

DEP SPECIFICATION

DEEPWATER UMBILICAL MANUFACTURING (AMENDMENTS/SUPPLEMENTS TO ISO 13628-5: 2002)

DEP 37.80.02.36-Gen.

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ECCN EAR 99

DESIGN AND ENGINEERING PRACTICE



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PART I INTRODUCTION AND GENERAL REQUIREMENTS

1. INTRODUCTION

1.1 SCOPE

This new DEP specifies the requirements and give recommendations for manufacture of steel tube umbilicals for subsea applications.

This DEP is based on ISO 13628-5:2002. Part II of this DEP amends, supplements and deletes various clauses of ISO 13628-5:2002.

Transportation and installation of umbilicals are not covered in this DEP (refer to DEP 37.80.03.30-Gen.).

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies, equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4 ABBREVIATIONS

Term	Definition
BR	Bend Restrictor
BS	Bend Stiffener
CoC	Certificate of Conformance
CoG	Centre of Gravity
CP	Cathodic Protection
CR	Conductor Resistance
DR	Deviation Request
DWP	Design Working Pressure
FAT	Factory Acceptance Test
GA	General Assembly
HAZ	Heat Affected Zone
IR	Insulation Resistance
ISO	International Organization for Standardization
IWOCS	Installation/Workover Control System
LV	Low Voltage
MBR	Minimum Bend Radius
MIT	Maximum Installation Tension
MLA	Mid Line Assembly
MPS	Manufacturing Procedures and Specifications
MRB	Manufacturing Record Book
NCR	Non-Conformance Report
OD	Outer Diameter
PE	Polyethylene
RDS	Reel Drive System
QA	Quality Assurance
QP	Quality Plan
SF	Safety Factor
SFL	Steel Flying Lead
SWL	Safe Working load
TDR	Time Domain Reflectometer
UTH	Umbilical Termination Head
UTHS	Umbilical Termination Head – Subsea
UTHT	Umbilical Termination Head – Topside
VIV	Vortex Induced Vibration
VR	Variation Request

WPQ	Welding Operator Performance Qualification
WPQR	Welding Procedure Qualification Record
WPS	Weld Procedure Specification

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (Part IV).

1.6 SUMMARY OF MAIN CHANGES

This is the first publication of this DEP; however, it is an update of the following Principal standards in whole or part:

- SDS-US-05, Revision 6, Umbilical Manufacturing Specification
- SDS-US-19, Revision 2, Tube and Umbilical Transportation Specification
- SDS-US-22, Revision 1, Umbilical Reel Design and Manufacture

1.7 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.8 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

2. GENERAL

Part II of this DEP is written as amendments and supplements to ISO 13628-5:2002. Wherever reference is made to ISO 13628-5, it shall be understood to mean ISO 13628-5:2002 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of ISO 13628-5 has been used throughout Part II of this DEP.

Clauses in ISO 13628-5 which are not mentioned in this DEP shall remain valid as written.

Any concessions agreed upon between Manufacturer/Supplier and Principal during tender negotiations shall be listed as technical clarifications to this DEP and included in any contract. Requests for concessions thereafter shall be in the form of a Technical Deviation Request, submitted in writing to and approved by the Principal.

Part III of this DEP includes additional requirements pertaining to umbilical tube transportation and reel design and manufacture.

PART II AMENDMENTS/SUPPLEMENTS TO ISO 13628-5:2002**5 QUALITY ASSURANCE**

Add new clauses:

a) Equipment Calibration

All test equipment shall be calibrated over full range (100% of measuring scale). Calibration certificates for all equipment shall list the last and next calibration dates and shall be checked for compliance before equipment use.

b) Equipment Calibration Register

All test equipment to be utilized during execution of the project shall be listed on a register with unique tag number and calibration status. The register shall then be submitted to the Principal Inspector.

c) Instrument Accuracy

The Quality Plan (QP) shall include the tolerances for all electrical and mechanical instrumentation used to measure or monitor criteria stated in the QP. These measurements include:

- Bundle length
- Bundle diameter
- Cable performance characteristics
- Pressure
- Temperature
- Flowrate

6 DESIGN REQUIREMENTS**6.3 ANALYSIS****6.3.5 Dynamic Service Analysis**

Delete "A suitable safety margin".

Replace with this clause:

A safety margin of **10** shall be maintained between calculated fatigue design life and required service life.

A dynamic analysis shall be performed using each of the wave states in the scatter diagram in the three (3) primary offset directions. The dynamic analysis shall be used to determine the theoretical fatigue design life of the umbilical and for input into the bend stiffener (BS) design iteration.

Fatigue SN Curve to use for the steel tube material specified in the Project Scope of Work:

Seamless Super Duplex, DOE-B Fatigue SN Curve: $C = 4.47E+11$, $m = 4$

Zinc Clad Duplex, DOE-B Fatigue SN Curve

Umbilical Service Life = Y years, to be stated on the Project Scope of Work

Allowable fatigue damage = 10% of fatigue design life over Y years

7 COMPONENT DESIGN MANUFACTURE AND TEST

7.1 GENERAL

Add to this clause:

Low voltage (LV) Electric Cables 7.2 – 7.7: ISO applies except where noted.

Medium voltage (MV) Electric Cables: Defined as cables with a rated voltage between 1 kV and 30 kV as per IEC 60502-2 and IEC 60502-1. Manufacture is governed by DEP 37.80.02.35. Certain sections of ISO 13628-05 (7.2-7.7 – ISO) apply where noted.

- Fibre Optical Fibre Cable (7.8): ISO applies except where noted.
- Hoses: Not applicable for steel tube umbilical manufacture.
- Steel Tubes (7.10): Does not apply.

Principal shall specify dimensions, material, and pressure rating of steel tubes according to the following specifications:

- Seamless Super Duplex steel tubes: DEP 37.80.02.31-Gen.
- Zinc Clad Duplex tubes: DEP 37.80.02.33-Gen.
- Seam welded Super Duplex tubes: DEP 37.80.02.32-Gen.

7.1.1 Design Qualification and Verification Testing

Add this new clause:

Qualification tests to support design are listed in four (4) categories below. These tests may be regarded as Qualification (on prototype article or prototype length) or Verification (on production article or sample of production length). The Project Scope of Work shall specify which are required. Those tests followed by a section designation in parentheses are further detailed within this document.

Component Qualification – Tubes

- Steel tube weldability trial (7.1.1.1)

Component Qualification – LV Cables

- a) Electric cable mechanical properties and transmission characteristics (7.1.1.2)
- b) Conductor core joint qualification (7.1.1.3)
- c) Insulation repair qualification (7.1.1.4)
- d) Electric cable joint/splice qualification (7.1.1.5)
- e) Water blocking seal for topside termination electric cable pigtails (7.1.1.6)

Full Scale Umbilical Cross-Section

- a) Welding procedure qualification & procedure qualification record for steel tube for lay-up (7.1.1.7)
- b) Lay up trial (7.1.1.8)
- c) Full umbilical repair splice kit design qualification (bundle) (7.1.1.9)
- d) Dynamic fatigue test, umbilical and BS design qualification (7.1.1.10)
- e) End strength terminations (pull head and subsea termination or two (2) subsea terminations) (7.1.1.11)
- f) Bundle impact test (7.1.1.12)
- g) Bundle squeeze/crush test (7.1.1.13)
- h) Torsion balance/tension test

- i) Bend stiffness test
- j) Internal/external friction factor assessment
- k) Free flooding rate
- l) Hydrostatic reduction of cross section
- m) Topside termination interface tests

Test sample drawings shall be prepared to illustrate:

- a) Sample length (note the pitch lengths of each pass on drawing)
- b) Pigtail lengths
- c) Tube termination details (to allow pressure monitoring/testing or not)
- d) Structural interfaces with the test rig
- e) Instrumentation placement and type
- f) Location of welds or electrical splices

The test samples for tensile tests and squeeze tests shall to be more than the longest pitch length plus some margin for end effects and preferably multiple pitch lengths (whole number of pitch lengths between resin terminations or tube ends if un-terminated). Terminations shall be mounted such that when the sample is straightened the termination is not cocked.

Umbilical Accessories

- Bend restrictor (BR) capacity and angle under load design qualification (7.1.1.14)
- Weak link mechanism (7.1.1.15)
- Temporary ROV subsea removable clamps
- Permanent subsea clamps
- Vortex induced vibration (VIV) strakes
- Crossing protection material
- Buoyancy modules (designed and tested according to project specifications)

Details of qualification and verification tests shall be included in the QP.

7.1.1.1 Steel Tube Weldability Trial

Add this new clause:

Applicable only for Seamless Super Duplex steel tubes.

If Manufacturer/Supplier's scope includes welding of Seamless Super Duplex tubes to produce coils, then preparation of the weld procedure specification (WPS) and welding procedure qualification record (WPQR) shall commence immediately upon receipt of straight tubes from tubing supplier. Refer to DEP 37.80.02.31-Gen.

7.1.1.2 Electric Cable Properties

Add this new clause:

The proposed cable construction shall be supported by qualification test results to support the associated published mechanical properties and cable transmission characteristics.

7.1.1.3 Conductor Core Joint

Add this new clause:

A procedure shall be qualified for joining stranded copper conductors. The qualification tests for the jointed conductor samples shall include as a minimum:

- Reverse Bends
Two (2) reverse bends (= 1 cycle) of 360° around a mandrel with radius 15 x conductor outer diameter (OD)
Acceptance: No defects after three (3) cycles followed by successful tensile test
- Tensile Test
Tensile test of the jointed core
Acceptance: Strength minimum 70% of original conductor
- Conductor Resistance (CR) Test
Measurement of CR
Acceptance: Confirm continuity of all conductor strands

Three (3) jointed samples and three (3) unjointed samples of identical length from the same conductor shall be tested in the same test rig under the same conditions to confirm the nominal (100%) value. Refer also to (7.6.4).

7.1.1.4 Insulation Joint

Add this new clause:

A procedure shall be qualified for repair of conductor insulation. The qualification tests for the repair samples of 3 – 5 m length (record actual length on the IR test report) shall include as a minimum:

- Reverse Bends
Two (2) reverse bends (= 1 cycle) of 360° around a mandrel with radius 15 x conductor OD
Acceptance: No defects after three (3) cycles followed by successful IR and voltage breakdown test
- Insulation Resistance (IR) Test
Measure IR under water
Acceptance: 100 GΩ at 1000 V DC
- High Voltage Test
High voltage test under water
Acceptance: Instantaneous breakdown minimum 50% of original core

Three (3) repaired samples and three (3) unrepaired samples of identical length from the same conductor shall be tested in the same test rig under the same conditions to confirm the nominal (100%) value. Refer also to (7.6).

7.1.1.5 Electric Cable Joint

Add this new clause:

A procedure shall be qualified for a cable joint during lay-up. The qualification shall be carried out on samples in the vertical or the horizontal orientation consistent with the work location for this activity during lay-up. The tools used shall be the same tools designated for such lay-up field joints. For qualification, three (3) cable joints shall be performed. The qualification tests for the jointed cable samples shall include as a minimum:

- Conductor core joints - Acceptance criteria as above
- Insulation joints - Acceptance criteria as above
- Rebuild bedding, screen, filler, outer sheath (as applicable for cable type) - Acceptance criteria; dimensions within QP tolerance limits, screen continuity.

7.1.1.6 Topside Termination Cable Seal Qualification

Add this new clause:

The method and materials for the water blocking seal on each umbilical cable size shall be qualified by hyperbaric testing to the host or potential abandonment depth, plus 10%, whichever is greater, as specified in Project Scope of Work.

7.1.1.7 Steel Tube WPS/WPQR for Lay-Up

Add this new clause:

- WPS/WPQR shall be governed by the requirements in DEP 37.80.02.31-Gen. Seamless Super Duplex Tubing Manufacturing Specification for Deepwater Umbilical and Subsea Distribution Hardware, DEP 37.80.02.33-Gen. Zinc Clad Duplex Tubing Manufacturing Specification for Deepwater Umbilicals, or DEP 37.80.02.32-Gen. Seam-welded Super Duplex Tubing Manufacturing Specification for Deepwater Umbilicals and Subsea Distribution Hardware as appropriate for the tube material being welded.

Backing gas shall be injected into the tubing such that no material contamination is present during any welding activity, and WPS and WPQR procedure development shall demonstrate representative conditions, e.g., actual welding unit to be used, representative reel length, fluid filled tubing, etc.

If the actual units used for welding vary, the same units and WPS used for lay-up shall also be used for the termination.

7.1.1.8 Lay-Up Trial

Add this new clause:

The length of the prototype and the criteria to be satisfied shall be specified in the Project Scope of Work. The prototype bundle lay-up shall include any planned or unplanned contingency electric cable or fibre optic cable splice. Such splices shall be performed using the procedure and personnel that would be utilized for a splice during production umbilical lay up.

7.1.1.9 Full Umbilical Repair Splice Kit

Add this new clause:

Qualification of the procedure and materials for a splice repair kit shall require:

- Hydrostatic test of the tubes to 1.25 x design working pressure (DWP), as listed on the Project Scope of Work, for 4 hours
- IR measurements of the cables
- CR measurements of the cables

IR and CR shall be compared to samples of the same length taken from the same cable as that used within the repaired bundle.

If a repair splice qualification be necessary, Manufacturer/Supplier may submit for Principal approval historical evidence in lieu of performing a new qualification.

7.1.1.10 Full Scale Fatigue Test

Add this new clause:

A full scale dynamic flex test with the BS and I-tube interface steelwork shall be performed to produce 100% of the umbilical theoretical fatigue design life [ten (10) times required service life) or tested to failure as specified in the Project Scope of Work.

The proposed steps for the full scale dynamic testing (with tension, deflection, number of cycles) shall be submitted to Principal for approval before commencing the test.

The tubes shall be pressurized to DWP and shall be recorded throughout the test period.

Electrical continuity measurements of the conductors shall be recorded continuously throughout the test period.

The test shall be stopped if and when hydraulic pressure or electrical continuity is lost and the reason shall be logged. Stoppages associated with the performance of the test rig or instrumentation shall be rectified and the test shall be re-started. Post test, (after failure or completion of 100% theoretical fatigue damage) Manufacturer/Supplier shall dissect the umbilical and examine all of the elements for damage, wear, and anomalies.

7.1.1.11 End Terminations

Add this new clause:

The pull-in-head or end terminations may be qualified without a project specific test only if Principal agrees in writing that an existing design has been proven for similar loads and any modifications to the design are not considered to detract from the load carrying capacity.

7.1.1.12 Impact Test

Add this new clause:

The impact resistance performance criteria shall be specified in the Project Scope of Work. Manufacturer/Supplier shall perform a systematic and controlled test with a weight of approx 1000 kg (2004 lb) from measured height intervals of 0.5 m (1.64 ft), 1 m (3.28 ft), 2 m (6.56 ft), 3 m (9.84 ft), etc. until visible penetrating damage to the outer elements (tubes or cables) is observed. Photos of the impact region for each specimen shall be taken with the drop height marked on the specimen and visible in the photo.

The sample that is anticipated to fail under cable checks (CR and IR) or tube pressure tests shall be tested first. If the test passes, the next more damaged specimen shall be tested. If this test fails, the previous less damaged specimen shall be tested.

The Manufacturer/Supplier shall propose exact weight and geometry of the dropped object, profile of the contact area and planned orientation of the bundle under the dropped object (assuming non-symmetrical cross section) for Principal approval. Procedure and results shall be included in the Project Document Register.

7.1.1.13 Squeeze Test

Add this new clause:

The squeeze test performance criteria shall be specified in the Project Scope of Work.

7.1.1.14 Bend Restrictor

Add this new clause:

The subsea BR design may be qualified without a project specific test only if Principal agrees in writing that an existing design has been proven for similar load and angle and any modifications to the design are not considered to detract from the proven load capacity.

Otherwise, a relevant length of BR sections or elements shall be tested to the design bending moment capacity with all bolts or fastening accessories torqued to the design value, as stated in the Project Scope of Work. Application of load shall continue in increments until failure. The bending moment at which damage occurs shall be recorded.

7.1.1.15 Weak Link Mechanism

Add this new clause:

Scope and criteria for weak link mechanism qualification shall be specified independently in the Project Scope of Work, if Principal requires this feature.

7.2 ELECTRIC CABLE

7.2.3.1 General

Add to this clause:

a) Source

Cables for the same service for the project shall be sourced from one (1) supplier and manufactured at one (1) facility unless otherwise agreed prior to award. Supplier shall be approved and qualified by Principal.

b) Splices

Splices shall be performed with qualified materials, method/procedure, and personnel. Qualification shall be specific for the cable type and dimensions.

c) Cable Splices

Conductors and completed electrical cables shall be manufactured in continuous lengths if possible. If splices of the completed electrical cable are required to achieve the final length requirement for the umbilical, splices may be performed with Principal approval and the following shall apply:

- Minimum cable splices shall be performed
- Splice shall be performed by a qualified joiner
- Physical restrictions requiring a splice in the cable length during cable manufacture or lay-up shall be reported to Principal
- Procedures for cable splicing shall be qualified (7.1) for the cable size and type
- Splice cross section shall be dimensionally identical or be within the outer dimensional tolerances of the cable being spliced
- CR measurements and insulation integrity tests utilizing water soak of the insulation repair area while measuring for leakage resistance to the other end of conductors shall be performed for all splices

In the event that a cable splice is made during lay-up, these tests shall be performed and documented before the lay continues. Locations of planned or unplanned splices during cable manufacture or umbilical lay-up shall be recorded in the cable or umbilical MRB and reported to Principal prior to layup or unplanned splice activity.

d) Insulation Thickness

The minimum insulation thickness specified by Manufacturer/Supplier shall be supported by qualification tests. The tolerance specified for the insulation thickness of the conductor insulation around the nominal shall be measurable in the water soak tests at the test voltage applied.

7.2.3.2 Configuration and Type of Conductor

Revise second paragraph:

Each conductor shall be comprised of a minimum of seven (7) strands.

Add to this clause:

With the exception of installation/workover control system (IWOCS) umbilical application, the minimum nominal cross sectional area shall be 6 mm². The conductor cross sectional area for any specific project will be defined in the Project Scope of Work.

7.2.3.5 Conductor Coding

Replace this clause by:

Core insulation standard colours for a pair (per BS 5467): Red, Black

Core insulation standard colours for a quad (per BS 5467): Red, Yellow, Blue, Black. The pairs shall be Red/Blue and Yellow/Black.

These conductor colours shall be used for pairs and quads unless otherwise specified in the Project Scope of Work or agreed to through clarifications.

7.2.3.8 Screening

Replace this clause by:

Screening requirements for electrical cables shall be defined in the Project Scope of Work.

If required, cables shall be screened with continuous overlapping copper tape. Non-metallic tape with copper film backing is acceptable. Cable supplier QP shall address quality assurance (QA) of copper tape thickness, overlap dimension, and bonding of any joints in the copper tape for continuity. Other screening alternatives may be considered, but are subject to prior approval by Principal.

7.2.3.9 Sheath

Replace this clause by:

Principal shall specify requirements for radial protection (in the form of steel tape, armour wire, or other) and/or tensile strength (armid fibre, armour wire, or other) in the Project Scope of Work.

NOTE: Requirements may differ for cables in static or dynamic applications.

7.2.3.10 Identification

Replace this clause by:

Umbilical bundles with more than one (1) cable of the same construction and size [e.g. two (2) quad cables] shall differentiate between the cables. The outer sheath of completed cables shall be colour coded to aid in identification within the umbilical cross section.

The wire/core/bundle/cable shall be measured during each process. At the outer sheath stage when the completed cable is being printed and marked, length measurements shall be taken by two (2) methods/devices. Methods to measure the cumulative length and accuracy of each method shall be specified in the QP.

In addition to colour coding, all cable labels shall be printed on the cables' outer sheath (not the sheath of the conductors) at intervals not exceeding 1 m (3.28 ft) with the following information:

- Cable manufacturer
- Unique cable identification (Principal specified tag number, if available)
- Batch number
- Voltage designation
- Order number (Manufacturer/Supplier's or Principal's)
- Number of cores and nominal cross sectional area

7.3 PERFORMANCE REQUIREMENTS – ELECTRIC CABLES

7.3.4 Performance Characteristics

Replace by this clause:

LV cable parameters shall be included in the Project Scope of Work.

7.5 MANUFACTURE – ELECTRIC CABLES

7.5.2 Insulation Extrusion

Delete second paragraph, last sentence:

“Repairs to the insulation shall not be permitted.”

Add to this clause:

Repair of Conductor Insulation

The statement that insulation shall be continuous without defects, shutdowns, or restarts (repairs to insulation not permitted) is incompatible with (7.2.3.1) regarding acceptance of splices.

Repairs to the insulation may be permitted with a non-conformance report (NCR) and Principal approval. Manufacturer/Supplier shall specify maximum allowable diameter change in the QP for the cable. Integrity tests utilizing water soak of the insulation repair area while measuring for leakage resistance to the other end of conductors shall be performed on all splices and repairs. Such insulation repair or splice of the electrical cable shall conform to all qualification and other additional requirements.

7.6 VERIFICATION TESTS

7.6.4 Insulation Tests

Add to this clause:

The existence or lack of a full length metal screen shall not change the test criteria. Principal requires the test to be performed at hydrostatic pressure equal to the maximum service depth stated in the Project Scope of Work. Three (3) jointed samples with conductor core joint and insulation repair shall be included in the test.

7.6.5 High Voltage DC Test

Add to this clause:

The existence or lack of a full length metal screen shall not change the test criteria. Principal requires the test to be performed at hydrostatic pressure equal to the maximum service depth stated in the Project Scope of Work. Three (3) jointed samples with conductor core joint and insulation repair shall be included in the test.

7.6.6 High Voltage AC Test

Add to this clause:

The existence or lack of a full length metal screen shall not change the test criteria. Principal requires the test to be performed at hydrostatic pressure equal to the maximum service depth stated in the Project Scope of Work. Three (3) jointed samples with conductor core joint and insulation repair shall be included in the test.

7.6.12 Attenuation Characteristics

Add to this clause:

The frequencies specified in the Project Scope of Work shall be used. Attenuation shall be measured. Derivation of only attenuation is not acceptable but may be accepted based on the evaluation of measured versus derived attenuation and Principal approval.

7.7 COMPONENT ACCEPTANCE TESTS – ELECTRIC CABLES**7.7.3 DC Conductor Resistance Test**

Add to this clause:

Where DC resistance of the stranded conductor exceeds the value specified in IEC 60228 with the 2% allowance to account for lay losses, Manufacturer/Supplier shall report assumed percent lay loss on the cable data sheet or QP. In all cases, the specified resistance in the Project Scope of Work (at the 20°C reference temperature) shall not be exceeded.

7.7.4 Insulation Resistance Test Voltages

Replace by this clause:

Test voltage for IR tests as a QA check for cable factory acceptance test (FAT) shall be 1000 V at release from the cable manufacturer's facility and tested at the same voltage by Contractor upon receipt or pre-lay up. After the cable is within the umbilical bundle (cable splice, umbilical FAT and thereafter), IR tests of the cable shall be 500 V.

Complete cable (not total length) samples shall be tested at 3.5 MPa (500 psi) hydrostatic pressure.

7.7.8 Attenuation Characteristics

Add to this clause:

The frequencies specified in the Project Scope of Work shall be used. Attenuation shall be measured. Derivation of only attenuation is not acceptable.

7.8 OPTICAL FIBRE CABLE

Add to this clause:

Fibre type shall be specified by Principle in the Project Scope of Work for the umbilical.

7.8.6 Performance Requirements**7.8.6.3 Cable Jointing**

Add to this clause:

A fibre optic cable splice is considered feasible and shall be qualified if a joint during lay-up is necessary. A splice block during lay up is not an acceptable solution.

7.10 METALLIC TUBES**7.10.2 Tube Sizing**

Replace by this clause:

ISO Section 7.10.2 does not apply for tube sizing.

Tube material and dimensions shall be specified by Principal in the Project Scope of Work.

7.10.2.4 Allowable Strain

Delete this clause.

7.10.3 Construction

Replace by this clause:

ISO Section 7.10.3 does not apply for tube construction.

Tube dimensions shall be specified by Principal in the Project Scope of Work. Tube construction for Seamless Super Duplex tube, Seam Welded Super Duplex, and Zinc Clad Duplex tube shall be per DEP 37.80.02.31-Gen., DEP 37.80.02.32-Gen., and DEP 37.80.02.33-Gen., respectively.