# Glossary of Terms and Abbreviated Terms for use with Umbilical Systems

# UMF – GN02

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Umbilical Manufacturers' Federation
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## Contents



## Appendices

## 1.0 PURPOSE

The purpose of this document is to provide a standard glossary of terms and abbreviated terms, to be used in conjunction with umbilical systems and other related products used by the offshore oil and gas industry.

## 2.0 GENERAL

The terms and abbreviated terms have, wherever possible, been taken from national/international standards/specifications. Where considered beneficial, supporting comments and sketches have been included.

It should be recognised that conflict may arise when responding to specifications, queries, etc, which contain, or, may appear to contain terminology/abbreviated terms which materially differ with this document. Where incorrect understanding could have significant impact, clarification shall be sought from the client or the client's terminology shall be suitably qualified where appropriate.

There may be some instances where the terms and abbreviated terms may need to have a wider or narrower meaning. In such instances a 'note' shall be included in the particular document, procedure, presentation, etc., detailing the extension to, or, narrowing, the intended meaning of the term or abbreviated term.

## 3.0 TERMS AND DEFINITIONS

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| **abandonment** | An unplanned process whereby an umbilical system or part system thereof (e.g. pull-in/hang-off arrangement) is left on the seabed or below waterline, partially or fully disconnected from the subsea production system and/or host facility. Typically occurs during the installation campaign where technical problems arise, or, bad weather requires the installation vessel to sail away from the affected area. |
| **abutment** | The part of a coupling or end fitting that mechanically attaches to a hose. |
| **AC conductor resistance** | The resistance of an electrical conductor to an alternating current. Measured in Ohms the resistance increases as the frequency increases. |
| **accidental load** | A load acting on an umbilical system because of a sudden, unintended and undesirable event. A typical accidental event has an annual probability of occurrence less than $10^{-2}$ |
| **accumulated plastic strain** | Summation of the plastic strain, irrespective of direction, experienced by a steel tube functional component during manufacture and installation. This can be used as an approximation of the plastic fatigue damage incurred. |
| **allowable bend radius** | Minimum bend radius to which an umbilical, at a given tension, may be bent without infringing design criteria or suffering loss of performance.<br><br>NOTE 1 The bend radius is measured to the centreline of the umbilical<br><br>NOTE 2 Allowable bend radius increases with increasing tensile load and varies depending on internal pressure and condition ie. safety level. |
| **allowable tensile load** | Maximum tensile load that an umbilical, at a given bend radius, can be loaded to without infringing design criteria or suffering loss of performance.<br><br>NOTE Allowable tensile load decreases with decreasing bend radius and will vary depending upon internal pressure and condition i.e. safety level. |
| **ancillary equipment** | Accessory to the umbilical system that does not form part of the main functional purpose.<br><br>EXAMPLES Weak link, buoyancy attachments, I-tube or J-tube seals, VIV strakes, centralizers, anchors, external clamps .<br><br>May also be known as an **appurtenance.** |
| **appurtenance** | See **ancillary equipment** |
| **armour** | Two or more layers of contra-helically applied steel wires surrounding the laid-up functional components of an umbilical. The wires may be galvanised, individually jacketed with a thermoplastic polymer, or, alternated with plastic rods of the same diameter. The armour provides mechanical strength, protection and ballast for the umbilical bundle. For some applications, where tensile capability and torque balance are not critical, one layer of armour may be acceptable. |

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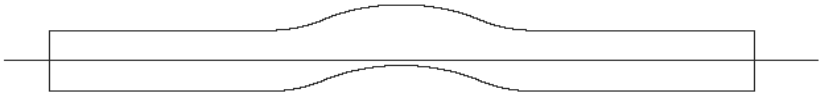
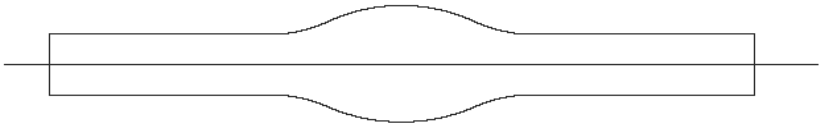
| **armour anomalies** | Often incorrectly grouped under the single heading of an armour birdcage. See **birdcage** below which defines one anomaly. The other type of armour anomaly in the opposite sense to a birdcage is characterised in a contra helical two layer armour construction by an outer movement of the inner layer and an inward movement of the outer layer. This can frequently lead to z-kinking of the inner layer of armour wires.<br>  <br>**Armour Distortion**<br>  <br>**Armour Relaxation** |
| **attenuation** | The reduction in level of the transmission signal at the transmission frequency. Measured in decibels (dB).<br><br>The reduction of a radiation quantity such as *radiant intensity, particle *flux density, or energy flux density, upon the passage of the radiation through matter. It may result from any type of interaction with the matter, such as absorption, scattering, etc. In an electric circuit it is the reduction in current, voltage, or power along a path of energy flow, See linear attenuation coefficient; attenuation constant. |
| **axial stiffness** | Resistance to extension along the primary axis of the umbilical measured as the ratio of the axial load applied and the resultant elongation. |

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| **bandwidth** | A measure of the data-carrying capacity of a cable. It is the frequency range which can be transmitted along the cable length; the units are in Hz (or multiples, eg., kHz or MHz). The bandwidth of a cable decreases with increase in length.<br><br>In multimode optical systems, the bandwidth of the fibre is normalised to MHz.km. Bandwidth limits the data-carrying capacity in multimode systems; however, in single mode systems the data-carrying capacity is limited by the direct dispersion characteristics of the optical fibre.<br><br>Bandwidth calculations tend to be complex and require technical support. |
| **battery limits** | The boundary of the scope of supply and scope of work for the provision of the goods. May also extend to provision of services for work to be performed at locations other than the design/manufacturing facility and/or offshore during the installation/commissioning phase. |
| **bend limiter** | See **bend restrictor** |
| **bend restrictor** | A device for limiting the bend radius of the umbilical, usually by mechanical means, typically comprising a series of interlocking metal or polymeric collars designed to lock at a pre-defined radius. Not to be confused with **bend stiffener** (Ref Appendix 1, Fig 1). |

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| **bend stiffener** | A device for controlling bending strain in the umbilical by providing a localised increase in stiffness. Usually a moulded device, sometimes reinforced depending on the required duty, applied over the umbilical. Sometimes referred to as a **bend strain reliever** (Ref Appendix 1, Fig 2). |
| **bend stiffness** | The resistance of an umbilical to bending from a straight condition to a radius. Bending stiffness in an umbilical is analogous to the structural stiffness of a rigid steel beam or steel pipe (modulus of elasticity x second moment of area), except it can vary with temperature and pressure levels within hoses. There can also be a significant level of hysteresis due to the materials of construction. Quantified as the product of applied bending moment x resultant bend radius of the umbilical. Expressed as $kN.m^2$. |
| **bend strain reliever** | See **bend stiffener**. |
| **birdcage** | Local distortion of the armour package of an umbilical or cable taking on the appearance of a 'bird cage'.<br><br>Armour wires locally rearrange with an increase and/or decrease in pitch-circle diameter as a result of accumulated axial and radial stresses in the armour layer(s)<br>(See also **armour anomalies**). |
| **bore** | The internal diameter of a hose liner, hose, or steel tube, used dimensionally to denote the size of a fluid conduit. |
| **breaking tenacity** | A term expressing the breaking strength of hose reinforcement yarn per unit textile 'count' (tex) and expressed in cN/tex, where one tex is the mass of yarn in grams per 1,000 m length. |
| **break-out arrangement** | An inline arrangement incorporated in an umbilical to facilitate breakout of functional components. |
| **buckle propagation** | Propagation at a buckle resulting from local buckling of a fluid conduit (due to ovality, bending or elastic instability) in the presence of a sufficiently large external pressure. The buckle propagates along the fluid conduit until it encounters a region of counteracting conditions such as low external pressure or an arresting device. See also **propagation pressure.** |
| **bundle** | The laid-up functional components (fluid conduits, electrical / optical fibre cables, power cores, strength elements), and associated fillers in the umbilical prior to further processing. See also **sub-bundle**. |
| **bundling** | See **lay-up.** |
| **buoyancy module** | An attachment to the umbilical to provide positive buoyancy for a dynamic umbilical installed between a floating facility and the seabed. Generally attached in multiples at specified intervals over a defined length of an umbilical in order to effect the desired installed configuration. (eg. lazy wave).<br><br>Generally a structure of light weight material, usually foamed polymer, clamped to the exterior of an umbilical to reduce the submerged weight of the umbilical and to achieve the desired operational configuration. |

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| **cable** | A generic term used to describe a group of electrical cores or optical fibres bundled together. Electrical cores may be taped and/or sheathed to maintain stability and mechanical protection; Fibres may be bundled loosely in a tube, or, incorporated in a slotted carrier which is over sheathed for mechanical protection. Armouring may also be included for mechanical protection and/or tensile strength. |
| **cable hauler** | See **cable tensioner** |
| **cable tensioner** | A device for paying out an umbilical from the installation vessel onto the over-boarding arrangement. Typically comprises two, three or four driven caterpillar tracks which apply squeeze to the umbilical. May also be used to recover an umbilical from the seabed or in the transpooling of an umbilical during factory processing or load-out<br><br>Other devices providing a similar function may be linear cable engine, capstan, drum engine, draw off hold back engine. |
| **cabling** | See **lay-up**. |
| **capacitance** | A measurement of the ability of an electrical cable to store electrostatic charge when potential differences exist between the conductors. Measured in Farads. |
| **capacity curve** | Curve that defines the relationship between the allowable bend radius and allowable tension for an internal pressure condition.<br><br>NOTE Curves can, therefore, differ for storage, testing, installation and operation scenarios. |
| **carcass** | A load bearing structure incorporated in a thermoplastic hose to prevent collapse when exposed to external hydrostatic pressure. Typically for deepwater applications with low specific gravity service fluids |
| **carousel** | Storage container which can be rotated by a drive about a vertical axis.<br><br>Note: there are several types of carousels |
| **caterpillar** | Device that holds the umbilical between belts or pads and which transfers axial linear motive power to the umbilical.<br><br>NOTE A caterpillar is also known as an in-line cable engine, or haul off, puller or tensioner. |
| **cathodic protection** | An arrangement whereby a more active metal is placed next to a less active metal; in seawater the more active metal serving as an anode becomes corroded instead of the less active metal. The anode is called a **sacrificial anode**. |
| **Certifying Authority** | The organisation that provides independent certification that the goods have been provided in accordance with the requirements of the applicable specification(s). |
| **characterisation data** | Data relating to a component or an umbilical giving an indication of performance but not giving specific acceptance/rejection criteria. |
| **characteristic impedance** | The ratio of voltage to current of a wave travelling in one direction along a transmission line, measured in Ohms. Only in case the transmission line is terminated reflection free (i.e. terminated with its characteristic impedance), this ratio is equal to ration of voltage and current at any point. It is a complex number with a resistive and reactive component and is a function of the frequency of the applied |

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| | signal and independent of length |

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| **chemical injection fluid (CIF)** | A fluid transported through the umbilical system containing one or more production chemicals for injection into the flow stream either at the well head or the well bore. Such fluids typically provide scale, corrosion, hydrate, emulsification and asphaltene inhibition service.<br><br>Each service is generally provided by a dedicated CIF and dedicated fluid conduit.<br><br>May also be knows as **production chemical fluid** |
| **Chinese finger** | Type of gripper or stopper used to hold the umbilical via its outer diameter, comprising a number of spirally interwoven wires or synthetic rope attached to a built-in anchorage arrangement.<br><br>Could also be identified as Pulling Stocking or Pulling Sock and available in a variety of different designs. |
| **cladding** (optical) | The element of an optical fibre which surrounds the core (optical) and which has a typical diameter of 125 µm. It is usually coated with a secondary dual-layer acrylate material to 250 µm nominal diameter. The acrylate coating may be colour-coded for identification. |
| **clamping load** | The load applied externally to an umbilical (or functional component) in order to grip and/or hold during spooling and installation operations and, also in service. |
| **coaxial cable** | A cable for the transmission of signal data of low to high frequency. The conductor pair is arranged concentrically with an annulus of di-electric material between the conductors. |
| **collapse resistance** | The resistance to external hydrostatic pressure created by water depth. Normally specified for fluid conduits whereby the internal pressure is less than the external pressure. |
| **completion FAT** | Testing of the goods fitted with end terminations and ancillary equipment (if applicable) and fluid conduits filled with delivery fluid prior to load-out. Not to be confused with **system integration testing**. |
| **compatibility testing** | A test undertaken to determine the resistance of a material or functional component to the fluid that they are in contact with during service. Elevated temperature may be applied to accelerate potential chemical/physical reactions. |
| **compression load** | The load applied axially or radially to an umbilical or functional component. |
| **conductor** | A conductive material, such as copper in either stranded or solid form used to transmit electrical power and/or electrical communication. |
| **connector (electrical / optical)** | A device, fitted to the end of an electrical or optical fibre cable enabling quick and safe connection and disconnection. A connector may be of a fixed design (bulkhead or stabplate mounted) or non fixed (free) design. Such connectors are either plug or receptacle configuration.<br><br>See **sub-sea connector, dry mate connector, wet mate connector, plug, receptacle and dummy connector**.<br><br>Note : Connectors used in topside / hazardous environments will be required to comply with the appropriate safety/certification requirements |

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| | applicable to the area of use. |
| **control fluid** | The fluid employed in a sub-sea production system to transmit both hydraulic signals and power from one location in the system to another location. Such fluids may be either oil or water based and contain inhibitors to prevent corrosion, biological growth, and to tolerate a degree of seawater ingress without having a significant effect on performance and characteristics.<br><br>May also be known as **hydraulic fluid** |
| **core (electrical)** | A generic term used to describe an individual electrically insulated conductor. |
| **corrosion allowance** | The amount of wall thickness added to steel materials of construction to allow for corrosion throughout the service life. |
| **coupling** | An arrangement used to splice two hose lengths together or to join two fluid conduits together by means of screwed or interlocking fittings. (Ref Appendix 2, Fig 3). |
| **crab lay** | Installation deployment activity whereby the installation vessel moves sideways along, or at the end of, the installation route. |
| **cradle** | An arrangement, usually resembling a saddle in shape, located between the rim of an installation/shipping/storage reel and the load bearing member, (ground, vessel deck, etc.) to enable the load to be distributed over a greater area. May also be known as **saddle** |
| **crimping** | Method of attaching a coupling or end fitting to a hose by compressing the coupling/fitting abutment with a radially applied load generally by means of a segmented die arrangement. (Ref Appendix 2, Fig 1). Also known as **pallet swage** |
| **cross sectional arrangement** | The arrangement of functional components fillers, armouring and sheaths relative to each other, as viewed on the end of an umbilical. |
| **cross-talk** | The trespass of electrical energy from one electrical circuit to another. Measured as a power ratio in two configurations:-<br>See also **NEXT** and **FEXT** |
| **crush load** | Load that acts in the radial direction that might not be evenly distributed around the circumference and that is limited in length along the umbilical. |
| **cyclic pressure decay** | A test to confirm the integrity of a thermoplastic hose whereby the hose is pressurised to a specified pressure, isolated, and the pressure allowed to decay for a specified time period. At the end of this period the hose is re-pressurised to the specified pressure and the process repeated for a specified number of cycles each of equal duration.<br><br>For integrity to be confirmed each successive pressure decay value shall be less than that recorded during the previous pressure cycle. |
| **DC conductor resistance** | The linear resistance of an electrical conductor to a direct current. Measured in Ohms. |
| **DC loop resistance** | The DC conductor resistance of a pair of conductors connected in series. Measured in Ohms. |

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| **deep water** | Water depth generally ranging from 610m (2000ft) to 1,830m (6000ft). |
| **default material** | The material specified as standard unless there are sound reasons why the default material would not be suitable (technically unsuitable, alternative material specified by client, etc.). |
| **delivery fluid** | The fluid that is in the umbilical fluid conduits at the time of delivery. This fluid may be the service fluid, or, where not the service fluid, will be changed-out with the service fluid following installation of the goods. |
| **de-mobilisation** | The disbanding of materials, equipment, personnel, etc., after undertaking a specific requirement, eg., umbilical load-out, offshore testing.<br>When de-mobilising after such events such as offshore testing, personnel and equipment may de-mobilise from different locations, eg., equipment from vessel in port and personnel from heliport. |
| **design** | The working out of the structure or form of the documentation required to enable production of a product or execution of a service. The documentation or parts thereof enable a design or service review to be performed. |
| **design life** | The period of time during which the goods are designed to fulfil performance requirements. |
| **design plan** | A schedule of design and qualification activities identifying the stages at which the manufacturer, purchaser, Third Parties or Independent Inspectorates are involved and, additionally, identifying the specifications involved, procedures, acceptance criteria, and instructions that are relevant. |
| **design review** | A formal, documented, comprehensive and systematic examination of a design to evaluate the design and the capability of the design to meet the requirements and to identify problems and proposed solutions. |
| **design tensile load** | Maximum tensile load multiplied by an appropriate factor that is equal to, or less than, one. |
| **design working pressure** | The maximum working pressure at which a hose or tube is rated for continuous operation.<br>Unless otherwise stated in the manufacturer's written specification design pressure is assumed to be equal to design working pressure. |
| **dielectric** | A substance that can sustain an electric field and act as an insulator. |
| **diameter to weight ratio** | Normally applies to dynamic umbilicals and is used as a measure of an umbilical hydro-dynamic response. It is used in order to harmonise an umbilical with adjacent risers, anchor or tether lines. May also be expressed as **weight to diameter ratio**. |
| **direct hydraulic control** | Control method whereby hydraulic pressure is applied through an umbilical line to act directly on a subsea valve actuator.<br><br>Note. Upon venting of the pressure at the surface, the control fluid is returned through the umbilical to the surface due to the action of the restoring spring in the valve actuator. Subsea functions may be ganged together to reduce the number of umbilical hydraulic lines. |
| **dispersion** | A pulse of light, with defined time duration when launched at one end of an optical fibre, will, by the time the pulse reaches the far end of the optical fibre, have a different time duration. It is dispersion effects |

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| | which cause this spreading in time. The units, for the most significant dispersion mechanisms, are ps/nm.km (some dispersion mechanisms have different units). Dispersion is strongly wavelength dependent.<br><br>It is dispersion effects which limit the data rate (amount of data transmitted per unit time) in single mode fibres. There are different mechanisms, some of which were previously of minor importance. The need to transmit more and more information on a single fibre has led to these mechanisms becoming significant. |
| **documentation package** | The documented history of a contract/purchase order typically in respect of design (drawings, calculations, procedures, ITP's, etc.), manufacture (inspection and test records, non-conformances, process parameters, etc), system assembly, completion testing, loadout and post load-out testing. |

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| **drain wire** | A conductor placed in contact with an electrical screen to improve and maintain the electrical continuity of the screen. Generally used in conjunction with metallised plastic film screens. |
| **dry mate connector (electrical / optical)** | A connector designed to be mated / de-mated in an environment free of water (eg., topside, underwater in an air chamber). |
| **dummy connector (electrical / optical)** | A connector with the same mating functionality as a full function connector but with a blank backshell replacing the cable interfacing arrangement. It mechanically and electrically protects the electrical contacts on the mating full function connector and may also be used for test purposes.<br><br>Dummy connectors may be provided in plug or receptacle configuration and internally configured to suit specific testing / monitoring requirements. Typically may be internally configured as follows:-<br><br>• Open circuit<br>• Specific conductors or fibres shorted (looped)<br>• Specific conductors wired together with resistors. |
| **dummy plug (electrical / optical)** | A dummy plug connector.<br><br>See **dummy connector.** |
| **dummy receptacle (electrical / optical)** | A dummy receptacle connector,<br><br>See **dummy connector.** |
| **dynamic analysis** | An analysis of an umbilical system that will be subject to continuous dynamic excitation to ensure that the system is designed, installed and operated safely and reliably. The results of analysis, typical histories of forces, moments, displacements and, curvatures and deformations, may be used in the design phase for checking and refining the proposed system design and determining appropriate installation procedures.<br><br>The analysis may be combined with the interaction analysis of adjacent dynamic umbilical systems and/or dynamic production risers. Used to determine the motion envelopes of the umbilical with respect to other elements (risers, anchor chains, buoys, etc.), and as an input to fatigue analysis assessments. |
| **effective span length** | The length of an idealised fixed-fixed span having the same structural |

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| | response in terms of natural frequencies as the real free span supported on soil. |
| **electro-hydraulic control** | Control method wherein electrical signals are conducted to the subsea system and used to open or close electrically controlled hydraulic control valves.<br><br>Note. Hydraulic fluid is locally sourced and acts on the associated subsea valve actuator. "Locally sourced" may mean locally stored pressurised fluid or fluid supplied by a hydraulic umbilical line. With electro-hydraulic control systems, data telemetry (read-back) is readily available at high speed. Multiplexing of the electrical signals reduces the number of conductors in the umbilical. |
| **end cap effect** | Axial stress generated in a steel tube or hose due to internal pressure. The cap force is the internal pressure multiplied by the effective cross sectional area.<br><br>Note. Where a steel tube or hose is terminated with an end fitting, the effective cross sectional area will invariably be larger than that of the fluid conduit to which it is attached. |
| **end fitting** | An attachment secured directly to the end of a hose or steel tube incorporating one half of a metal-metal seal, used to enable connection of the hose or tube to another piece of equipment. |
| **end termination** | A mechanical fitting/assembly attached to the end of an umbilical which provides a means of transferring installation and operating loads, fluid and electrical/optical and medium voltage power services, as applicable, to a mating assembly mounted on the sub-sea equipment or surface facility. |

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| **environmental load** | Load due to the environment, such as waves, currents, wind, ice and storms. |
| **factory acceptance test (FAT)** | Series of tests carried out on the completed umbilical component or complete umbilical to demonstrate the integrity of the item under test. |
| **far end cross talk (FEXT)** | Cross talk as measured in a conductor pair when the measurement is undertaken at the opposite end to the signal/power input into the conductor pair. |
| **fatigue** | Cyclic loading causing a reduction in physical properties of a material or a structural element, ultimately leading to failure of the material or structural element. |
| **fibre optics** | A general term used for the transmission of information modulated on light transmitted along thin fibres of glass (or plastic).<br><br>The term usually includes connectors, splices, electro-optic devices (eg., lasers or light emitting diodes) and optical components (in addition to the optical fibre itself).<br><br>The term is used by the Electronic Industries Association (EIA) in the USA for its fibre optic test procedures (FOTP). In Europe, IEC/ISO/ITU/EN/BS standards tend to be referenced rather than those of the EIA. |

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| **filler** | Item wholly or partially filling the voids between the functional components with the purpose of maintaining the relative location of the components, maintaining the shape of the cross-section, influencing the weight-to-diameter ratio, separating components for wear considerations, or providing a certain radial stiffness. |
| **final documentation dossier** | A formally structured historical record of the design, manufacture and testing associated with the production of an umbilical system(s) to demonstrate compliance with the requirements of the purchaser's specifications. |
| **flexible joint** | A jointing system for umbilicals in which functional components are spliced over a short length (typically <2m) without increase in umbilical diameter and without reduction in flexibility. To avoid interference such splices are staggered. |
| **floater** | Buoyant installation which is floating and fixed to the sea bottom bed by mooring systems in temporary or permanent phases, eg., TLP, bouy, semi-submersible, spar, etc. |
| **floater offset** | The total offset of the floater, taking into account the floater mean offset, wave frequency motions and low frequency wind and wave motions. |
| **floater mean offset** | The position in the middle of the excursion envelope. |

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| **fluid conduit** | Steel tube or thermoplastic hose used in an umbilical or jumper bundle/assembly connecting pipework, etc.,. for the transmission of control and CIF's used in, a sub-sea production system. Also includes conduits used for the transmission of hydrocarbons as part of annulus or gas injection requirements. |
| **flying lead** | A jumper bundle, complete with end terminations, that is installed using an ROV whereby the bundle end termination may be attached to a buoyancy arrangement to facilitate movement by the ROV.<br><br>This type of umbilical jumper is typically relatively lightweight and hence may be picked up from a deployment basket on the seabed and manoeuvred into position. |
| **free issue** | Equipment or services provided by a purchaser at no direct cost to supplier, to be used by supplier in connection with supplier's work scopes. |
| **free span** | A scenario whereby a section of static umbilical is unsupported along its length for a distance, typically greater than 3 metres. |
| **functional component** | Hoses, tubes, electrical/ optical fibre cable or power core incorporated in an umbilical which are required to fulfil the operational service needs. |
| **functional load** | A load caused by the physical existence of the umbilical system and by the operation and handling of the system. |
| **functional specification** | A document that specifies the totality of needs expressed by features, characteristics, process conditions, boundaries and exclusions, defining the performance of a product or service including quality assurance requirements. |

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| **global analysis** | Analysis of the complete riser system, (umbilicals, flow lines, mooring ropes, etc.) and their interaction with each other. |
| **goods** | A general term describing the tangible elements of the scope of supply associated with a contract/purchase order, (umbilical systems, spares, jumper bundles, jumper assemblies, buoyancy modules, documentation, etc.). |
| **helical lay-up** | See **planetary lay-up**. |
| **hold point** | An inspection / test activity of an Inspection and Test Plan requiring witness by purchaser or purchaser's nominated representative. |
| **hose** | A flexible fluid conduit comprising a thermoplastic liner with externally applied reinforcement and a protective sheath, which can perform functions similar to a rigid tube and withstand repeated flexure at relatively small bend radii without adverse effects. For a sub-sea production system such hoses are generally of non metallic construction but may incorporate an internal metallic or polymeric support arrangement for the transmission of low specific gravity fluids |
| **hose assembly** | A length of hose with an end fitting attached at each end. |
| **hose liner** | The inner most component of a hose providing the diaphragm seal for the containment and conveyance of fluids. |
| **hose reinforcement** | One or more layers of high tenacity synthetic fibre applied around the hose liner to provide the design pressure rating requirements. |
| **host facility** | Fixed, floating or land based facility to which the umbilical is mechanically and functionally connected and that provides the functions and services transmitted through the umbilical.<br>Note: Produced fluids may flow to the host facility or some other facility. |
| **hydraulic fluid** | See **control fluid** |
| **hydrogen scavenger** | Gel material applied inside the tube (metal or polymer) holding the optical fibre to absorb hydrogen ions that prevent fibre from 'darkening' and from reducing transmission capabilities.<br>Note: Could also be used for other applications. |
| **Health, Safety and Environment (HSE) Plan** | A document which describes the project specific health, safety and environmental management systems, procedures, and controls to be implemented to ensure a safe working environment. |
| **impedance** | The rms (root mean square) value of an ac voltage applied to a circuit divided by the rms value of the current flowing within that circuit. |
| **inclusion** | A small unplanned foreign body incorporated in a material prior to, or, following processing. Examples are degraded polymer in 'as delivered' pellets and/or in an extruded hose liner. |
| **independent verification agent** | Party or group independent from the manufacturer and purchaser. |
| **inductance** | A constant relating the electromagnetic force induced within the electrical cable to the current variation with time. SI derived unit of Henry.<br><br>The property of a circuit whereby energy is stored in the form of an |

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| | electromagnetic field. The inductance (L), is defined in terms of the emf generated to oppose a given change in current. |
| **Inspection and Test Plan (ITP)** | A schedule of manufacturing, inspection and test activities identifying the stages at which the manufacturer, purchaser, Third Parties, or Independent Inspectorates are involved and, additionally, identifying the specifications, procedures, acceptance criteria, and instructions that are applicable. Not to be confused with **Quality Plan.** |
| **installation analysis** | The analysis undertaken to evaluate the proposed installation method for the goods is feasible and does not compromise the safe installation parameters for the goods. Normally undertaken by the installation contractor using parameters supplied by the umbilical manufacturer. |
| **insulation** | The layer of dielectric material covering an electrical conductor. |
| **insulated conductor** | A conductor insulated with a suitable dielectric material. May also be known as **core**. |
| **insulation resistance (IR)** | The resistance of the conductor insulation measured using a constant DC potential across the cable insulation. Measured in Ohms and expressed typically as Megohms. km. |
| **I-tube seal** | A seal at the base of a I-tube to prevent exchange of fluid within the I-tube with seawater. See **J-tube seal**. |
| **joint** | The process or physical means of joining together two lengths of umbilical to achieve the required production length or effect a repair. |
| **J-tube seal** | A seal at the base of a J-tube to prevent exchange of fluid within the J-tube with seawater. See **I-tube seal** |
| **jumper assembly** | An electric cable, optical fibre cable, hose, or steel tube with end fittings/connectors installed at each end to provide a flexible connection between sub-sea terminations or between a sub-sea termination/sub-sea distribution unit and a sub-sea system. |
| **jumper bundle** | A group of electric cables, hoses or steel tubes on their own, or with combinations of each other, bundled or cabled together to provide a short flexible connection between sub-sea systems, or between a sub-sea termination/sub-sea distribution unit and a sub-sea system. May also include optical fibre cables and/or power cores. |
| **lay angle** | Angle between the axis of a spiral-wound element (eg armour wires) and a line parallel to the longitudinal axis of the umbilical. |
| **lay-up** | The operation of assembling umbilical components into a bundle, or sub-bundle. Also known as **cabling** or **bundling** and may be undertaken using planetary or SZ techniques. See Appendix 3. |
| **limit state** | The state beyond which the umbilical or part of the umbilical no longer satisfies the requirements specified as to its performance or operation. Examples are structural failure (rupture, local buckling) or operational limitations. |
| **linear density (yarn)** | Mass per unit length of yarn expressed in tex, where tex is the mass of yarn in grams of 1,000 m length. Eg., a yarn designated 330 tex has a mass of 330 g per 1,000 m length. |
| **load** | Refers to physical influences which cause stress, strain, deformation, displacement, motion, etc., in umbilicals, functional components, end terminations, electrical, etc. |
| **load-out** | The transfer of an umbilical or umbilical system from the storage |

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| | facility or dockside onto a shipping/installation vessel involving lifting of reeled product directly onto the vessel, and/or transfer by spooling from the storage system (reel, carousel) onto the vessel storage system (reel, carousel). |
| **load effect** | Response or effect of a single load or combination of loads on a structure, such as bending moment, effective tension, stress, strain, deformation, etc. |
| **looped connector** | See **dummy connector** |
| **low voltage** | 1kV to 3kV (0.6/1(1.2)kV AC to 1.8/3.0(3.3)kV AC rating designation by IEC60502-1). |
| **mapping** | The process of making diagrammatic representations of aspects/issues relating to the design, manufacture, loadout and installation of umbilical systems. Eg., splice locations, materials of construction, damage / potential damage locations |
| **manufacturer's written specification** | Specification for the umbilical, the umbilical functional components and their manufacture, generated by the manufacturer detailing criteria for design and operations, in response to purchaser specified requirements. The specification may comprise a multiplicity of documents (design plan, manufacturing/test procedures, inspection and test plan, management systems procedures, etc.). |
| **material certification** | The process whereby materials used in the manufacture of the goods are certified to be the correct form and grade and issued by the material manufacturers as part of the manufacturer's Quality Assurance system. |
| **maximum operating condition** | Maximum condition in which the normal operations are carried out. |
| **maximum tensile load** | Maximum tensile load that an umbilical, with zero curvature, can with stand without infringing the stress criterion or suffering loss of performance. Also known as maximum tensile capacity. |
| **may** | Indicates a possible course of action. |
| **mechanical completion** | The assembly testing and delivery of the goods in accordance with the requirements of the contract but excluding as-built documentation |
| **medium voltage** | 6kV to 30kV (3.6/6 (7.2kV) AC to18/30 (36kV) AC rating designation by IEC60502-2). |
| **messenger wire** | Device installed or pre-fitted into an I-tube of J-tube for transferring the primary pulling device, usually a wire rope, into the tube to provide means of pulling the umbilical through the tube. |
| **minimum bend radius (MBR)** | The minimum bend radius, to which a functional component or umbilical at zero tensile load, can be bent to without infringing the design criterion or suffering from loss performance.<br><br>NOTE: The bend radius is measured to the centreline of functional component or umbilical as applicable. |
| **minimum breaking load** | The minimum tensile load that the umbilical or end fitting/termination can sustain before mechanical failure occurs when the load is applied with the umbilical in the straight condition, unless specified otherwise. |

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| | May also apply to functional components.<br>. |
| **mobilisation** | The organising of materials, equipment, personnel, etc., and their transportation where necessary to undertake a specific requirement, eg., umbilical load-out, offshore testing.<br><br>When mobilising for such events as offshore testing personnel and equipment may mobilise to different locations, eg., equipment to vessel in port, personnel to heliport. |
| **monitor** | A person or piece of equipment that observes, warns, checks, controls, or keeps a systematic record of an event, (eg., umbilical manufacturer representative monitoring umbilical installation by a third party). |
| **mono-coupler** | A single hydraulic coupler arrangement generally with self sealing capability. In practice one coupler half (fixed) is invariably mounted on a sub-sea structure, sub-sea termination, christmas tree, etc., with the mating half (free) attached to the end of a jumper hose assembly. |
| **multi-coupler** | Multi-way connector arrangement comprised of two mating stabplate sub-assemblies, one of which is made of a number of hydraulic and/or electric and/or optical coupler halves, each carrying a separate service, that mate simultaneously with corresponding coupler halves on the other sub-assembly when the two sub-assemblies are brought together. |
| **near end cross talk (NEXT)** | Cross talk as measured in a conductor pair when the measurement is undertaken at the same end as the signal/power input into the conductor pair. |
| **nominal** | Value by which a quantity is designated.<br><br>Note: Nominal values in specifications give rise to values to be checked by measurements taking into account specified tolerances. |
| **normative reference** | The details (title, reference number, revision number, etc. ) identifying a specific document that provides rules , guidelines, or characteristics for activities or their results.<br><br>Note: The term ‘normative reference ‘ is a generic term that covers the references of such documents as standards, technical specifications, codes of practice and regulations. |
| **on-bottom stability** | See **seabed stability**. |
| **optical fibre** | A thin glass or polymer strand which conducts light between each end. Different fibre designs and materials are optimised to operate at different wavelengths. Generally, optical fibres for communications are glass and operate at:-<br><br>850 nm / 1300 nm (multimode)<br>1310 nm / 1550 nm (singlemode)<br><br>Optical fibres are primarily characterised in terms of:-<br><br>i) Optical performance:-<br>• Maximum attenuation (dB/km at the operating wavelength),<br>• Bandwidth (MHz.km at the operating wavelength – multimode fibres only) |

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| | • Dispersion (ps/nm.km – primarily single mode fibres).<br><br>ii) Fibre geometry<br>iii) Mechanical performance (proof test)<br><br>Selection of an optical fibre for use in an optical fibre cable is governed by the optical system requirements. |
| **optical fibre cable** | A cable which contains optical fibres. The structure of the cable provides mechanical protection to the optical fibres. Design of the cable needs to consider the optical system, the operating wavelength, the allowable optical attenuation of the fibres within the cable and the stresses the individual fibres and cable will experience during umbilical manufacture, installation and service. |
| **optical system** | A system in which an optical fibre (usually packaged in an optical cable for protection) guides light from the transmitting electronic device (LED or laser) to the receiving electronic device (photodiode).<br><br>The optical system comprises the cable and termination elements (connectors, fusion/mechanical splices). The system design must match the optical performance of the cable (optical attenuation, bandwidth or dispersion) and connectors/splices to the performance of the electronic terminal equipment.<br><br>System operating requirements dictate optical fibre selection and optical fibre cable design. |
| **OTDR** | A fault finding test to locate breaks or significant change in attenuation in optical fibres by pulse reflection techniques. |
| **oscillatory lay-up** | A method of laying-up whereby the elements (functional components, fillers, etc) to be cabled together are rotated around the axis of the cabled product, typically 360°-720°, followed by a reversal in the direction of rotation for a similar level of angular rotation, after which the rotation sequence is repeated. Also known as **SZ lay-up**. (Ref Appendix 3, Fig 2). |
| **ovalisation** | The cross section deviation of an umbilical or a functional component from a circle to elliptical form. |
| **over-sheath** | An additional extruded thermoplastic covering applied to an umbilical or functional component. Used to provide additional protection, and/or to increase the diameter to meet geometrical requirements during bundle or sub-bundle lay-up.<br><br>May also be locally applied to an umbilical to meet a specific installation or operational requirement, eg., abrasion/dropped object protection. |
| **pair** (electrical) | A cable for the transmission of electrical power or low frequency signals, consisting of two insulated conductors twisted together with a constant lay length. The cable may be screened to reduce cross-talk. |
| **pallet swage** | See **crimping**. |
| **parking connector** (electrical/optical) | A dummy connector, usually bulkhead mounted on a sub-sea structure whereby production sub-sea connectors can be temporarily located under controlled conditions eg., during intervention activities. |

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| **parking plate** | A temporary locating device for a connector or jumper termination prior to hook up by diver or ROV. |
| **penetrator** | Typically an optical fibre or electrical cable device to allow transition of a sealed connection through a bulkhead acting as a pressure and/or fluid boundary. |
| **permeability** | The characteristic of a material which allows liquid or gas to diffuse through it. Typically applies to polymeric materials and very low molecular weight fluids. |
| **permeation** | The passage of low molecular weight fluids through a solid barrier. |
| **pigtail** | A length of functional component at the end of an umbilical or exiting an arrangement, of sufficient length whereby the component can be manipulated and connected to its mating component either by splicing, welding or inclusion of mating couplers/connectors. |
| **planetary lay-up** | A method of laying-up, whereby the elements (functional components, fillers etc.) to be cabled together are continuously rotated in the same direction around the axis of the cabled product, such that the elements are incorporated in the form of continuous helices. The method necessitates rotating ( or a drum twister) the element lengths to be laid-up which is typically undertaken by a revolving carriage, into which the individual lengths are located on their processing reels. (Ref Appendix 3, Fig 1). |
| **plastic strain** | The non recoverable strain after removing the load after being subject to a high strain level. |
| **plug (electrical / optical)** | The connector which inserts into the mating receptacle connector. A plug connector may contain male or female conductor mating arrangements depending on whether the plug is live whilst unmated or other considerations applicable to recoverable equipment (eg., control pod). |
| **post load-out testing** | Testing undertaken following load-out of an umbilical system onto the installation/shipping vessel to confirm functional component integrity has been maintained. Generally only applies to spooled load-outs. |
| **potable water** | See **town mains water**. |
| **power cable** (umbilical functional component) | A cable designed to transmit electrical energy generally at electrical transmission voltages up to and including standard rated voltages Uo/U(Um) = 3.6/6 (7.2) kV rms. |
| **power core** | An insulated conductor for the transmission of low or medium voltages for power applications. |
| **powered reel** | A reel mounted in a structure and connected to a motor, allowing product to be wound onto the reel or to be unwound or deployed from the reel. |
| **preform** | The introduction of curvature into stiff functional components to assist the lay-up operation and reduce residual stress in the completed umbilical. Generally undertaken as an integral part of the lay-up operation.<br><br>Also applies to high tensile armour wires to assist the armouring operation. |

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| **pressure balance arrangement** | An arrangement whereby the internal pressure of a sub-sea system or component installed sub-sea is equal to the external hydrostatic pressure. Typically used for electrical connectors and SEM's to reduce the risk of sea water entering such critical parts of the sub-sea production system. |
| **pressure decay test** | A test to determine the amount by which the pressure falls in a fluid conduit, after having being raised to a particular level and then isolated from the pressurizing source. Used to demonstrate the characteristics of a hose due to creep of the materials of construction and the hydraulic integrity of the fluid conduit. |
| **product life-cycle management** | PLM (also known as Life Cycle Information) : the process of managing the entire life cycle information of an umbilical from design and manufacture to service and ultimate disposal. |
| **produced fluid** | Fluid emanating from a well bore or well head arrangement during production operations of a SPS**.** |
| **production joint** | A mechanism for factory, or, dockside jointing umbilical lengths to achieve the final production length. Used where the production length is in excess of the factory manufacturing length, or where a flexible joint in inappropriate. |
| **proof pressure test** | A test undertaken at the proof test pressure. See also **proof test pressure.** |
| **proof test pressure** | A pressure, typically higher than the design pressure, applied to a hose/assembly or a steel tube/assembly for a short duration to demonstrate integrity without causing destruction or deterioration. See also **proof pressure test.** |
| **propagation pressure** | The pressure at which a buckle propagates in a fluid conduit. See **buckle propagation**. |
| **protective cap** (electrical/optical) | A simple cap to provide protection to the mating part of the connector during transport and storage prior to use. Not to be confused with **dummy connector**. |
| **protective conduit assembly** | An assembly comprising a flexible conduit complete with end fittings to provide mechanical protection to exposed umbilical functional components. Such an arrangement may be fitted between the platform hang-off and the TTU. |
| **pull-in conduit** | An I/J-tube or caisson shore crossing through which an umbilical is pulled to allow mechanical and functional interfacing with the host facility. |
| **pull-in head** | Device used for terminating the end of an umbilical so that it can be loaded/offloaded from a vessel and pulled along the seabed and/or through an I-tube or J-tube.<br><br>NOTE In some designs, the terminated armours can be used to anchor the umbilical at the top of the I-tube or J-tube. It normally is comprised of a streamlined cylindrical housing into which the umbilical armouring is terminated and within which the ends of the functional components are contained. It is usually capable of rapid disassembly to access the components for post-pull-in tests and monitoring. A form of pull-in head may also be used at the subsea end of the umbilical. |

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| **pup-piece** | See stub pipe. |
| **quad** (electrical) | A cable for the transmission of electrical power or low frequency signals, consisting of four insulated conductors twisted together in a symmetrical arrangement with a constant lay length. The cable may be screened or unscreened depending on functionality requirements. |
| **Quality Assurance (QA)** | Those planned systematic and preventative actions which are required to ensure that materials, products or services will meet specified requirements. |
| **Quality Control (QC)** | Inspection, test or examination to ensure that materials, products or services conform to specified requirements. |
| **Quality Plan** | A project plan which describes the project philosophy and objectives to be employed throughout the project. It shall be considered as the controlling quality assurance document during the execution of the work scope for the project and supported by sub-contractors quality plans where necessary. Technical, administrative and quality procedures also support the quality plan in the control of the performance of the work during all phases of the project.<br><br>Not to be confused with **Inspection and Test Plan.** |
| **receptacle (electrical / optical)** | The connector which mates with the plug connector. A receptacle may contain male or female conductor mating arrangements depending on whether the plug is live whilst unmated or other considerations applicable to recoverable equipment. |
| **reel** | Device for storing, transporting, or installing umbilicals or components comprised of two flanges, separated by a barrel, with the barrel axis normally being horizontal.<br><br>NOTE Reels are designed for the intended use. |
| **repair joint** | The physical means of joining together part lengths of umbilical following removal of a damaged section of the original umbilical length. May be associated with the incorporation of a spare length of umbilical where the damaged length of umbilical is significant. |
| **rigging** | A general term to describe the ropes chains and tackle used to secure umbilicals, terminations, etc. |
| **ring swage** | See **swaging** |
| **roving** | A layer of fibres, usually in string form, helically applied around bundled components to act as a bedding layer, or around an armour layer to provide protection to the galvanizing, and, if required, contrasting colour arrangement (‘barber pole finish’) to assist in the installation of an umbilical. |
| **running tool** | Surface located tool used to remotely operate, retrieve, position or connect subsea equipment. |
| **sacrificial anode** | The metal forming the anode in a cathodic protection system whereby the anode is attached to a metal structure such as a sub-sea termination to inhibit corrosion of the structure. When installed sub-sea, the anode electrolytically decomposes leaving the structure free of corrosion. |

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| **saddle** | An arrangement, usually resembling a saddle in shape, located between the rim of an installation/shipping/storage reel and the load bearing member, (ground, vessel deck, etc.) to enable the load to be distributed over a greater area. May also be known as **cradle**. |
| **scouring** | See **sea bed scouring** |
| **screen** | A continuous conducting layer applied around laid-up electrical cores to minimize electrical interference from another circuit, or, around an individual power core to provide a uniform radial electrical field in the power core. Also may be referred to as a **shield**. |
| **sea-bed scouring** | Localised erosion of the sea bed caused by the disturbance to water flow arising from a sea bed installation. Such scouring may undermine the support/protection of an umbilical, in particular, at the touch down location on exiting a J-tube |
| **sea-bed stability** | This normally applies to static sections of umbilicals. It is the ability of the umbilical to remain stable when considering a number of factors such as seabed conditions, seabed current, product weight and diameter. |
| **service fluid** | The fluid conveyed by the goods during operational service. Such fluids include chemical injection control and gas lift service. May also include produced fluid service where an annulus bleed arrangement forms part of the SPS. |
| **service life** | Specified time during which the umbilical is expected to be in service (usually less or equal to design life) |
| **services** | Work undertaken in support of, or incidental to, the main work scopes, and which does not form a permanent part of the goods; usually involving the provision of labour, consumables, assembly/test equipment by Supplier and/or specialist organisations. Eg., electrical connector manufacturer in respect of fitment of free issue electrical connectors, third party analysis of dynamic motions during installed conditions |

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| **shall** | Indicates mandatory requirement. |
| **sheath** | A covering of a functional component, a bundle, a sub-bundle or an outer armour layer, generally of polymeric material, to provide mechanical protection and/or to meet geometrical requirements as part of the umbilical lay-up. |
| **shield** | See **screen**. |
| **should** | Indicates preferred course of action or is recommended as good practice. |
| **sigma phase** | The most predominant third phase which precipitates when Super Duplex Stainless Steel is incorrectly heat treated or welded. The presence of such a third phase can significantly reduce mechanical and corrosion resistance properties. |
| **signal cable** | A cable for the transmission of electrical control and communication signals up to and including standard rated voltages Uo/U=0.6/1kV rms. Sometimes called a telecommunication (telecom ) cable and frequently screened. |

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| **SN Curve (Data)** | A curve derived by plotting the cyclic stress and the corresponding number of fatigue cycles to failure for a given material or structure, as a function of different cyclic stress levels. |
| **SN Design Curve** | Cyclic stress and corresponding to the number of fatigue cycles derived from statistical manipulation of SN Curve data. |
| **span length** | The visual span length where a gap exists. Generally applies where umbilicals are installed on, or, in the seabed, where depressions occur. |
| **span shoulder** | The point of transition between supported and unsupported sections of an umbilical in conjunction with free spans. |
| **spark test** | Usually an in-line process test to locate faults in the insulation or sheath covering using a high voltage source that shorts when a hole or inclusion is detected. |
| **splash zone** | Transition zone of external surfaces of a structure, pipeline, or umbilical that are wetted by seawater, permanently or periodically, due to influence of waves and tides. |
| **splice** | The joining together of functional components in an umbilical to achieve the required production length, or, affect a repair. |
| **spool piece** | A short length of large bore pipe typically fitted between the umbilical termination interface and a sub-sea termination/subsea distribution unit effectively increasing the interface length to facilitate routing of the functional components to their respective connection points within the termination. |
| **spooling** | The process of winding functional components, umbilical elements, (armour wires, fillers etc.) and umbilicals onto their respective storage/processing arrangements, (bobbins, reels, carousels, etc.). |
| **spooling tension** | The tension applied during spooling. Too low a spooling tension will result in instability of the item on its deployment or processing reel resulting in trapped turns preventing pay-off. |
| **spreader bar** | A beam arrangement to allow reels to be lifted in a controlled manner using a single rope system such as used on a crane usually by means of strops attached each end of the beam with the rope attached to the centre of the bar. The other end of the strops generally attach to a spindle inserted through the centre of the reel. |
| **stab plate** | A plate containing hydraulic or electrical connectors or combinations of each service. Such plates are used in conjunction with a mating plate to allow multiple connections to be made by means of a single operation. In practice, one plate is invariably mounted on a sub-sea structure, eg., sub-sea termination, christmas tree (fixed) and the mating plated attached to the end of a jumper bundle/flying lead (free). |
| **stand-by (installation)** | The time in which the installation vessel is stationary with the umbilical suspended from the deployment chute, usually as a result of unplanned events, eg., installation equipment breakdown. |
| **static application** | Application for which the load effect(s) due to dynamic loads (e.g. wave action, induced vibrations etc.) when installed can be neglected.<br><br>NOTE Free spans, in an otherwise static umbilical, should be considered |

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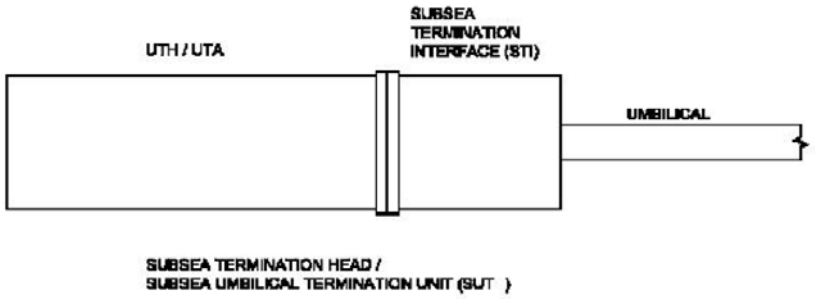
| | as a dynamic application. |
| **strain history** | Summation of the elastic-plastic strain cycles experienced by a steel tube functional component during manufacture and installation. Modelling of the hysteresis loops for each cycle enables the plastic fatigue damage to be accurately quantified. |
| **stub pipe** | A short length of small bore pipe, generally attached to a hydraulic coupling, to facilitate welding/connection to another length of pipe which forms part of the fluid circuit. |
| **sub-bundle** | Laid-up functional components grouped together as a separate bundle within the overall umbilical bundle. |
| **submarine power cable** | An underwater cable for transmitting electrical power at medium or high voltage. May include data communication capability in the form of one or more optical fibre cables but does not include production control and chemical injection functional components. |
| **sub-sea** | Generally used in the context on or close to the seabed where sub-sea production equipment is, or will be, installed. |
| **sub-sea connector** | A connector for use in a sub-sea environment which may be of the 'dry mate' or 'wet mate' design.<br><br>See **dry mate connector, wet mate connector** |
| **sub-sea distribution unit (SDU)** | A mechanism for mechanically, electrically, optically and hydraulically, as required, independently connecting the umbilical to more than one sub-sea system. (In this context, hydraulically includes chemical injection, control, produced and gas lift fluids). |
| **sub-sea production control system** | Control system operating a subsea production system |
| **sub-sea termination interface (STI)** | mechanism that forms the transition between the umbilical and the subsea termination |
| **sub-sea umbilical termination unit (SUT)** | A mechanism for mechanically, electrically, optically and hydraulically, as required, connecting an umbilical or jumper bundle to a sub-sea system. In this context, hydraulically includes chemical injection, control, produced fluids and gas lift lines.<br><br>The SUT can also be named **UTH/UTA etc.**<br><br>  <br><br><br>**Note: Normally a bend protection device is used in the transition between the umbilical and the STI.** |
| **swaging** | Method of attaching an end fitting/coupling to a hose by application of an axial compressive force to the front of the end fitting. The fitting |

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| | abutment is forced into a die of a smaller diameter. (Ref Appendix 2, Fig 2). |
| **system integration test (SIT)** | A test or series of tests whereby an umbilical system is connected to mating arrangements (control pod, actuator, tree, etc.) to confirm correct line functionality and overall system performance. |
| **system operating pressure** | The highest continuous internal pressure at which a hose or steel tube, including attached end fittings/couplings and associated hydraulic connectors are intended to be used in service. It shall not exceed the umbilical hose/tube design working pressure and is invariably determined by the performance characteristics of equipment connected to the umbilical/ umbilical system. |
| **SZ lay-up** | See **oscillatory lay-up**. |
| **tagging** | The identification applied to goods, functional components, elements of the goods, etc., to identify such information as part numbers, connection service, handling instructions, safety considerations, etc. |
| **tensile armour** | Structual layer consisting of e.g. steel wires, fibre reinforced plastic rods, etc. that is used to sustain tensile loads in the umbilical.<br><br>NOTE For some applications, the tensile armour may also have the additional function of providing weight and/or impact protection. |
| **tether** | A length of rope or chain used to connection between the tether clamp and the anchor to a stationary point. |
| **tether clamp** | A clamp attached to the object to be tethered and which is connected to the tether. |
| **teredo worm** | Form of marine life, often called 'ship worm' because of it's attachment to the hulk of a wooden sailing ship. Existing in shallow sea water near to land, in some regions of the world, umbilicals and submarine power cables generally require the incorporation of metal tape to prevent polymer attack by such worms leading to functional component breakdown. |
| **test pressure** | A constant pressure, normally higher than its design working pressure, applied to a fluid conduit for a short duration to demonstrate its integrity without causing destruction or deterioration. |
| **third party** | See **independent verification agent** |
| **time domain reflectometry (TDR)** | A fault finding test to locate breaks or significant change in impedance n electrical conductors by pulse reflection techniques. |
| **topside umbilical termination unit (TUTU)** | An enclosure located on a platform or floating production facility, usually directly above or adjacent to the I/J-tube riser system, to provide the means of connecting the umbilical functional components to the topside supply/return lines. |

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| **torque balanced** | An umbilical design which shows little or no propensity to rotate about its axis under the action of a tensile load.<br><br>Note: It is invariably not possible for an umbilical to show no propensity to rotate between zero and its maximum working load. The degree of torsional loading shall be such that the umbilical does not induce significant twist during installation deployment and, for a dynamic umbilical during service, which could result in loops or |

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| | abnormal configurations. |
| **torsional stiffness** | The torque required to produce or resist angular rotation in an umbilical or functional component. |
| **town mains water** | Water from a town water supply suitable for drinking. May also be known as **potable water**. |
| **traction test** | A test which applies a combination of radial crush and tensile load to an umbilical sample in order to simulate the installation scenario using a tensioner to verify the hold back tension capacity (sometimes referred to as crush friction or crush tension test). |
| **trefoil arrangement** | A geometrical arrangement whereby electrical power cores in a three phase electrical circuit are laid up, with the centre of each core positioned at the corner of an imaginary triangle whose sides are of equal length. Thus, six power cores located on a PCD would contain two trefoil arrangements. |
| **triad** (electrical) | A cable for the transmission of electric power or low frequency signals consisting of three insulated conductors twisted together in a symmetrical arrangement with a constant lay length. The cable may be screened to reduce cross-talk. Sometimes referred to as a triple. |
| **ultimate tensile load** | Load at which the weakest components of the umbilical bundle fails when the load is applied with the umbilical in a straight condition. |
| **ultra-deep water** | Term used to imply depths exceeding 1,830m (6,000ft), which can necessitate the consideration of design and/or technology alternatives. |
| **umbilical** | A group of functional components, (electrical/optical fibre cables, hoses, steel tubes and power cores,) laid-up or bundled and sheathed or roved for external mechanical protection.<br>May also be armoured for mechanical strength, additional protection, or ballast. |
| **umbilical joint** | Means of joining together two lengths of umbilical to effect a repair or to achieve the required production length. |
| **umbilical system** | An umbilical complete with end terminations. May also apply when fitted with ancillary equipment. |
| **unaged hose** | Recently manufactured hose which may or may not have been subjected to manufacturing pressure tests, and has not been incorporated in an umbilical, or subject to damaging pressures. |
| **unaged representative sample** | Non-degraded sample of umbilical, or component that has not previously been subjected to operational or installation loadings, stresses, elevated temperature, and/or other conditions that can degrade the sample. |
| **UTA** | See **SUT subsea umbilical termination unit** |
| **UTH** | See **SUT subsea umbilical termination unit** |
| **utility umbilical** | An umbilical for the provision of electric power, process fluids and data communications installed between two fixed platforms, a fixed platform and a floating facility, or a fixed platform/floating facility and a land based station. |

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| **verification test** | Tests performed on an umbilical component, or a production length of umbilical, designed to determine conformance with specified design requirements, or predicted properties. |
| **virgin material (non-metallic materials)** | Raw material as supplied by the material manufacturer. Virgin material does not comprise or contain re-granulated, recycled, reprocessed, reused or other similar material. |
| **visual examination** | Examination of material, functional components, part completed functional components, finished and part-finished goods, for visible defects in material and workmanship. |
| **volumetric expansion** | The increase in internal volume of a hose when pressurized, expressed as a percentage change in volume at the specified pressure. |
| **weight to diameter ratio** | This normally applies to dynamic umbilicals and is a measure of the products hydro-dynamic response. It is used in order to harmonise an umbilical with adjacent risers, anchor or tether lines.<br>May also be known as **diameter to weight ratio**. |
| **weak link** | A mechanism incorporated within the umbilical or the umbilical system, such that in the event of the umbilical being subject to excessive tensile loading(as a result of anchor drag, etc) damaging forces are not transmitted to other areas. May also be included between a STU/SDU and the system connecting to the STU/SDU. |
| **wet mate connector (electrical / optical)** | A connector designed to be mated / de-mated in an underwater environment whilst directly in contact with water. |
| **wet parking** | A process of leaving an umbilical system or part of an umbilical system on the seabed or below the waterline, partially or fully disconnected from the subsea production system and/or host facility. In such a situation, additional corrosion protection of metallic components/structural elements and long term sealing arrangements for electrical/optical fibre cables, etc., may be required. Wet parking is typically undertaken during intervention activities, or, where an umbilical system, or, part umbilical system, is deployed prior to interfacing with mating elements of the sub-sea production system. See also **parking plate.** |
| **will** | Indicates an intent. |

## 4. ABBREVIATED TERMS

| Abbreviation | Abbreviation Expanded |
|---|---|
| **ABS** | American Bureau of Shipping |
| **AC** | alternating current |
| **AFE** | approved for expenditure |
| **ALS** | accidental limit state |
| **ANSI** | American National Standards Institute |
| **API** | American Petroleum Institute |
| **ASME** | American Society of Mechanical Engineers |
| **ASTM** | American Society for Testing of Materials |
| **BOD** | basis of design |

| | |
|---|---|
| **BOP** | blow-out preventer |
| **BS** | British Standard |
| **BSI** | British Standards Institute |
| **BSR** | Bend Strain Reliever or Bend Stiffener |
| **CCITT** | International Telegraph and Telephone Consultative Committee |
| **CIF** | chemical injection fluid |
| **cm** | Centimetre |
| **CNS** | Central North Sea |
| **COSH** | Control of Substances Hazardous to Health |
| **CP** | cathodic protection |
| **CRA** | corrosion resistant alloy |
| **CRM** | corrosion resistant material |
| **CTR** | cost, time, resource |
| **CS** | carbon steel |
| **Cv** | coefficient of flow |
| **DBB** | double block and bleed |
| **DC** | direct current |
| **DFF** | design fatigue factor |
| **DFCGF** | design fatigue crack growth factor |
| **DHSV** | down hole safety valve |
| **DIN** | Deutsches Institut fur Normung |
| **DNV** | Det Norske Veritas |
| **DP** | dynamic positioning |
| **DSV** | diving support vessel |
| **DWP** | design working pressure |
| **E & A** | exploration and appraisal |
| **E & P** | exploration and production |
| **ECA** | engineering criticality assessment |
| **EH** | Electro-hydraulic |
| **EOR** | enhanced oil recovery |
| **EPC** | engineer, procure and construct |
| **EPC** | ethylene propylene co-polymer |
| **EPCI** | engineer, procure, construct and install |
| **EPDM** | ethylene propylene diene monomer |
| **EPIC** | engineer, procure, install and commission |
| **EPM** | ethylene propylene monomer |
| **EPR** | ethylene propylene rubber |
| **EQDC** | emergency quick disconnect |
| **ESD** | emergency shut down |
| **ESDV** | emergency shut down valve, may also be known as **sub-sea isolation valve** |
| **ESP** | electrical submersible pump |
| **FAT** | factory acceptance test |
| **FD** | frequency domain |
| **FEA** | finite element analysis |
| **FEED** | front end engineering design |
| **FEXT** | far end cross talk |
| **FIR** | full indicated reading |
| **FLS** | fatigue limit state |
| **FMEA** | failure mode and effect analysis |
| **FMECA** | failure modes, effect and criticality analysis |
| **FPS** | floating production system |
| **FPSO** | floating production, storage and offloading |
| **FPU** | floating production unit |
| **Ft** | Feet |
| **GA** | general assembly |

| | |
|---|---|
| **gm** | Gram |
| **GPS** | global positioning system |
| **HAT** | highest astronomical tide |
| **HAZ** | heat affected zone |
| **HAZA** | hazard analysis |
| **HAZID** | hazard identification |
| **HAZOP** | hazard and operability |
| **HCR** | high collapse resistance |
| **HDPE** | high density polyethylene |
| **HIPPS** | high integrity pipeline protection system |
| **$H_{max}$** | maximum wave height |
| **HP** | high pressure |
| **HP/HT** | high pressure/high temperature |
| **HPU** | hydraulic power unit |
| **$H_s$** | significant wave height |
| **HSE** | health safety and environment |
| **HT** | high temperature |
| **ICEA** | International Electrical Manufacturers Association |
| **ID** | internal diameter |
| **IEC** | International Electrotechnical Commission |
| **in** | Inch |
| **IRM** | intervention and routine maintenance |
| **ISO** | International Standards Organization |
| **ITB** | invitation to bid |
| **ITP** | inspection and test plan |
| **ITT** | invitation to tender |
| **IVB** | Independent Verification Body |
| **J** | Joule |
| **JIC** | Joint Industries Council |
| **JIP** | Joint Industry Project |
| **JSA** | job safety analysis |
| **JV** | joint venture |
| **kg** | Kilogram |
| **kN** | Kilonewton |
| **kV** | Kilovolt |
| **lb** | pound |
| **LAT** | lowest astronomical tide |
| **LDPE** | Low density polyethylene |
| **LNG** | liquefied natural gas |
| **LOA** | letter of award |
| **LOF** | life of field |
| **LOI** | letter of intent |
| **LOP** | life of project |
| **LPG** | liquefied petroleum gas |
| **LP** | low pressure |
| **LTI** | lost time incident |
| **LV** | low voltage |
| **m** | metre |
| **mboe** | million barrels oil equivalent |
| **MBR** | minimum bend radius |
| **MCS** | master control station |
| **MDPE** | medium density polyethylene |
| **MDR** | master document register |
| **MSDS** | Material safety data sheet |
| **MDS** | material data sheet |
| **MEG** | mono-ethylene glycol |

| | |
|---|---|
| **MeOH** | methanol |
| **mmcfd** | millions of cubic feet per day |
| **mm** | millimetre |
| **MMT** | material movement ticket |
| **MPI** | magnetic particle Inspection |
| **MPQ** | manufacturing procedure qualification |
| **MPT** | magnetic particle testing |
| **MSL** | mean sea level |
| **MTBF** | mean time between failure |
| **MTI** | medical treatment incident |
| **MUX** | multiplexed |
| **MV** | medium voltage |
| **MWA** | mid-water arch |
| **MWD** | maximum water depth |
| **MWP** | maximum working pressure |
| **N** | Newton |
| **N/A** | not applicable |
| **NACE** | National Association of Corrosion Engineers |
| **NAMAS** | National Measurement and Accreditation Service |
| **NAS** | National Aerospace Standards |
| **NB** | nominal bore |
| **NCR** | Non Conformance Report |
| **NDE** | non destructive examination |
| **NDT** | non destructive testing |
| **NEXT** | near end cross talk |
| **NNS** | Northern North Sea |
| **NORSOK** | Norsk Sokkels Konkurranseposisjon |
| **NPT** | National Pipe Thread |
| **OD** | outside diameter |
| **O & G** | oil and gas |
| **O & M** | operations & maintenance |
| **OMM** | Operation & Maintenance Manual |
| **Opex (OPEX)** | operating expenditure |
| **OTDR** | optical time domain reflectometer |
| **P & ID** | process and instrument diagram |
| **PCD** | pitch circle diameter |
| **PE** | Polyethylene |
| **PLEM** | pipe line end manifold |
| **PP** | Polypropylene |
| **ppb** | parts per billion |
| **ppm** | parts per million |
| **PRE** | pitting resistance equivalent |
| **PREN** | pitting resistance equivalent number |
| **psi** | pounds per square inch |
| **PTFE** | Polytetrafluoroethylene |
| **PU** | Polyurethane |
| **PVC** | polyvinyl chloride |
| **QA** | quality assurance |
| **QC** | quality control |
| **QCDC** | quick connect disconnect |
| **QM** | Quality Management |
| **QMS** | Quality Management System |
| **QP** | Quality Plan |
| **RAM** | reliability, availability and maintenance |
| **RAO** | response amplitude operator |
| **RFC** | rain flow counting |

| | |
|---|---|
| **$R_{max}$** | period associated with $H_{max}$ |
| **rms** | root mean square |
| **ROV** | remotely operated vehicle |
| **RP** | Recommended Practice |
| **SAE** | Society of Automotive Engineers. |
| **SCC** | stress corrosion cracking |
| **SCF** | stress concentration factor |
| **SCM** | sub-sea control module |
| **SCR** | steel catenary riser |
| **SDRL** | Supplier Document Requirements List |
| **SDU** | sub-sea distribution unit |
| **SEM** | sub-sea electronic module |
| **SI** | System International |
| **SIT** | system integration test |
| **SMTS** | specified minimum tensile strength |
| **SMYS** | specified minimum yield stress |
| **SNS** | Southern North Sea |
| **SOR** | statement of requirements |
| **SOW** | scope of work |
| **SPM** | single point mooring |
| **SPS** | Sub-sea production system |
| **SRT** | site receipt test |
| **SSIV** | sub-sea isolation valve. May also be known as an **emergency shutdown valve (ESDV)**. |
| **SSS** | side scan sonar |
| **SSV** | sub-surface safety valve |
| **STI** | sub-sea termination interface |
| **STL** | submerged turret loading |
| **STP** | submerged turret production |
| **SUT** | sub-sea umbilical termination |
| **SURF** | Subsea, umbilicals, risers and flowlines |
| **SWL** | safe working load |
| **TBA** | to be advised |
| **TBC** | to be confirmed |
| **Tcf** | trillion cubic feet (of gas) |
| **TDR** | time domain reflectometry |
| **Tg** | glass transition temperature |
| **TLP** | tension leg platform |
| **Tp** | peak wave period |
| **TPI** | Third Party Inspection |
| **TRAP** | technical risk assurance process |
| **TUTU** | Topside umbilical termination unit |
| **Tz** | period associated with Hs |
| **U** | The rated power-frequency voltage between two insulated conductors, for which cables and accessories are designed. |
| **UKCS** | United Kingdom Continental Shelf |
| **ULS** | ultimate limit state |
| **Um** | The maximum power-frequency voltage between each insulated conductor and screen or sheath, for which cables and accessories are designed. It is the highest voltage that can be sustained under normal operating conditions at any time and at any point in a system. It excludes temporary voltage variations due to fault conditions and the sudden disconnection of large loads |
| **UNS** | Unified Numbering System |
| **Uo** | The rated rms power-frequency voltage between each insulated conductor and screen or sheath, for which cables and accessories are designed. |

| | |
|---|---|
| **UTA** | umbilical termination assembly |
| **UTH** | umbilical termination head |
| **UTS** | ultimate tensile strength |
| **UV** | ultra violet |
| **V** | Volts |
| **VLS** | vertical lay system |
| **VIV** | vortex induced vibration |
| **WF** | wave frequency |
| **WOCS** | Work-over control system |

| | |
|---|---|
| **WP** | working pressure |
| **WPQ** | weld procedure qualification |
| **WPQR** | welding procedure qualification record |
| **WPAR** | welding procedure approval record |
| **WPS** | welding procedure specification |
| **WT** | wall thickness |
| **XLPE** | cross-linked polyethylene |
| **XT** | X-mas tree |
| **%vol** | percentage volume |
| **%wt** | percentage weight |

# Appendix 1, Bend Strain Relief Arrangements

Figure 1.1: Bend Restrictor in Neutral Position

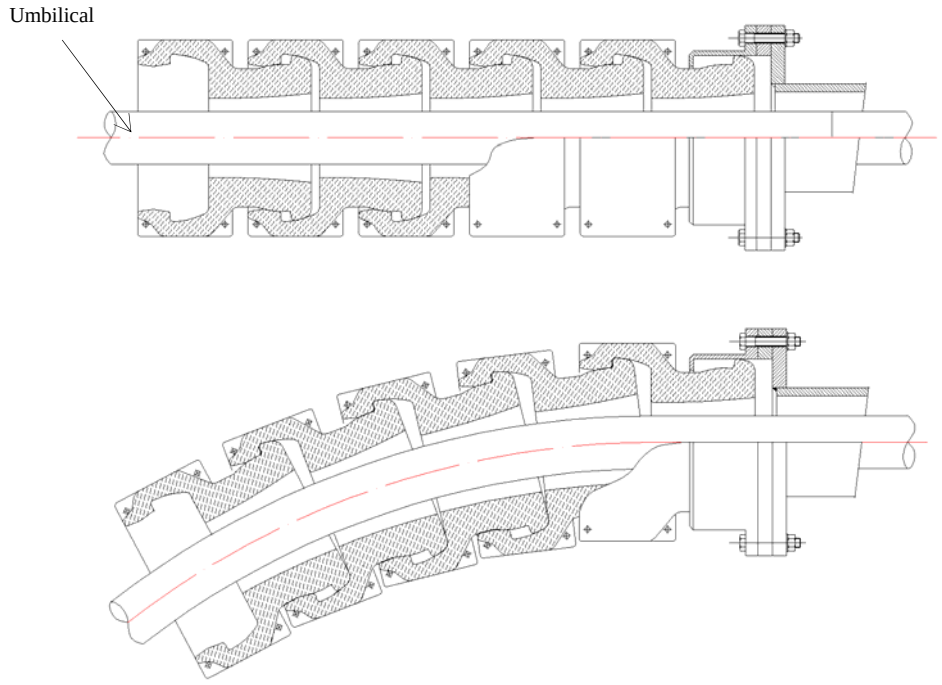



Figure 1.2: Bend Restrictor in Bent Position

**Figure 1: Example,Typical Bend Limiter**

Figure 2.1: Bend Stiffener in Neutral Position

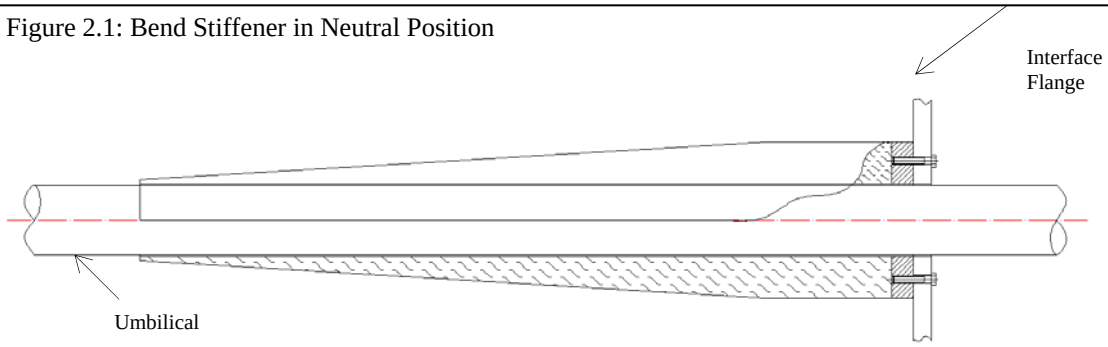



Figure 2.2: Bend Stiffener in Bent Position

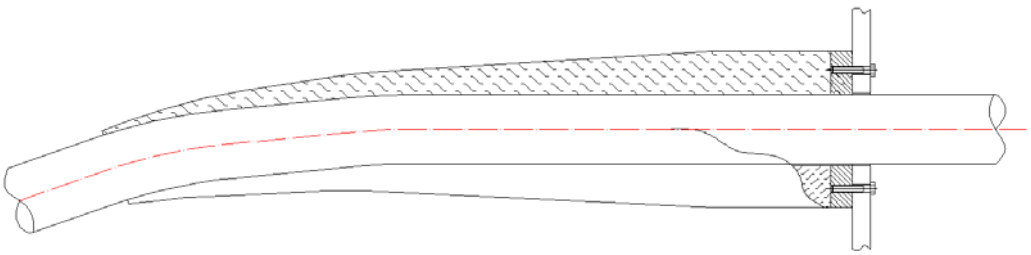


**Figure 2: Example, Typical Bend Stiffener**

# Appendix 2, Drawings

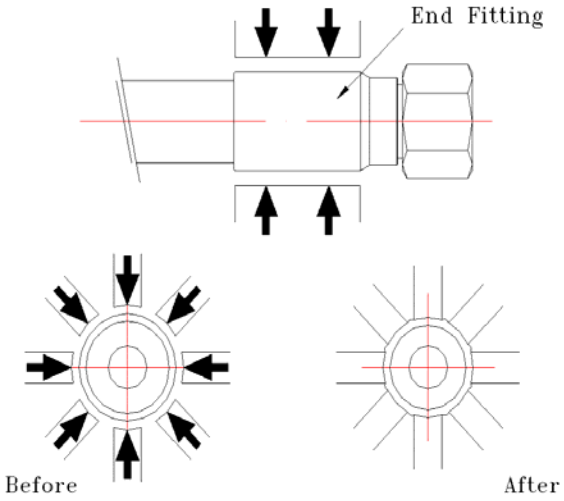



**Figure 1: Typical Method of Crimping**

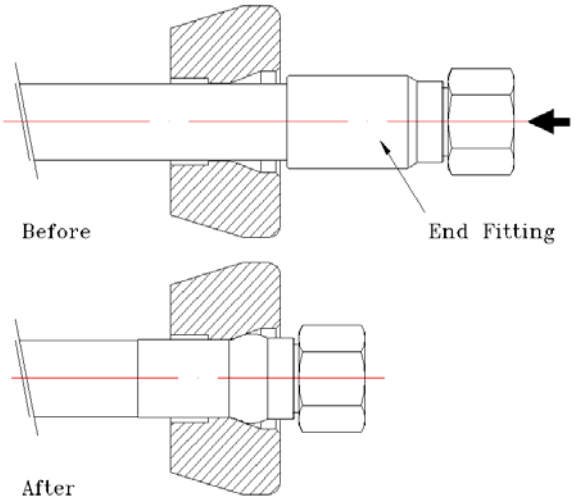
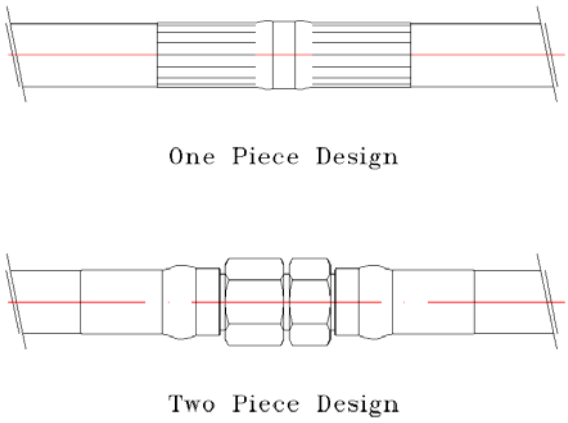



**Figure 2: Typical Method of Swaging**




Note: One piece coupling used to join thermoplastic hoses in umbilical without the need for a rigid joint box.

**Figure 3: Typical Coupling Arrangement**

# Appendix 3, Laying-up Process Arrangements/Cabled Product Forms

Figure 1.1: Typical Lay-up Process Arrangement

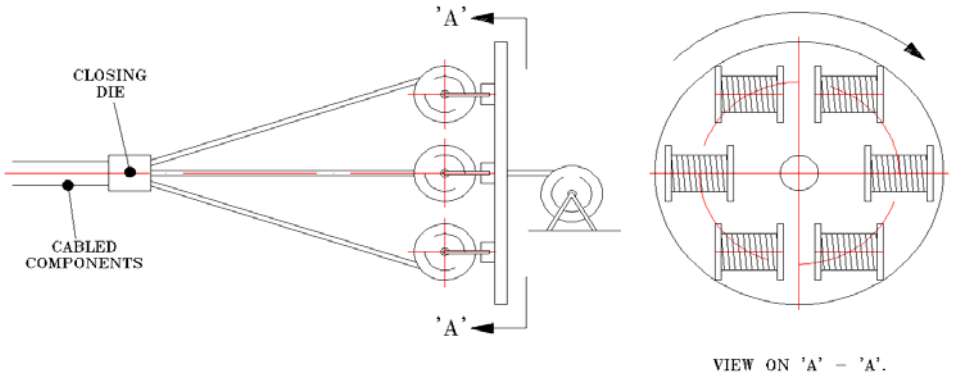



Figure 1.2: Typical Lay-up Form

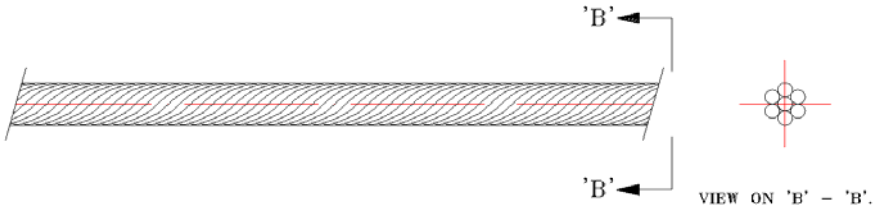



**Figure 1: Planetary Lay-up**

Figure 2.1: Typical Lay-up Process Arrangement

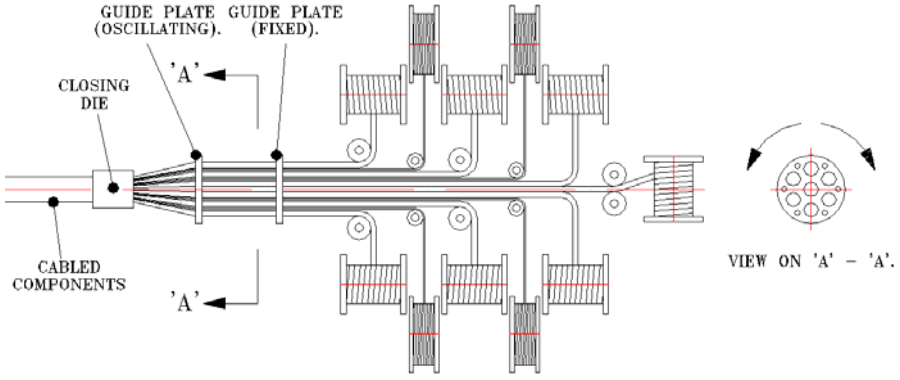



Figure 2.2: Typical Lay-up Form

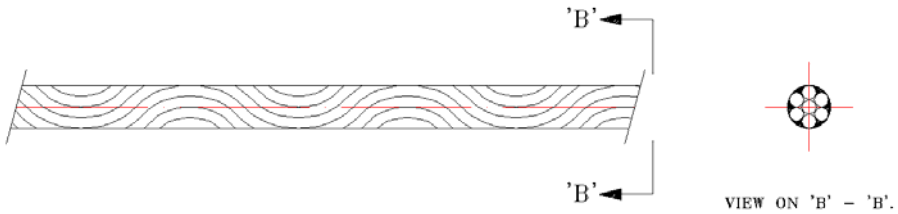



**Figure 2: Oscillatory (SZ) Lay-up**