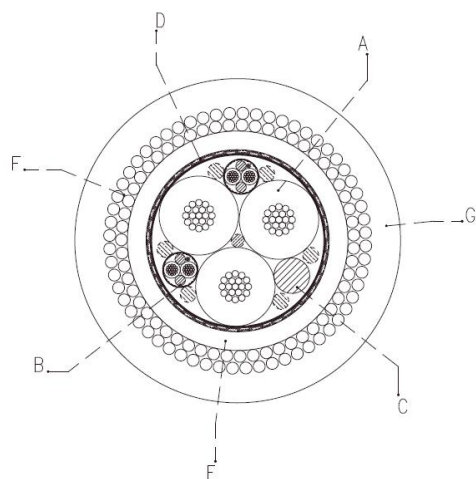


3 x 10 mm² Armoured Electro/Optical 6,6 kV Subsea Power & Signal Cable

Type SQ15689-E



FOR INFORMATION ONLY

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Construction Characteristics

- A) 3 off EPDM insulated 10.0 mm² stranded plain copper power conductors, (U₀/U = 3.8/6.6 kVrms max i.a.w. IEC60502).
- B) 2 off individually screened 1.34 mm² twisted signal pairs. Screens comprise copper/polyester laminate tape and tinned copper drain wire.
- C) Fibre and/or extruded filler elements. May be added or omitted at the discretion of Cortland Fibron BX Ltd.
- D) Collective screen comprising 9.0 mm² tinned copper wire braid and over-lapped copper/polyester laminate tape.
- E) Polyurethane inner sheath, (2.5 mm nominal thickness).
- F) Two contra-helical layers of galvanised steel wire armour.
- G) Low density polyethylene outer sheath, (3.6 mm nominal thickness).

Mechanical Characteristics

Finished diameter:	41.0 mm.
Weight in air:	3,150 kg/km.
Weight in sea-water:	1,800 kg/km, (note 1).
Minimum bend radius:	375 mm, (static).
Minimum bend radius:	490 mm, (dynamic).
Minimum breaking load:	260 kN.

General Design Information (Additional Information)

Cable components:

The cable components included in this umbilical have been designed to offer a robust format for dynamic use. The individual components are cabled into a twisted helix around the central member. The helix limits tensional and compressional strains and improves cable flexibility during bending. The fibre

optic cable components are positioned in the umbilical to provide excellent service throughout the design lifetime.

The large power cores are insulated with Ethylene-Propylene-Diene-Modified co-polymer. This is a cross-linked synthetic rubber. IEC 60502-1 & -2 allows the use of this polymer for voltage ratings of 3 & 6 kV without recourse to conductor and insulation screening. It is considerably more flexible than PE or XLPe; preferable when x-section is thick.

Inner Sheath:

The inner sheath is an extruded layer(s) of thermoplastic material, UV inhibited, of suitable radial thickness and hardness (85 – 92 Shore) compatible with the components within the assembly.

The polyurethane jacketing grades used by Cortland Fibron BX (CFBX) have been chosen to provide excellent flexibility and abrasion resistance combined with resistance to long term immersion in seawater. The polyurethane jacketing grades are based on polyether based polyurethane and as such are resistant to microbiological attack.

Polyether based polyurethanes has been used as jacketing materials for underwater cables since the 1980's.

The material has been used in many subsea application such as military tow cables, oil well control cables, subsea power cables and subsea telecommunication cables.

Cables containing polyurethane sheaths are readily terminated using either connectors. All evidence we have is that polyurethane is fit for 30 years service if it remains intact and free from damage.

Outer Sheath:

The polyethylene jacketing grades used by Cortland Fibron BX have been chosen to provide good flexibility and abrasion resistance combined with a low coefficient of friction. The grades used for jacketing contain a well dispersed UV-stabiliser to provide weathering resistance.

Polyethylene has been used as a jacketing material for underwater cables since the 1950's and has a proven life expectancy of greater than 25 years in the subsea environment. The material has been used in many subsea application such as military tow cables, oil well control cables, subsea power cables and subsea telecommunication cables. Polyethylene sheaths require more consideration when terminating electrical cables. The surface is 'waxy' and requires special primers or injection moulding techniques in order to attain a watertight seal.

Companies such as Tronic and Ocean Design International (ODI) manufacture special pressure compensated connectors that are widely used when terminating cables for the Oil & Gas industry. Connectors that utilise compression glands are not suitable for use on polyethylene sheathed cables.



Polyethylene sheaths are predominantly better as they adhere to the armour packages better than other jacketing grades.

Sheath Colour, Printing & insulation:

Any preferred outer sheath or insulation colours are to be advised to assess feasibility. The outer polyethylene jacket can be printed with our standard print which includes CFBX, Part No & CFBX run number or if preferred MacArtnes own details at no extra cost. Note - we can't print on a black sheath

Umbilical Armour Package

The strength (260kN minimum break load) of the umbilicals are provided by a two-layer armour package consisting of galvanised high tensile steel wires of grade 1,560 N/mm². The figures offered are based on a 5:1 safety factor. The armour package offered here is very similar to those supplied by BIL/CFBX on numerous other projects, and has seen considerable service life. It is predominantly to provide protection on the seabed, ballast & support the cable during deployment.

The armour package is torque balanced, designed to impart less than 1.0°/m rotation at loads up to 100 kN. From testing performed (backed up by service experience) we are able to state that the no damage load is 145 kN. Similar construction of cables utilising this armour package have been subjected to bend fatigue cycling at normal working loads. Cables were subjected to 5,000 cycles and 10,000 cycles respectively with no evidence of any deterioration.

This armour package has been very well received in the market. There is considerable operational experience and it is offered with complete confidence

Certificates:

Standard cable test certificate to include insulation & continuity, will be supplied with the goods

Terminations:

The cables will be left un terminated with ends sealed with heat shrink boots (not subsea rated)

Standard Production Testing

Production testing as standard:

General

Production testing is performed on all umbilicals & cables produced by CFBX and are designed to show that they meet the specification to which it was manufactured.

Dimensional

During umbilical construction the following checks will be carried out on each component against the design

- Number and size of components
- Insulation thickness
- Lay lengths
- Assessment of amount of filling
- Sheath thickness and diameter

All dimensions will meet CFBX internal specifications and manufacture will be under the control of our Quality Control System, which is approved to BS EN ISO 9001:2000.

Final inspection will be carried out on a sample of completed cable after final production.

Electrical

The cable will undergo full electrical testing and this will include the following:

- Insulation resistance tests on all electrical components
- Conductor resistance
- High Voltage Testing all insulated conductors
- Resistance of the screens
- Capacitance on all electrical components

All electrical tests will meet the CFBX specifications and will be completed under the control of ISO9001.

Immersion / Soak Testing of cores:

Immersion / Soak testing of insulated conductors, including in-process CR, HV & IR prior to lay up in cable assemblies.

Additional Functional Testing if required or deemed to be applicable**Umbilical Breaking Strength Test**

A representative sample of the cable will be tested to destruction in a tensile test machine through ends prepared with resin cones.

Load & Elongation

This test determines the cable elongation under load. It will also enable an evaluation of the electrical components and optical fibres under the pressure and elongation applied to the umbilical core from any strength member package.

Rotation

This test provides an indication of the amount of rotation to be expected on the cable at the working load.

Bend Cycling Under Load

This test will assess the effects on the electrical and optical properties resulting from bend cycling under load.

Hydrostatic External Pressure Test

The purpose of this test is to determine the effects of hydro-static pressure on both the electrical and optical components of the cables. It is known that the optical components can be seriously affected by hydro-static pressure.

Codes, Inspection and Testing:

Codes and standards

CFBX works to the following relevant codes and standards. We use the referenced standards as the basis of our production and testing.

Description	Applicable standard
Cable manufacture	ISO / API
Cable conductor spark testing	BS5099
Cable conductors	IEC 228 / BS6360
Cable insulation	IEC 60502 part 1
Umbilical manufacture – lay-up	ISO / API
Umbilical manufacture – sheathing	ISO / API
Quality	ISO 9001:2000

Project Management

Standard project management will include the following which will be issued for acceptance within 2 weeks of order:

Project / Production plan (MS Project Gantt Chart)	Quality plan (witness points to be agreed and accepted)
SMDL (document list)	FAT Procedure

A single point contact will be allocated to the project. Progress reporting will be issued to agreed customer contact as required.



Certification and Documentation

CFBX delivered will be supplied with final documentation to include, but not limited to the following content:

General
Delivery / release note
Umbilical Drawings
Cable data sheets
Certificates of Conformity
Certificates
FAT electrical test reports
Material certificates to EN10204 3.1.B
Umbilical material certificates
Other materials (hose ends etc.)
Other
Processing instrumentation, calibration certificates
Non-conformance reports
Functional Testing. If part of scope of supply
Third Party Inspection. If part of scope of supply