features to activate.

Fusion. The melting together of base metal, or a base metal with a filler metal to produce a weld.

Fusion Zone. The area of base metal melted as determined on the cross-section of a weld.

Gas. A state of matter, in which the molecules move freely and consequently the entire mass tends to expand indefinitely, occupying the total volume of the container in which it is confined. A gas is compressible, therefore, volume is dependent on the size and pressure exerted on the container.

Gas Lift. A method of artificial lift in which the energy of compressed gas entrained within a column of liquid is used to lift the fluid to the surface. This process of producing fluids from a well incorporates the injection of gas through the tubing or the tubing casing annulus to a point below the liquid level in the wellbore. The injected gas aerates the fluid to reduce the exerted pressure at the formation consequently allowing fluids to flow from the formation.

Gate Valve. A valve which employs a sliding gate to open or close the flow passage. The valve may or may not be full-opening.

Gauge Ball. A ball constructed from one of various materials which is supplied in a specified diameter and pumped through the finished coiled tube to verify the minimum ID clearance.

Gauge Pressure. The pressure exerted on the interior walls of a containment vessel as indicated by the device capable of measuring this pressure, commonly in units of psig or kpa. Absolute pressure is equal to gauge pressure plus atmospheric pressure.

Gel. A semi-solid state of colloidal suspension in which shearing stresses below a certain finite value fail to produce permanent deformation. The minimum shearing stress that will produce permanent deformation is known as the shear or gel strength. Gels commonly occur when the dispersed colloidal particles have a great affinity for the dispersing medium, i.e., hydrophilic.

Gooseneck. The curved tubular connection located between the rotary hose and kelly swivel components of a completion or drilling rig. Within the CT industry, gooseneck is sometimes used to refer to the tubing guide arch.

Gouge. Elongated grooves or cavities caused by mechanical removal of metal.

Grade. Classification of tubing based on minimum yield strength, tensile strength and chemistry.

Gradient (Pressure). Pressure exerted by a unit height of fluid column.

Gravity (Specific). The density expressed as the ratio of the weight of a specified volume of substance to the weight of an equal volume of another standard substance. In the case of liquids and solids, the standard used is fresh water. In the case of natural gas or other gaseous fluids, the standard used is air.

Gripper Blocks. The traction system gripping mechanism used in chain drive injectors. The machined blocks are applied to the coiled tubing with hydraulic rams which apply normal forces, when accounting for the static coefficient of friction between the two surfaces, is sufficient to maintain control of the tubing without slipping.

Hardness. The measure of the material hardness as demonstrated by one of the following tests:

Brinnell Hardness - Material hardness determined as a measurement of the depth of residual penetration of a test piece upon the surface of the material after a specified load is applied. The Brinnell Hardness (HB) is determined with a ball pressure test using a steel ball having a diameter of 0.413 inch (10.5 mm) or 0.098 inch (2.5 mm) and a specified test load. Typically, a force of 6,614 lbs (3,000 kg) is applied to the 0.413 inch (10.5 mm) diameter steel ball size, conducted in accordance with DIN 50 133.

Knoops Hardness - Material hardness readings taken with a microhardness tester using a load of 1.10 lbs. (500 grams) with a diamond-shaped indenter which may be converted to Rockwell B or Rockwell C readings from a corresponding table.

Rockwell Hardness - Material hardness determined as a measurement of the depth of residual penetration of a test piece upon the surface of the material after a specified load is applied. A Rockwell B Hardness test (HRB) uses a steel ball having a 0.0625 inch diameter (1.59 mm) with an initial test force of 22 lbs (98 N) and a test force of 198.5 lbs (883 N). A Rockwell C Hardness test (HRC) uses a diamond cone with a tip rounded to a radius of 0.0078 inch (0.2 mm) and an apex angle of 120 with an initial test force of 22 lbs (98 N) and a test force of 264 lbs (1173 N). The Rockwell Hardness test is conducted in accordance with DIN 50 103.

Vickers Hardness - Material hardness determined as a measurement of the depth of residual penetration of a test piece upon the surface of the material after a specified load is applied. The Vickers Hardness (HV) test uses a diamond pyramid having a four-sided surface and an apex angle of 136 , conducted in accordance with DIN 50 133.

Microhardness - The hardness measured in a very small area with a specified type of indenter that has a small specified load, relative to the standard hardness tests described above.

Heat Affected Zone. The zone directly adjacent to the weld fusion zone in a longitudinal seam weld, circumferential tube-to-tube weld, and skelp-end weld. The mechanical properties in the heat affected zone (HAZ) are affected by the resultant heat produced during the welding process.

Heat Treatment. A combination of heating and cooling operations, timed and applied to a metal or alloy in the solid state in a way that will produce desired properties. Heating for the sole purpose of hot working is excluded from the meaning of this definition.

Heaving. The partial or complete collapse of the walls of a borehole resulting from internal pressures due primarily to swelling from water absorption or the formation of gas pressure (see Sloughing).

Heavywall End (Thickwall End). A term used in describing a segment of a tapered wall thickness coiled tubing string. The "Heavywall End" is the heaviest or thickest wall thickness within the string. Note: Some tubing strings may have heavy wall ends at both ends of the string.

Helical Buckling. Buckling in which the pipe forms a helix or spiral shape within a host conduit.

High-Angle Hole. Generally conceded to be boreholes for which the inclination angle from vertical exceeds 50 degrees.

High Strength, Low Alloy Steel. Low alloy steel forming a specific class in which enhanced mechanical properties and, in most cases, good resistance to atmospheric corrosion are obtained by the incorporation of moderate proportions of one or more alloying elements other than carbon. The preferred terminology is "High Strength Low-Alloy" (HSLA) steels.

Hole Azimuth Angle. The angle between north and the projection of the borehole axis onto a horizontal plane. Angle is referred to either true north, magnetic north, or grid north.

Hole Curvature. Refers to the changes in inclination and direction of the borehole.

HWO Jack. The HWO (hydraulic workover) jack is comprised of two or more hydraulic cylinders which provide the forces needed to deploy or retrieve the jointed tubing. The hydraulic jack is also equipped with at least one set of stationary tube slips (located near the base of the jack) and a set of traveling slips (located at the top of the jack). Piston rods exit the top of the hydraulic cylinders and manipulate the position of the traveling slip assembly.

Hydrate. A hydrocarbon and water crystalline substance which form in gas gathering and compression systems or in wellbores under reduced temperature and pressure. In appearance, hydrates resemble snow or ice.

Hydraulic Control Manifold. A system of valves and piping used to control the flow of hydraulic fluid for the operation of hydraulic power components (typically the well control stack).

Hydraulic Horsepower (HHP). Power term typically calculated as the product of liquid circulation rate (in gallons per minute) and differential pressure (in psig), divided by the value 1,714 (constant).

Hydrostatic Head. The pressure which exists at any point in the wellbore due to the weight of the column of fluid above that point.

Hydrostatic Testing. A proof test method wherein the test segment is filled with liquid and held at high pressure for a specified period of time.

Impeder. A ferrite cylinder placed inside the tube at the weld point to control the electrical impedance of the local weld area.

Imperfection. A discontinuity or irregularity in the tubular product. Also commonly referred to as a flaw.

Impression Block. A lead block which is run into a well and dropped onto the top of lost tools or other fish to obtain an impression of the top profile of the obstruction or fish lost in the hole.

Inadequate Flash Trim. A condition in which height of the weld flash after trimming exceeds the limits set in the specification to which the tube was manufactured.

Inboard CT. The segment of the coiled tubing which is spooled in close proximity to the drum of the service reel.

Inclination. The angle of the wellbore as measured from a true vertical reference.

Inclination Survey. A survey to obtain the angle through which the bit was deflected from the vertical during drilling operation. Usually implies a survey where no azimuth readings are taken.

Incomplete Fusion. Lack of complete coalescence of some portion of the metal in a weldment. Typically referred to as "lack of fusion".

Incomplete Penetration. A condition where the weld metal does not continue through the thickness of the work. Typically referred to as "lack of penetration".

Inclusion. Particles of non-metallic impurities, usually oxides, sulfides and silicates that are mechanically held within steel during and after solidification.

Indication. A deviation of a non-destructive test inspection device from baseline and exceeding a specified threshold level set by a test imperfection that is caused by a material change which may or may not be considered as a discontinuity or defect. In non-destructive test usage, an indication requires prove-up.

Induction. The magnetism induced in a ferromagnetic body by an outside magnetizing force.

Inflow Performance Relationship. The relationship of flowing bottomhole pressure to the gross liquid producing rate for a particular well.

Inhibitor (Corrosion). Any agent which, when added to a system, slows down or prevents a chemical reaction or corrosion. Corrosion inhibitors are used widely in drilling and production operations to prevent corrosion of metal equipment.

Injector. The equipment component which is used to grip the continuous-length tubing and provide forces and control for tube deployment into and retrieval out of the wellbore. Designs for injector tubing gripper systems include opposed counter-rotating chains, sheave drive, arch-chain roller, and single-chain opposed grippers.

Inside Diameter. The distance between the inside tube walls as measured along a line bisecting the tube cross-section. The inside diameter (commonly referred to as ID) is a specified dimension of the tube, typically defined in inches or millimeters.

Inspection. The process of examining materials and tubes for possible defects and imperfections or for deviation from established standards.

Internal Yield Pressure. An internal pressure which produces a stress in the tube equal to the specified minimum yield strength, based on the specified outside diameter and wall thickness.

Jack-Up Vessel. An offshore drilling or well service structure with tubular or derrick legs that can be moved vertically to lift and support the deck and hull above the water level.

Jar. A percussion tool that operates on a mechanical or hydraulic principle and is designed to deliver a impact to objects in which it is attached within the borehole. Jars are typically used for the purposes of freeing stuck objects within the borehole during fishing operations or imparting a jarring motion to downhole devices. The design of the jar often permits impacts to be delivered in either a downward or upward direction, with control being effected at the surface.

Jar Accelerator. A hydraulic or pneumatic tool used in conjunction with a jar. The accelerator is made up in the fishing string above the jar and serves to provide free travel of the jar rod once the restriction is released. The free travel of the jar rod increases the magnitude of the jarring impact delivered to the fish.

Jet Nozzle Port. A fluid flow port in a wash nozzle, drill bit or similar tool.

Jetting. The action of causing erosion by fluid impingement on the formation.

Junk. Refers to metal debris lost in a borehole. Junk may be lost tools, pieces of wire, or any relatively small object that impedes activity to the extent that it must be removed from the hole.

Junk Basket. A fishing tool run into the wellbore when it is necessary to retrieve small parts or lost tools.

Kelly. The square or hexagonal-shaped steel pipe connecting the swivel to the drill pipe. The kelly moves through the rotary table and transmits torque to the drillstring.

Kick. Intrusion of formation liquids or gas into the wellbore. This influx of fluids commonly results in an increase in pit volume or an increase in observed wellhead pressure.

Kill. To control a kick by taking suitable preventive measures (e.g., to shut in the well with the blowout preventers, circulate the influx of fluids out of the wellbore, and increase the weight of the fluids to render it incapable of flowing).

Kill Line. A high-pressure fluid pump line run between the pumps and some point below a well control component. This line allows fluids to be pumped into the well or annulus with the well control component closed.

Killed Steel. Steel treated with a strong deoxidizing agent such as silicon or aluminum used to reduce the oxygen content to a minimum so that no reaction occurs between carbon and oxygen during solidification.

Knuckle Joint. A deflection tool placed above tools within the workstring that employs a ball-type universal joint, allowing the toolstring to be deflected at an angle.

Ladle Analysis. The term applied to the chemical analysis representative of a heat of steel and is typically one of the analyses reported to the purchaser. The ladle analysis is determined by analyzing (for such elements as have been specified) a test ingot sample obtained from part of the heat during the pouring of the steel from a ladle.

Laminar Flow. Fluid elements flowing along fixed stream lines which are parallel to the walls of the channel of flow. In laminar flow, the fluid moves in plates or sections with a differential velocity across the front which varies from zero at the wall to a maximum at the center of flow.

Lamination. An internal metal separation creating layers generally parallel to the surface.

Levelwind. Mechanism used to control the position of the coiled tubing on the tubing wrap as it is spooled off and onto the service reel.

Lift Frame. A structural device used support the injector and well control stack on floater rig operations. The lift frame is suspended by the traveling block, which is motion compensated to maintain position and weight of the drill string or riser within the derrick.

Lifting Sub. A short piece of pipe with a pronounced upset (or shoulder) on the upper end which is screwed into drill collars to provide a positive grip for the elevators.

Lightwall End (Thin Wall End). A term used in describing a segment of a tapered wall thickness coiled tubing string. The "Lightwall End" is the lightest or thinnest wall thickness within the string.

Limestone. A type of sedimentary rock rich in calcium carbonate. Limestone sometimes serves as a reservoir rock for petroleum accumulations.

Linear Imperfection. Linear discontinuities or irregularities which include, but are not limited to, seams, laps, cracks, plug scores, cuts, and gouges.

Liner. Partial length of pipe string extending between the bottom of a borehole to an elevation above the bottom of the previous casing string. Liners perform the same function as production casing in sealing off productive zones and water-bearing formations. Liners may or may not be cemented in place.

Liquid. A substance which flows readily, does not tend to expand indefinitely like a gas, assumes the form of its container while retaining its independent volume, and has form which can be seen and felt.

Liquid Penetrant Inspection. A nondestructive method for determining the presence of two-dimensional and small three-dimensional surface-breaking flaws wherein a dyed fluid is allowed to be absorbed by surface tension into the flaw and leached out with a developer. This process is used for weld inspections and prove-up inspections.

Live Oil. Crude oil that contains gas and has not been stabilized or weathered.

Log. A detailed record of the physical nature of formations and/or fluids contained within formations penetrated during drilling operations. Data recorded may consist of electrical, radioactive or acoustic surveys, descriptions of borehole cuttings, core analysis, or any other physical correlation with depth.

Longitudinal Imperfection. An imperfection which has its principal direction or dimension in the approximately longitudinal direction.

Lost Circulation. A condition which occurs when the fluid pressure within the wellbore acting at the formation face exceeds reservoir pressure, resulting in loss of fluids from the wellbore into the formation. This loss of fluids into the formation may result in reduced or interrupted fluid circulation at the surface.

Lubricator. A specially fabricated length of pipe with union connectors and bleed-off valves that is temporarily installed above the upper valve on the christmas tree. Lubricators afford a method of sealing off pressure yet still allow the passage of devices, usually run on wireline, into a producing well without having to kill the well.

Magnetic Particle Inspection. An inspection process that requires magnetizing of the material and applying a prepared magnetic powder which adheres to the test specimen along lines of flux leakage. Magnetic particle inspection also shows the existence of surface and subsurface non-uniformities.

Malleability. The property that determines the ease of deforming a metal when the metal is subjected to rolling. A highly malleable metal can be rolled into thin sheets easily.

Manifold. An assemblage of pipe, valves, and fittings by which fluid from one or more sources is selectively directed to various systems or components.

Martensite. An unstable constituent in quenched steel, formed without diffusion and only during cooling below a certain temperature. The structure is characterized by its acicular appearance on the surface of a polished and etched specimen. Martensite is the hardest of the transformation products of austenite. Tetragonality of the crystal structure is observed when the carbon content is greater than 0.5 percent.

Mast (Derrick). The steel tower component of a drilling or well servicing rig which supports the crown block, traveling block and hoisting lines and is capable of being raised as a unit. Derricks and masts may be stationary structures normally requiring dismantling and disassembly when moved from location to location or may be portable with the capability of being laid down and raised to and from ground level fully assembled.

Master Coil. The wide coil of skelp that is originally supplied by the manufacturer of the skelp. The master coil is then slit into several narrower coils of skelp, each of the appropriate width for the manufacture of the specified coiled tubular products.

Master Valve. A large, produced fluid control valve located in the vertical run of the christmas tree. The master valve is usually positioned as the lower-most flow control valve and is used to open or close the well.

Maximum Allowable Working Pressure. The maximum pressure permissible by the ASME Code in any component other than a pipe line during normal operation or static conditions.

Maximum Anticipated Surface Pressure. The highest pressure **calculated** to be encountered at the surface of the well. Typically, the "anticipated surface pressure" prediction is obtained by subtracting the hydrostatic pressure exerted by a column of given fluid within the wellbore from the static reservoir pressure. However, the "maximum anticipated surface pressure" prediction assumes that the hydrostatic pressure is derived only from a column of dry gas within the wellbore acting against the static reservoir pressure.

Measured Depth. Actual length of the wellbore as measured from surface to a specified depth.

Mechanical Properties. Those properties of a material that reveal the elastic and inelastic reaction when force is applied, or that involve the relationship between stress and strain (for example, the modulus of elasticity, tensile strength and fatigue limit). These properties have often been designated as "physical properties", but the term "mechanical properties" is preferable.

Migration. The movement of liquids or gases within the pore spaces of the formation or vertically within the flow pathways of the borehole or wellbore.

Mill. A tool configured with a rough, sharp and extremely hard cutting surface used for removing metal or resistive materials by grinding, cutting or chipping.

Milled Length. Single length of CT created during the continuous HFI milling operation of a tubing manufacturer. A milled length of tubing may include a number of lengths of skelp having a single wall thickness or several lengths of skelp having various specified wall thicknesses.

Mill Scale. An oxide of iron which forms on the surface of hot steel.

Minimum Internal Yield Pressure. The lowest pressure at which permanent deformation of the pressure containing vessel or tube will occur.

Moderate Angle Wellbore. Generally conceded to be wellbores which have an inclination from vertical between 20 degrees and 50 degrees.

Modulus of Elasticity. The ratio of the unit stress to the unit strain of a structural material, resulting in a defined slope for the elastic portion of the stress-strain curve in mechanical testing. The tensile or compressive elastic modulus is called "Young's modulus"; the torsional elastic modulus is known as the "shear modulus" or "modulus of rigidity".

Montmorillonite. A clay mineral commonly used as an additive to drilling fluids. Sodium montmorillonite is the main constituent in bentonite. The structure of montmorillonite is

characterized by a form which consists of a thin platy-type sheet with the width and breadth indefinite, and thickness that of the molecule. The unit of the molecule consists of three layers. Attached to the surface are ions that are replaceable. Calcium montmorillonite is the main constituent in low-yield clays.

Mud. The liquid circulated through the wellbore during drilling operations. In addition, to its function of bringing cuttings to the surface, drilling muds cool and lubricate the bit and drill stem, protect against blowouts by holding back subsurface pressure, and deposit a mud cake on the wall of the borehole to prevent loss of fluids to the formation.

Mule Shoe. A shaped form resembling a mule shoe or that of the end of a pipe cut both concave and diagonally which is used on the bottom of orienting tools to position the tool. The shaped end forms a wedge which causes the tool to rotate when lowered into a mating seat for the mule shoe.

Multi-Phase Flow. The flow of fluids in which gas and liquids are commingled.

Natural Gas. A mixture of hydrocarbons and varying quantities of non-hydrocarbons that exist either in the gaseous phase or in solution with crude oil in natural underground reservoirs.

Near-Bit Stabilizer. A stabilizer placed in the bottomhole assembly and located in close proximity to the bit.

Neat Cement. A slurry composed of portland cement and water.

Necking Down. The narrowing or constriction into a smaller cross-sectional area, which occurs at a localized place on a tensile test piece while it is being pulled.

Needle Valve. A valve having a tapered gate that rests in a tapered orifice and used for extremely fine regulation of flow.

Newtonian Fluid. The basic and simplest fluids from the standpoint of viscosity consideration in which the shear force is directly proportional to the shear rate. These fluids will immediately begin to move when a pressure or force is applied. Examples of Newtonian fluids are water, diesel oil and glycerine. The yield point as determined by direct-indicating viscometer is zero.

Nondestructive Testing. Inspection to detect internal, surface and concealed defects or flaws in materials using techniques that do not damage or destroy the items being tested.

Non-Newtonian Fluid. A fluid whose consistency is a function of shear stress, and the shear rate-shear stress relationship is non-linear. The non-Newtonian class of fluids can be further divided in pseudo-plastic, dilatant, Bingham plastic, and thixotropic categories. Examples of non-Newtonian fluids are highly viscous and complex polymers, drilling mud gels, cement, high-density sand slurries and foam.

Normal Circulation. The smooth, uninterrupted circulation of fluids pumped down the tubular conduit within the wellbore, up the annular space between the tube and the borehole, and back to the surface.

Normalize. A heat treatment of steel whereby the steel is heated to a temperature above the upper critical temperature to achieve transformation to austenite and then allowed to cool in still air to a temperature substantially below the lower critical temperature.

Open Hole. Borehole in which casing or liner has not been set.

Opening Ratio. The ratio of the well pressure to the hydraulic actuation pressure required to operate the well control component.

Orientation. The process of positioning a deflection tool within the wellbore so that it faces in the direction necessary to achieve the desired direction and drift angle for a directional hole.

Outside Diameter. The distance between the outside surface of the tube walls as measured along a line bisecting the tube cross-section. The outside diameter (commonly referred to as the OD) is a specified dimension of the tube, typically defined in inches or millimeters.

Ovality. The term used to represent the physical condition of a tube which has assumed an oval geometry. The calculation used to quantify ovality is obtained by dividing the maximum difference in outer diameter tube measurements (taken about the circumference) by the specified diameter of the tube. Ovality is generally represented as a percent change in tube roundness.

$$\text{Ovality (\%)} = \frac{(D_{Max} - D_{Min})}{D_{Specified}} \times 100$$

Overpull. The tension load applied on the tubing in excess of the buoyed load of the tubing string and tools hanging below the injector (CT) or jointed tubing lift mechanism. Overpull loads are the combined loads resulting from tubing-to-pipe friction and anticipated axial downhole service loads.

Overshot. A fishing tool which is lowered over the stuck pipe or fish and affixes itself to the outside diameter of the stuck pipe or fish through a frictional grip. The overshot is the female counterpart of a spear.

Oxide. In the steel industry, this term usually refers to oxide of iron, of which there are three principal types: FeO, Fe₃O₄ and Fe₂O₃. In addition, there are many mixtures of these oxides which form on the surface of steel at different temperatures and give the steel different colors, such as yellow, brown, purple, blue and red. Oxides must be thoroughly removed from the surface of steel objects which are to be coated.

Pack-Off. The process by which a pressure isolation device is installed and activated within the wellbore such that it forms a seal between the concentric tubulars.

Packer. Downhole equipment consisting essentially of a sealing device, a holding or setting device, and an inside passage for fluids. The packer is used to block the flow of fluids through the annular space between the tubing and the wall of the wellbore (or between tubing and casing) by sealing off the space between them.

Passivating. Immersion of steel in an acid bath to remove surface impurities and to render the surface passive.

Penetrameter. A small steel shim of known thickness with machined holes of a calculated size used to determine the sensitivity of the radiographic inspection technique.

Perforating. The act of making holes in pipe, cement, or formation at desired depths (usually formed with an explosive device utilizing bullets or shaped charges).

Permeability (Reservoir Rock). The measure of the ability of a rock to transmit fluids. The unit of measurement for permeability is the Darcy.

Permeability (Magnetic). Magnetic permeability is the ratio of the magnetic induction to the intensity of the magnetizing field.

Pinhole. A short, unwelded area in the weld line extending through the entire tube thickness so that fluid will leak out through the area very slowly. Although an incorrect term, the CT industry sometimes uses "pinholes" to describe fatigue cracks which have penetrated through the tube wall.

Pipe Body Yield Load. The axial tension load (in the absence of pressures or torque) which produces a stress in the tube equal to the specified minimum yield strength in tension.

Pipe Ram. The rams in a well control stack which are designed to seal around coiled tubing to close and isolate pressure in the annular space below the rams.

Pipe/Slip Ram. The rams in a well control stack which are designed to provide the functions of both a pipe ram and a slip ram in one ram body.

Pit. An irregularly-shaped depression resulting from the removal of foreign material rolled into the surface during manufacturing.

Plastic Deformation. Permanent distortion of a material under the action of applied stresses.

Plastic Viscosity. A measure of the internal resistance to fluid flow attributable to the amount, type and size of solids present in a given fluid. It is expressed as the number of dynes per square centimeter of tangential shearing force in excess of the Bingham yield value that will induce a unit rate of shear. This value, expressed in centiPoise, is proportional to the slope of the consistency curve determined in the region of laminar flow for materials obeying Bingham's law of plastic flow. When using the direct indicating viscometer, the plastic viscosity is found by subtracting the 300 RPM reading from the 600 RPM reading.

Plasticity. The ability of a metal to be deformed extensively without rupture.

Plug and Abandon. The process of permanently sealing off an uneconomic completion interval, wellbore sections or a dry hole by placement of a cement plug or plugs.

Plug Back. To place cement or other material at or near the bottom of a well to exclude bottom water or to perform other operations such as sidetracking or producing from another depth.

Plug Valve. A valve whose mechanism consists of a plug with a through-bore hole oriented along the same axis as the direction of fluid flow. Turning the plug 90 opens or closes the valve. The valve may or may not be full-bore opening.

Poissons Ratio. The ratio of the lateral or perpendicular strain to the longitudinal or axial strain.

Porosity (Reservoir Rock). The percent of void space in a formation rock usually expressed as percent voids per bulk volume. Absolute porosity refers to the total amount of pore space in a rock, regardless of whether or not that space is accessible to fluid penetration. Effective porosity refers to the amount of connective pore spaces, i.e., the space available to fluid penetration.

Porosity (Welding). Voids in a metal, usually resulting from shrinkage or gas entrapment occurring during solidification of a weldment.

Power Fluid. Pressurized hydraulic fluid dedicated to the operation of mechanical functions.

Power Supply (Prime Mover). The equipment component which provides all of the power requirements to operate the coiled tubing unit. This power supply is typically provided with hydraulic power.

Precharge. See "Accumulator Precharge".

Pressure Gauge. An instrument for measuring fluid pressure. A pressure gauge usually registers the difference between atmospheric pressure and the pressure of the fluid being measured by indicating the effect of such pressure on a measuring element (such as a column of liquid, a bourdon tube, a weighted piston, a diaphragm, or other pressure-sensing devices).

Pressure Survey. An operation designed to measure and record the pressures at various depths in the wellbore with the well either producing or shut-in. The pressures may be measured and recorded by memory tools installed within a self-contained unit run on slickline or with tools which transmit data immediately to surface through electrical conductors (electric wireline) within the wireline cable.

Pressure Test. The process of performing an internal pressure test on any device or containment vessel required to perform services with internal pressure present.

Primary Barrier. The primary barrier is the means which allows the coiled tubing and HWO services to be performed in underbalanced conditions. Coiled tubing and HWO service units are designed to operate with surface well pressure present. Therefore, the primary barrier for coiled tubing and HWO services is the "well control stack", which includes the stripper assembly and the multi-ram well control assembly.

Proportional Limit. The greatest stress a material is capable of sustaining without a deviation from the law of proportionality of stress and strain. If the load is removed for any stress up to this point, the material will assume its original dimension.

Prove-Up. In non-destructive testing practices, the act of using several nondestructive methods in accordance with written procedures for the location, assessment and measurement of imperfections detected during full body nondestructive examination of a tube.

Pulling Force (Maximum). The maximum tensile force that the injector can apply to the CT above the stripper at the hydraulic operating pressure recommended by the manufacturer.

Purchase Order. A legal contract between a buyer and a seller.

Quality. The suitability of the material used to construct the tube or component for the purpose or purposes for which it is intended.

Rated Working Pressure. See "Design Pressure".

Reamer. Tool employed to smooth the wall of a wellbore, enlarge the borehole, stabilize the bit, and straighten the wellbore where kinks or doglegs are encountered.

Reaming. The operation of enlarging the borehole. Reaming can be used to enlarge an undersized borehole or to remove obstructions and return the borehole to its original ID size.

Recommended Practice. A standard to facilitate the broad availability of proven sound engineering and operating practices. The Recommended Practice (RP) is generally non-mandatory unless specified by the customer or by a government agency.

Reduction of Area. The difference between the original cross-sectional area and that of the smallest area at the point of rupture; usually stated as a percentage of the original area (also called "contraction of area").

Reel Core Radius. The smallest bend radius imposed onto the coiled tubing when spooled onto the service reel or shipping reel.

Reel Swivel. The high-pressure component which connects the stationary piping to the coiled tubing and is used to direct fluids into or out the tubing on the service reel. The reel swivel is mounted either on the axial hub of the service reel or on the reel frame at a point which corresponds to the axis of reel rotation.

Reference End. The reference end of the coiled tubing string is the end of the tubing segment which is intended to be connected to the reel with a high-pressure fitting.

Reference Standard. A tube containing machined notches or holes used to establish a baseline for comparison and standardization of non-destructive test inspection equipment. This section of material contains one or more reference discontinuities used for standardizing the inspection equipment.

Regulator (Pressure). A hydraulic device that reduces or regulates upstream supply pressure to a desired pressure. It may be manual or remotely operated and, once set, will automatically maintain the regulated output pressure unless reset to a different pressure.

Relevant Indication. An indication resulting from a discontinuity in the tube.

Reservoir (Hydraulics). A storage tank for control fluids used to operate the well control components and other hydraulically-actuated devices.

Residual Bend. The post-bend cycle deflections along the longitudinal axis of the coiled tube body which are the result of unbalanced stresses within the tube body material after all bending loads have been removed.

Reverse Circulate. The method by which the normal flow of a fluid is reversed by circulating down the borehole through the annulus and back up to surface through the tubing conduit.

Rheology. The study of the deformation and flow of matter.

Rig. The derrick, drawworks and attendant surface equipment of a drilling or workover unit.

Rigidity. Usually refers to the stiffness or flexibility characteristics of a bottomhole assembly or an element thereof.

Riser. The assembly of high-pressure tubing sections which are installed within the well control stack to space out equipment components or provide the desired length of pressurized tube to allow deployment of long tool segments in pressurized wellbores.

Rolled-In Slug. A foreign metallic body rolled into the metal surface, usually not fused.

Root Face. The surface which is perpendicular to the tube axis between the bevel and the inside surface of the tube. Also referred to as "land" or "root land".

Rotary Shoulder Connection. Tool joint and similar connections where the mating surface is the shoulder and not within the threads.

Sand Pump. A cylindrical tool with a plunger inside and a valve at the bottom which is used to remove solids and accumulated debris from within the wellbore.

Satellite. Subsea completion installation, including the template.

Scab. Also known as "mill scab". An imperfection in the form of a shell or veneer, generally attached to the surface by sound metal. It usually has its origin as an ingot defect.

Secondary Barrier. The secondary barrier is the means which provides a contingency for maintaining well control in the event the primary barrier is unable to function properly. For coiled tubing and HWO service units, the secondary barrier may include additional surface well control components or kill weight fluids.

Sensitivity. The size of the smallest discontinuity detectable by a nondestructive test method with a reasonable signal-to-noise level.

Service Reel. A cylindrical-shaped core drum typically fabricated from steel and bounded by parallel flanges mounted transverse to the core for use in storing and transporting coiled tubing. The service reel is generally equipped with a self-contained hydraulic drive system to control rotation of the reel, an onboard hydraulic levelwind apparatus, and onboard high-pressure piping which connects to the coiled tubing through a high-pressure rotating swivel. The diameters of the cylindrical core and boundary flanges will vary relative to the tube diameter and length to be spooled onto the reel.

Service String. The construction of a specific length of coiled tubing used for concentric well intervention operations.

Shall. Denotes requirements which must be satisfied or performed in order to comply with specifications dictated by regulatory agencies.

Shear Ram. The rams in a well control stack which are designed to mechanically separate the coiled tubing which is located at the point directly across the shear ram position.

Shear/Seal Ram. The rams in a well control stack which are designed to provide the functions of both a shear ram and a blind ram in one ram body.

Shipping Reel. A cylindrical-shaped piece of equipment fabricated from wood or steel and used to store and ship coiled tubing. The reel consists of the cylindrical core and parallel flanges mounted transverse to the core. The diameters of the internal core and flanges vary accordingly to the tube diameter and length.

Should. Denotes a recommended practice (1) where safe, comparable alternative practices are available, (2) that may be impractical under certain circumstances, or (3) that may be unnecessary under certain circumstances.

Shoulder (Make-Up). Flat surface at the extremities of rotary pins and boxes lying at right angles to the longitudinal axis of the connection. When pin and box are fully engaged, the shoulders are forced together and provide a seal which prevents leakage into or out of the connection.

Shut-In. To close valves on a well to halt the flow of fluids to the surface.

Shut-In Bottomhole Pressure. The pressure observed as the bottom of a wellbore when the well is completely closed to flow.

Shut-In Tubing Pressure. The pressure observed at the wellhead when the well is not flowing.

Shut-Off Valve. A valve that closes a hydraulic or pneumatic supply line.

Sidetrack. An operation performed to redirect the wellbore by starting a new hole at a position above the bottom of the original hole.

Skelp. Flat hot or cold rolled steel sheet which is generally coiled from which coiled tubular products are manufactured. These narrower sections of the master coil have been slit to the appropriate width prior to forming the high-frequency induction welded tubing. Skelp segments are joined end-to-end with skelp-end welds prior to milling into a continuous length of coiled tubing.

Skelp-End Weld - A weld which is used to join skelp ends together. Skelp-end welds are performed on flat skelp and are typically made using plasma arc welding methods in accordance with qualified welding procedures.

Slag Inclusions. Non-metallic solid material entrapped in the weld deposit or between weld metal and base metal.

Slip Cut. Transverse indentation or mark made in drill pipe or tubing by rotating it in the slips. Such cuts may develop fatigue cracks.

Slip Ram. The rams in a well control stack which are equipped with tubing slips that, when engaged, prevent upward and downward movement of the coiled tubing but do not isolate pressure or control flow.

Sloughing. The partial or complete collapse of the walls of a borehole resulting from incompetent, unconsolidated formations, high angle repose, and/or wetting along internal bedding planes.

Snubbing. Condition for working tubing through an energized stripper, where wellbore pressure applied against the cross-sectional area of the tube creates an upward acting force **greater than** the weight of the tubing in the wellbore. In this condition, mechanical assistance is required to apply thrust to the tubing while injecting or to maintain control of the tubing when extracting. This condition is commonly called "pipe-light operations".

Snubbing Force (Maximum). The maximum compressive force the injector can apply to the coiled tubing immediately above the stripper at the hydraulic operating pressure recommended by the manufacturer.

Source. The origin of radiation such as an x-ray tube or radioisotope.

Spear. A fishing tool which is designed to stab inside of lost or stuck pipe within the wellbore. This stabbing action creates an internal friction grip sufficient to recover the fish. The spear is the male counterpart of an overshot.

Specified Wall Thickness. Published wall thickness values for coiled tubing. Note that actual wall thicknesses may differ from the specified wall thickness due to engineering tolerances and imperfection removal.

Speed. The rate at which the tubing is deployed or retrieved during the prescribed service. The speed of the tubing movement is typically stated in terms of "feet per minute" or "meters per minute".

Spool. The total length of "as manufactured" coiled tubing product which is placed either on the service or shipping reel for storage and/or transport. A spool may contain one or more coiled tubing "strings".

Spooling. The act of transferring tubing from one reel to another by means of unwinding the payout string and rewinding the take-up string, or from the injector to the service reel.

Spooling Radius Ratio. The ratio of the radius of the service reel or shipping reel to the radius of the coiled tube. This ratio is used in determining the minimum recommended bending radius when spooling coiled tubing onto the reel.

Spume. Small particles of metal ejected from the welding "vee" during the high frequency induction welding operation as a result of electromagnetic forces produced by the weld current. Spume tends to take the form of very small, spherical particles of metal and refractory oxides. If spume is deposited on the weld pressure rolls, it can become rolled into the tube surface. If spume enters the welding "vee", it can cause weld defects.

Squeeze Cementing. Refers to a secondary cementing job where cement is pumped through tubing to a specific location within the wellbore to seal off holes or undesired flow paths within the wellbore.

Standard. A prescribed set of voluntary rules, conditions, or requirements concerned with the definition of terms; classification of components; delineation of procedures; specification of dimensions; construction criteria, materials, performance, design or operations; measurement of quality and quantity in describing materials, products, systems, services, or practices; or descriptions of fit and measurement of size.

Stiff Wireline. Term commonly used to refer to a string of coiled tubing with electric wireline installed internal to the string. This service string is designed to perform basic logging services.

Stored Hydraulic Fluid Volume. The fluid volume recoverable from the accumulator system between the maximum designed accumulator operating pressure and the precharge pressure.

Straightener. A mechanical device used to remove the residual bend in coiled tubing. A straightener is typically constructed of opposed rollers which are adjusted to create a reverse bend in the coiled tube sufficient to straighten the tube prior to entering the wellbore. On some injector designs, the straightener is located directly below the tubing guide arch, where other injectors locate the straightener directly above the stripper.

Stress. The load per unit area.

Stress Relieving. A process of reducing residual stresses in a metal object by heating the object to a suitable temperature and holding at that temperature for the prescribed time to produce the desired effect. This treatment may be applied to relieve stresses induced by cold working or welding.

String. The makeup of a specific length of coiled tubing used for well intervention or other concentric wellbore operations.

Stripper. A device with a resilient elastomeric element used to effect a seal in the annulus. This device is used primarily to isolate well pressure from the atmosphere when injecting or extracting the coiled tubing in pressurized wellbores.

Stripping. Condition for working tubing through an energized stripper, where wellbore pressure applied against the cross-sectional area of the tube creates an upward acting force **less than** the weight of the tubing in the wellbore. In this condition, mechanical assistance is required to support the tensile load of the tubing and maintain control when injecting or extracting. This condition is commonly called "pipe-heavy" operations.

Sub-Surface Safety Valve (SSSV). A device installed in the production tubing in a well below the wellhead and designed to prevent uncontrolled well flow when actuated. These devices can be installed and retrieved by wireline and pump-down methods or may be installed as an integral part of the tubing string.

Surge. The increase of pressure in a liquid filled wellbore due to the interaction of the wellbore liquids in contact with the concentric pipe and tools when the tubing and attached tool string are moved downward within the wellbore. The drag forces created through the relative motion of the liquid and the tube generate an increased wellbore pressure similar to that of equivalent circulating density.

Swab. The decrease of pressure in a liquid filled wellbore due to the interaction of the wellbore liquids in contact with the concentric pipe and tools when the tubing and attached tool string are moved upward within the wellbore. The drag forces created through the relative motion of the liquid and the tube generate an decrease in wellbore pressure.

Swab Valve. The uppermost valve in a vertical line on the christmas tree, always located above the production flow-tee or flow-cross.

Swivel Joint. Metal pipe fittings equipped with one or more elbows and integral ball-bearing points of rotation which provides a means to assemble surface piping systems in any orientation as required.

System Pressure Test. The integrity test used to verify the ability of the pipe and pressure containment equipment in service to maintain a pressure seal.

Tally. Measured record of the total length of pipe, casing, or tubing that is to be run into a well.

Tapered String (CT). A coiled tubing string manufactured with a constant outside diameter and variable wall thicknesses within the length of the spooled tube. The tapered string may be constructed (1) as a continuously-milled string incorporating multiple, single wall thickness skelp segments joined using skelp-end welds, (2) as a continuously-milled string incorporating single wall thickness skelp segments with continuously-tapered skelp segments joined using skelp-end welds, or (3) continuously-milled coiled tubing segments of single wall thickness joined to other finished tube segments of increased wall thickness using the tube-to-tube welding process.

Tapered String (Jointed). A string of tubing assembled for deployment into the wellbore with segments of the string comprised of tubing joints having either a variable ID, variable OD, or both.

Telescoping Joint. A device used in the marine riser system of a mobile offshore drilling rig to compensate for the vertical motion of the rig caused by wind, waves, or weather.

Tensile Strength. The maximum tensile stresses which a material is capable of sustaining. Tensile strength is calculated using the maximum load observed during a tension test (carried to rupture) divided by the original cross-sectional area of the specimen.

Tensile Test. Test which is used to determine the actual tensile strength of the tube. The tensile test involves cutting a section of tubing, carefully measuring the cross-sectional area, mounting the tube section within a tensile test fixture and applying a tensile load onto the tube sufficient in magnitude to pull the tube to destruction. The load at which the specimen breaks is divided by the original cross-sectional area to obtain the ultimate tensile stress or strength. By mounting an extensometer or strain gauge onto the specimen before applying the load, the yield strength can be determined. The yield strength is a defined point at which the steel becomes plastic and elongates without any additional tensile load being applied. The elongation is defined as the percentage of stretch over a one or two inch gauge length after the specimen has been broken.

Tensioner System. A system of devices installed on a floating offshore drilling rig to maintain a constant tension on the riser pipe despite any vertical motion made by the rig.

Tolerance. The permissible deviation from the specified value.

Top Drive. A device similar to a power swivel that is used in place of the rotary table on a drilling rig to turn the drill stem. Hung from the hook of the traveling block, a top drive also suspends the drill stem in the hole and includes power tongs. Modern top drives combine elevators, tongs, swivel and hook.

Tool String. An assembly of downhole tool components used to perform specified service(s) within the wellbore during the operation.

Torque. In engineering mechanics usage, a torque often refers to the torsional or twisting moment or couple which tends to twist a rigidly fixed object, such as a shaft, about an axis of rotation. Torque is generally measured in Lb-ft or meter-Newtons.

Torsion. Strain created by twisting action. The stress within the material resisting the twisting.

Torsional Strength. The maximum torque (twisting force) above which tubular goods or any other device will suffer permanent dimensional change or fracture.

Total Depth (TD). The maximum measured depth of the wellbore.

Traction (Maximum). The maximum axial traction force that the injector can apply to push or pull the coiled tubing. A gripping force normal to the coiled tubing axis must be applied to the OD of the coiled tubing body.

Transition Point. The point on the tapered coiled tubing string where tubing segments of different wall thicknesses are joined together.

Transverse. Literally means "across", usually signifying circumferential in direction.

Trip (Coiled Tubing). The event which describes the complete deployment and retrieval of a segment of coiled tubing. Specifically, a trip occurs when an identified point on the coiled tubing string (originally on the service reel) is spooled off, deployed below the stripper into the wellbore and subsequently retrieved back onto the reel.

Trip (Jointed Tubing). The event which describes the complete deployment and retrieval of a string of jointed tubing. Specifically, a trip occurs when an identified point on the tubing string is deployed into the wellbore and subsequently retrieved back to surface.

True Vertical Depth. The depth within a given borehole as measured vertically from the surface reference.

Tube-to-Tube Weld. A circumferential seam weld used to join two segments of tube together. Tube-to-tube welds may be performed using gas metal arc welding, plasma arc welding, gas tungsten arc welding or a combination of such welding processes and shall be made in accordance with qualified welding procedures.

Tubing Guide Arch. The equipment component which provides support of the continuous-length tube and guides the tubing from the service reel through a bend radius (ranging from 45 to as much as 180) prior to entering the injector gripping mechanism. In general, the tubing guide arch incorporates a series of upper and lower rollers which center the tubing as it travels over the guide arch. The number, size, material, and spacing of the rollers varies significantly with different tubing guide arch designs.

Turbulent Flow. Fluid flow in which the velocity at a given point changes constantly in magnitude and direction of flow. This fluid flow pursues erratic and continually varying courses.

Ultrasonic Testing. A nondestructive inspection method which uses compression and shear waves in the frequency range 2.25 - 10 MHZ to detect and size material imperfections. In coiled tubing, ultrasonic testing is used for wall thickness measurements or prove-up of imperfections.

Under-Cut. Under-cutting on tube welding is the reduction in thickness of the tube wall adjacent to the weld where it is fused to the surface of the tube.

Union. A coupling device used to connect pipe without requiring rotation of the pipe.

Unloading. The act of returning an inactive well to a flowing condition. This activity generally requires underbalancing the hydrostatic fluid column within the wellbore to initiate flow.

Useable Hydraulic Volume. The hydraulic fluid volume which can be recovered from the accumulator system between the maximum designed accumulator operating pressure and the minimum operating pressure.

Valve. A device used to control the rate of flow in a line, to open or shut off a line completely, or to serve as an automatic or semiautomatic safety device. Valves which find extensive use in the oil and gas industry include the gate valve, plug valve, needle valve, check valve, and relief valve.

Velocity String. Term commonly used to describe a string of tubing installed concentric to an existing production tubing string. This concentric string is used to enhance production from the wellbore through increased flow velocity, derived from the reduced ID of the string. Also referred to as "Siphon String".

Viscosity. The internal resistance offered by a fluid to flow. This phenomenon is attributable to the attractions between the molecules of a liquid, and is a measure of the combined effects of adhesion and cohesion to the effects of suspended particles, and to the liquid environment. The greater this resistance, the greater the viscosity.

Volumetric Efficiency. The percentage relation between the actual delivered capacity of a pump and the calculated displacement of the pump.

V-Door. An opening at the floor level in a side of the derrick or mast. The V-door is located on the rig floor opposite to the drawworks and is used as an entry point to bring in drill pipe, casing, and other tools from the pipe rack.

Wall Thickness. The thickness of the finished tube wall.

Weight (Air). The weight of an empty string of tubing, typically given as weight per unit length.

Weight (Buoyed). The weight of the tubing string immersed in a fluid. The tubing may be gas filled (maximum buoyancy), filled with a reference fluid (conventional buoyancy), or filled with a heavier fluid.

Weight Indicator - Coiled Tubing. A device which measures the hanging weight of the tubing string and drag forces associated with deployment and retrieval of the tubing string. The weight indicator is typically installed at a location which measures the weight of the chain drive section and tubing deployed through the stripper assembly. The weight of the chain drive assembly is "zeroed" prior to deployment, yielding readings for load resulting from tubing weight and drag. In cases where the coiled tubing is snubbed into the wellbore, the weight indicator must be constructed to measure the compressive force, often called "negative weight".

Weight Indicator - HWO. The weight indicator is typically determined through the hydraulic pressure readings observed when operating the hydraulic jacks during tubing deployment and retrieval.

Weight Indicator - Jointed Tubing Rigs. The weight indicator is typically installed at the base of the derrick and connected to the drill line (cable), taking the weight indication as a measurement of the amount of tension in the cable. The loads associated with weight of the traveling block and cable is "zeroed" prior to rig operations, yielding readings for load resulting from tubing weight and drag.

Weight on Bit. The amount of downward force applied to the bit through slackoff of the surface weight of the string or as applied through a mechanical thruster device.

Weld. The fusion of materials, with or without the addition of filler materials.

Weld Area Crack. A crack that occurs in the weld deposit, the fusion line, or the heat affected zone. Note that a crack is a stress-induced separation of the metal, which, without any other influence, is insufficient in extent to cause complete rupture of the material.

Welding Processes. The welding practices commonly used in manufacturing coiled tubular products are described below.

High-Frequency Induction Weld (Seam) - A longitudinal seam weld produced through electric induction welding, where the heat for welding is generated by resistance to flow of electric current, and the edges to be welded are mechanically pressed together. This process does not use filler metal.

Gas Metal-Arc Welding - The welding process that produces coalescence of metals through heat generated by an arc (or arcs) created between a continuous consumable electrode and the work product. All gas used for shielding during the welding process is externally supplied and may be pure inert gas or a mixture of inert gases. Gas metal-arc welding does not require pressure, and the electrode provides the filler metal.

Plasma Arc Welding - The welding process that produces coalescence of metals through heat generated by a constricted arc created between a continuous consumable electrode and the work product, or the continuous consumable electrode and a constricted nozzle. The gas used for shielding during the welding process is provided by the hot ionized gas discharging from the torch and may be supplemented by additional pure inert gas or a mixture of inert gases. Plasma arc welding may or may not use pressure in creating the weld, and the electrode provides the filler metal.

Gas Tungsten Arc Welding - The welding process that produces coalescence of the metals through heat generated by an arc created between a single tungsten electrode and the work product. Gas tungsten arc welding does not require pressure, and filler metal may or may not be used. Pure inert gas is used for shielding during the welding process.

Welding Stress. The stress resulting from localized heating and cooling of metal during welding.

Well Control Component, Ram Type. A device designed to form a seal on the wellbore with or without coiled tubing in the well or to perform a specific operation on the coiled tubing body. Ram-type well control components include a set of blind rams, shear rams, slip rams and pipe rams to effect the required wellbore seals or perform the specific physical action on the coiled tube body. Combination shear/seal and pipe/slip rams are available.

Well Control Stack. An integral body or an assembly of well control components including ram-type components, annular-type components, spools, valves and nipples connected to the top of the wellbore to control well fluids.

Well Control Equipment Drill. A training procedure to ensure that onsite service and operations personnel are familiar with correct operating practices to be followed in the use of well control equipment for blowout prevention.

Wellhead. An assemblage of valves and spools located below the christmas tree and above the casing strings for the purpose of hanging and isolating the various tubular strings.

Work Hardening. Hardness developed in metal as a result of cold-working.

Yield Point. For carbon steel material, the yield point is the stress at which a marked increase in deformation occurs without an increase in load. Also the point where permanent set occurs.

Yield Strength. The stress required to produce a specified limiting deviation from the proportionality of stress to strain. This deviation may be expressed in terms of strain, percent offset or total elongation under load.

Young's Modulus. The ratio of stress-to-strain in measuring the stiffness of a material. This ratio is also referred to as "modulus of elasticity" and is the slope of the straight line portion of the stress-strain diagram.