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.

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.

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.

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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.

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).

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.

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.

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.

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".

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.

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

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

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

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.

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

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

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".

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.

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.