



Exploration & Production

GENERAL SPECIFICATION

ELECTRICAL

GS ELE 161

Electrical cables

02	10/04	Updating Colour coding & "zero halogen" requirements
01	09/03	Change of Group name and logo
00	03/01	First issue
Rev.	Date	Notes



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1. Scope

This specification defines the minimum requirements for design, manufacture and testing of electrical cables for power, control, and lighting systems.

This specification covers onshore and offshore projects, but subsea cables and heating cables are excluded from this scope.

Cables related to HVAC services (except power) shall be in accordance with the instrumentation cables specification.

The MANUFACTURER shall make clear in his bid any deviation from this specification. No deviation from the requirements of this specification are allowable unless itemised in the MANUFACTURER's quotation and subsequently specifically agreed within the purchase order documents.

In cases where the COMPANY's standard specification has been amended by Project specifications and is so noted, the Project specifications will govern.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Design and engineering shall conform as a minimum requirement to the current edition of the following in order of preference:

- Applicable laws, rules and regulations of the country in which the system will be operated. In cases where no "local" regulations exist, the French laws and legislation shall be used
- COMPANY Particular Specifications (if any)
- COMPANY General Specifications
- Applicable International Electro-technical Commission (IEC) Standards
- Applicable CENELEC Standards

Applicable recognised standards and codes (e.g. UTE-NFC, BSI, VDE, etc.) where IEC publications have not yet been issued.

Standards

Reference	Title
IEC 60183	Guide to the selection of high-voltage cables
IEC 60227-1-2-3-4	PVC insulated cables of rated voltages up to and including 450/750 V
IEC 60228	Conductors of insulated cables
IEC 60287-1-2-3	Electric cables - Calculations of the current rating
IEC 60331	Fire resisting characteristics of electric cables
IEC 60332	Tests on electrical cables under fire conditions. Part 3: Tests on bunched wires and cables
IEC 60502-1-2-4	Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV
IEC 60754-1-2	Tests on gases evolved during combustion of materials from cables
IEC 60811-1-2-3	Common test methods for insulating and sheathing materials of electric cables (formerly 540)
IEC 60885-1-2-3	Electrical test methods for electric cables. Partial discharge tests
IEC 61034-1-2	Measurements of smoke density of cables burning under defined conditions
ASTM D 2863	Oxygen Index
ASTM E 662	Standard test method for density of smoke from the burning or decomposition of plastics
UL 1581 (partial)	Reference standard for electrical wires, cables and flexible cord: Part about Physical properties after immersion in oil

Professional Documents

Reference	Title
HD 308 S2	Identification of cores in cables and flexible cords

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
Not applicable	

3. Environmental conditions

Cables for onshore projects shall generally be directly buried in the ground. Cables for offshore projects shall be run on cable trays/ladders. In technical voids of technical rooms they shall be supported on cable trays/ladders (offshore/onshore).

Environmental data is given in the environmental data Project specification.

4. Construction requirements

4.1 Rated voltages

The voltage designation of the cables shall be $U_0/U(U_m)$ as defined in [IEC 60502-2](#) and [4.1](#).

System Voltage	Rated Voltage $U_0/U(U_m)$
LV (control)	450/750V
LV (< 1000 V) Power and lighting	600/1000 V
≤ 6.6 kV	6/10 (12) kV
11 kV	8.7/15 (17.5) kV
20 or 22 kV	12/20 (24) kV
33 kV	18/30 (36) kV

4.2 Conductors

For all cables, conductors shall be class 2 for fixed installations and class 5 for flexible installations.

Cable conductors shall be of high conductivity, stranded plain annealed copper.

Exceptionally for sites where the concentration of H_2S is high, all cable conductors shall be tinned.

For large cross-section, aluminium conductor may be used, depending on economical considerations.

Minimum cross-sections authorised are:

- Power = 2.5 mm²
- Control = 1.5 mm²
- Lighting = 2.5 mm²

Maximum cross sections authorised are:

- LV = 3 x 240 mm² (three cores) onshore
 = 3 x 185 mm² (three cores) offshore
 = 1 x 400 mm² Copper (single core)
 = 1 x 630 mm² Alu (single core)
- HV = 3 x 185 mm² (three cores) onshore
 = 3 x 120 mm² (three cores) offshore
 = 1 x 300 mm² Copper (single core)
 = 1 x 630 mm² Alu (single core)

HV cables shall incorporate a conductor screen made of an extruded semi-conducting compound applied to the conductors.

4.3 Insulation

4.3.1 HV Cables

The insulation material shall be XLPE (cross linked polyethylene). in accordance with [IEC 60502](#).

EPR insulated cables may be quoted as an alternative for HV cables in accordance with [IEC 60502](#).

HV cables shall incorporate an insulation screen which consists of an extruded semi-conducting layer in combination with a metallic layer (copper tape).

4.3.2 LV Cables

Power and lighting cables shall be XLPE insulated in accordance with [IEC 60502](#).

Control cables (multi-core cables) shall be PVC insulated in accordance with [IEC 60502](#).

4.4 Inner sheath and fillers

The assembly of three core cables shall be arranged to form a round shape, using appropriate fillers.

The inner sheath shall be of the extruded type to provide a good radial seal against humidity, gas and vapours.

4.5 Metallic armour

When required, the metallic armour shall be made of double galvanised steel tape for multi core cables or aluminium tape for single core cable. Tape thickness shall be in accordance with [IEC 60502](#).

4.6 Oversheath

The oversheath shall be an extruded layer of low smoke PVC compound with the necessary additives to obtain the following characteristics:

- Flame retardant as per [IEC 60332-3 22](#) (previously called Cat A)
- Oxygen index: minimum = 30 as per [ASTM D 2863](#)
- Minimum production of noxious gases and fumes in the event of fire:
 - Acid gas generation: HCl < 17% as per [IEC 60754](#)
- U.V. proof as per [NFC 32-061](#)
- Proof against aliphatic hydrocarbons. PVC compound shall meet the requirements of [IEC 60227-1](#) (ST9) and [UL 1581](#) – Physical properties after immersion in oil.

4.7 Earthing cables

Earthing cables shall be copper, PVC sheathed, green/yellow striped.

4.8 Colour identification

The following colour coding for cores shall be used:

- LV Cable = As per [HD 308 S2](#) professional document
- HV Cable = Manufacturer standard
- Multi core control cable: White with a number marked on the sheath of each core.

The following colour coding for over sheath shall be used:

- LV Cable = black
- HV Cable = red
- Fire resisting Cable = orange
- Earthing Cable = yellow and green stripes.

4.9 Cable marking

The over sheath of the cable shall be legibly and permanently marked by indelible printing or embossing with MANUFACTURER name, voltage grade, cross-section, number of cores, metric indication and references to [IEC 60332-3](#) or [IEC 60331](#).

4.10 Cable lengths

The tolerances used for cable lengths during manufacturing shall be - 0%, + 3%.

5. Special cables

5.1 Fire resisting cables

Fire resisting cables shall meet the following requirements in addition/deletion to those requirements specified in paragraph 4.

- The conductors shall have silicone rubber insulation or as an other alternate mica/glass tape with EPR or XPLE insulation
- The inner sheath shall be made of a low smoke fire retardant compound
- The armour and oversheath shall be of the same type as defined for flame retardant cables (see 4.5 and 4.6)
- The cables shall be manufactured in accordance with [IEC 60331](#), but the cable shall have circuit integrity for a minimum 30 minutes and shall withstand a flame test at 1000°C
- Use of MICC (Mineral Insulated Copper Cables) is prohibited.

5.2 "Zero halogen" cables

When required by the PROJECT, cables shall be Zero halogen type i.e. with insulation filler inner and outersheath made with suitable elastomers or thermoplastic materials.

The MANUFACTURER shall meet the following requirements:

- [IEC 60332/3-22](#) for Flame retardant cables
- [IEC 60331](#) for Fire resisting cables
- Acid gas generation: HCl < 0.5% as per [IEC 60754](#)
- Maximum smoke density: Dm < 250 As per [ASTM E 662](#) (tests on materials)
- Smoke in chamber (4 mm): VOF4 < 150 As per [ASTM E 662](#) (tests on materials)
- Oxygen index: > 30 as per [ASTM D 2863](#) except for core insulation
- Transmittance: as per [IEC 61034](#).

5.3 Cables for aromatic hydrocarbons

Whenever cables may come into contact with aromatic hydrocarbons they shall be fitted with a sealed lead sheath or other appropriate material proposed by Manufacturer, subject to Company approval.

6. Inspection and testing

6.1 Type tests

Type test certificates issued by a recognised testing authority in accordance with the relevant IEC standards shall be provided by the MANUFACTURER for Company review before purchase order.

- Flame retardant test to [IEC 60332](#) - Part 3- 22 -. For flame spread test, the cables shall be in a touching configuration.

- Oxygen index tests as per [ASTM D 2863](#)
- Smoke emission test to - [ASTM E 662](#)
- Fire resistance test to [IEC 60331](#) but with a 1000°C temperature during 30 mm
- Acid gas generation test to [IEC 60754-1](#)
- Transmittance as per [IEC 61034](#)
- Aliphatic hydrocarbons withstand
- UV rays withstand.

6.2 Factory acceptance tests

Acceptance tests shall be performed by the MANUFACTURER in the presence of COMPANY or his representatives.

These tests shall be performed either on all finished cable lengths or on samples of completed cables.

The tests to be made shall be specified by the COMPANY from the lists given hereafter at the time of purchasing. Normally the "Usual non-electrical checks" (6.3.2) and "Electrical tests" (6.3.4) shall be carried out.

If special tests (see 6.3.3) are required they shall be agreed on with the MANUFACTURER and shall be explicitly specified in the purchase order.

After testing the ends of the cable shall be sealed by an approved method to prevent the ingress of moisture.

6.3 Test list

6.3.1 General checks

- Qualitative and quantitative control of technical documentation given with cables and its compliance with the general and particular specifications if any
- Control of drums: quality of flanges, marking and labelling, cable designation, length, section, sizes and weight, observance of minimum curve radii, capping of terminations, packaging and protection against shocks
- Control of conformity with the technical documentation
- All routine and acceptance test shall be carried out on cables as per IEC standards listed in paragraph 2.

6.3.2 Usual non-electrical checks

- Control of the nature and composition of conductors
- Measurement of the thickness of the insulating material
- Inspection of bedding and assembly
- Measurement of inner sheath diameter (cable gland sizing)
- Measurement of the thickness of the external sheath
- Check of the nature and constitution of the conductor or semi-conductor screens

- Verification of the nature, composition and thickness of the metallic armour
- Measurement of the external dimensions of the complete cable.

6.3.3 Special non electrical checks

Following tests shall be carried out on a sample length of cable when required and indicated in the Purchase Order (PO) documents:

- Check for flame retardant properties as per [IEC 60332-3 -22](#)
- Oxygen Index and temperature index tests as per [ASTM D 2863](#)
- Acid gas generation test as per [IEC 60754-1](#)
- Smoke generation as per [ASTM E 662](#)
- Transmittance as per [IEC 61034](#)
- Check of the oversheath resistance to aliphatic hydrocarbons. Manufacturer procedure to be submitted for company review.
- For fire resisting cables all routine and acceptance tests shall be carried out as per [IEC 60502](#) and [IEC 60331](#) with modifications as indicated in paragraph 5.1
- For zero halogen cables tests with values as indicated in paragraph 5.2
- Control of mechanical properties of insulating material.
- Control of the mechanical properties of the external protective sheaths ([IEC 60502](#))
- Test of the anti-corrosion protective coatings of the metallic armour ([IEC 60502](#))
- Bending test ([IEC 60502](#))
- Alternating flexibility test - for flexible cables (class 5) only
- Hot set test for EPR, HEPR and XLPE insulations and elastomeric sheaths ([IEC 60502](#))
- Low temperature tests (PVC).

6.3.4 Electrical tests

- Voltage tests as per [IEC 60502](#)
- Partial discharge tests (HV only)
- Impulse tests followed by power frequency tests for HV cable only- when required in Purchase Order.

6.4 Test reports

A specimen test report shall be submitted to the COMPANY for approval before the placing of the order.

The test reports shall detail as a minimum:

- Expected theoretical values

- Permitted tolerances
- Results of measurements carried out, including any intermediate values, which lead to a temporary non-acceptance, if any.

The test reports shall be incorporated into the contractual technical documentation.

7. Information required from cable MANUFACTURER

The MANUFACTURER shall submit with the tender the information listed below for every cable size supplied:

- Standard Drum Length
- Maximum and minimum manufacturing drum lengths and weights of individual drums for each size and type of cable
- Number and size of conductors making up the cross-sectional area of each core
- Insulation thickness
- Inner sheath diameter with maximum tolerance
- Oversheath diameter with maximum tolerance
- Armour thickness
- Minimum installation temperature
- Minimum bending radius at minimum installation temperature
- Weight per unit length
- Current carrying capacity with specified ambient and installation conditions
- Rated conductor temperature
- Maximum conductor temperature
- Resistance per unit length
- Reactance per unit length
- Capacitance per unit length
- Short-circuit withstand capacity
- Voltage drop in A/km.

For fire resisting cables: fire resistance behaviour (temperature/duration).

For zero halogen cables: Dm, VOF4, acid gas generation (%), transmittance.