MATERIAL STANDARD

FOR

CABLES AND WIRES

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1. SCOPE

This standard covers the minimum requirements for the materials, manufacturing, inspection and testing of electrical cables and wires, control cables, power cables up to 33 kV to be used in oil, gas and petrochemical industries in Iran under service/site conditions stated in data sheets.

General requirements of wires and cables are given in this standard, and the specific requirement of individual cases will be given in pertinent data sheets and requisitions.

2. SERVICE CONDITIONS

Service and site conditions as per relevant data sheets or requisition.

3. REFERENCES AND STANDARDS

Cables shall be designed, manufactured, inspected and tested in accordance with all the applicable sections of the following standards that are in effect at the time of publication of this standard.

The applicability of changes in standards that occur after the date of this standard shall be mutually agreed upon by the company and manufacturers/suppliers.

Electrical cables shall comply with the relevant sections of IEC standards and or applicable ISIRI standards.

IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSION)

IEC 38	"Standard Voltages"
IEC 55-2	"Paper Insulated Metal Sheathed Cables for Rated Voltage from 0.6/1 kv up to 18/30 kv "
IEC 173	"Colors of the Core of Flexible Cables and Cores"
IEC 183	"Guide to the Selection of High Voltage Cables"
IEC 227	"PVC Insulated Cables of Rated Voltage up to and Including 450 / 750 V"
IEC 228	"Conductors of Insulated Cables"
IEC 245	"Rubber Insulated Cables of Rated Voltage up to 450 / 750 V"
IEC 332	"Test on Electric Cables under Fire Conditions"
IEC 502	"Extruded Solid Dielectric Insulated Power Cables from 1 kV up to 30 kV"
IEC 540	"Test Method for Insulations and Sheaths of Electric Cables and Cords"
IEC 811	"Common Test Methods for Insulating and Sheathing Materials of Electric Cables"
IEC 840	"Test for Power Cables with Extruded Insulation for Rated Voltages above 30 kV"
IEC 885	"Electrical Test Method for Electric Cables for up to and Including 450 / 750 V"

ISIRI (INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH OF IRAN)

ISIRI 607	"PVC Insulated Cables and Flexible Cords"
ISIRI 1926	"Rubber Insulated Flexible Cables and Cords with Circular Conductor and Rated Voltage not Exceeding 750 v."

Note:

When standards other than IEC are used, manufacturer/supplier shall submit the pertinent deviations from IEC standards specified.

4. UNITS

This Standard is based on International Systems of Units (SI) except where otherwise specified.

5. CABLE DESIGN AND CONSTRUCTION

All cables shall be designed, and manufacturered for use on electrical systems of petroleum industries to run above ground on cable tray/rack or under ground in cable trenches at the site conditions stated in data sheet.

5.1 Applicable Cable Voltages

The cables will be installed in electrical systems with folowing voltages: 33 kV, 20 kV, 10 kV, 6 kV, 0.4 kV. (For existing facilities, 3.3 kV may be specified).

6. CABLE SELECTION

6.1 Low Voltage Cables

Low voltage cables shall be copper conductor with PVC, or XLPE insulation 600-1000 V grade, lead sheathed, single wire armoured, and PVC overall jacketed.

Lead sheath may be eliminated for some applications as per owner's requirement. This will be specified in data sheet.

6.1.1 Conductors

Conductors shall be plain solid annealed copper. Conductor sizes up to and including 10 mm^2 will be solid annealed copper. Conductor sizes 10 mm^2 up to 50 mm^2 will be stranded annealed circular copper. Conductor sizes 50 mm^2 and above will be stranded annealed sector shaped copper.

6.1.2 Insulation

Insulation for low voltage cables up to 1000 V shall generally be PVC.

Cross linked polyethylene (XLPE) insulation may be used. If specified in data sheet.

6.1.3 Filler

When necessary to obtain circular form of cables, suitable interstice material such as jute string or polyproplene string shall be used, or manufacturer's recommendation is acceptable.

6.1.4 Binder

Cores laid up with filler shall be lapped with suitable binder tape.

6.1.5 Metalic Sheath

The metalic sheath shall consist of lead alloy, and minimum thickness shall be in accordance with the requirement of IEC 55-2.

6.1.6 Bedding

The bedding shall be extruded layer of PVC or manufacturing recommendation.

6.1.7 Armour

The armour shall be galvanized flat or round steel wire, unless otherwise specified in data sheet. The minimum dimension of the armour shall be in accordance with the requirement of IEC 502.

6.1.8 Over sheath

The outer sheath over the armour shall be extruded black colored, PVC compound complying with the requirement of IEC 502.

To protect the cables against rodent and termite attack, suitable chemicals shall be added in the PVC of the over sheath.

If flame retarding over sheath is specified in data sheet the Outer protective jacket shall be made of non flame propagating PVC to level C as per IEC 332-1.

6.2 Medium Voltage Cables

Medium voltage cables shall be copper conductor with cross linked polyethylene (XLPE) insulation, lead sheathed single steel wire armoured with overall PVC jacket.

6.2.1 Conductors

Conductor of cables shall be circular plain annealed stranded copper according to class 2 of IEC 228.

6.2.2 Conductor screen

Conductor screen shall consist of extruded semi-conducting compound according to IEC 502.

6.2.3 Insulation

Cable insulation for medium voltage, shall be cross linked polyethylene (XLPE). The minimum thickness of insulation shall be according to pertinent IEC recommendations.

6.2.4 Insulation screen

Insulation screen shall consist of a layer of semi conducting tape or compound with a metalic layer. The metalic layer shall be copper tape 75 μm applied with 15% overlap over each conductor according to IEC 502.

6.2.5 Filler

Medium voltage cables shall be laid up with filler according to IEC 502 or as per manufacturers' standard and recommendations.

6.2.6 Binder

The laid up screened cores together with filler shall be lapped with a suitable binder tape or as per manufacturers' standard.

6.2.7 Metalic sheath

Medium Voltage cables shall be lead sheathed. The sheath shall consist of lead alloy, and minimum thickness shall be in accordance with the requirements of IEC 55.2

6.2.8 Bedding

The bedding shall be extruded layer of PVC compound or manufacturer's recommendation.

6.2.9 Armour

The armour shall be single layer of galvanized flat or round steel wire plus a helix of galvanized steel tape. The dimensions of the armour and galvanized steel tape shall be in accordance with the requirements of IEC 502.

6.2.10 Over sheath

The outer sheath over the armour for medium voltage cables shall be extruded red colored PVC compound according to IEC 502.

To protect the cables against rodent and termite attack suitable chemicals shall be added in to the PVC compound of the over sheet.

If flame retarding over sheath is specified in data sheet. The outer protective jacket shall be made of non flame propagating PVC to level A according to IEC 332.3.

6.3 Control Cables

Control cables are used for remote control, on-off, reverse, indication lights, etc. Control cables shall be multi core and the number of cores required shall be in accordance to data sheet.

6.3.1 Conductors

Conductors for control cables shall be plain annealed solid copper. Conductor size shall be 2.5 mm^2 as minimum. Copper conductor shall be in compliance with IEC 228. Conductors in the same cable shall be ail of the same size.

6.3.2 Insulation

Primary insulation shall consist of an extruded layer of PVC with rated voltage of 600 V.

6.3.3 Binder Tape

Control cable gores shall be lapped with a suitable binder tape as per manufaurer's standard.

6.3.4 Metalic sheath

A metalic sheath of lead alloy shall be applied, and the minimum thickness of lead sheath shall be in accordance with the requirement of IEC 55.2.

6.3.5 Bedding

The bedding shall be extruded layer of PVC compound or manufacturer's recommendation.

6.3.6 Armour

The armour shall be single layer of galvanized flat or round steel wire, the dimensions of the armour shall be as per requirements of IEC 502.

6.3.7 Over sheath

The outer sheath over the armour shall be extruded PVC complying with the requirement of IEC 502. The color of sheath shall be black PVC. For flame retardancy, cables shall be made in accordance with IEC 332.3 cat. A.

6.3.8 Core identification

The control cables identification shall be achieved by numbering the cores. The numbering of the cores shall start from No. one for the wire in center.

The insulation of the cores shall be of the same color and numbered sequentially. There shall be a clear contrast between color of cores and color of numbers ie. color of core will be black and color of numbers will be white.

The height of individual numbers shall not be less than 1.5 mm, and the interval between and adjacent numbers shall not be more than 100 mm.

6.4 Low Voltage Wires

6.4.1 Low voltage wires shall be stranded copper conductor PVC insulated, rated voltage 600-1000 V according to IEC 227.

6.4.2 Wires shall be suitable for installation in rigid steel galvanized conduits or truncking.

6.5 Earthing Cables and Wires

6.5.1 Earthing cables and wires shall be single core insulated plain annealed stranded copper conductor.

6.5.2 Insulation shall be PVC with rated voltage 450 V.

6.5.3 The color of insulation for earthing cables and wires shall be green/yellow.

6.6 Communication Cables

For communication cable specifications refer to relevant standards.

6.7 Color Coding for Power and Control Cables

Color coding of individual cable cores insulation shall be as follows:

Phase conductors	Red-Yellow-Blue
Neutral	Black
d.c positive conductor	Red
d.c negative conductor	Black
Control conductor cables	Black numbered, White
Earthing conductors	Green/Yellow

The requirements for specific cables will be given in the relevant data sheet.

6.8 Marking

The external surface of the over sheath shall be embossed at least with the following:

- Manufacturer
- Year of manufacture
- Type of insulation(s)
- Rated voltage
- Number of cores
- Size of conductors

6.9 Cable Accessories

Cable manufacturer shall supply all cable accessories such as, termination kits, straight joint kits with insulation and sealing, and other special tools in required quantities as specified in data sheet or requisition.

7. INSPECTION, QUALITY CONTROL AND QUALITY RECORDS

7.1 Inspection, Quality Control

7.1.1 The purchaser's inspector, or his authorized representative shall have free access to the manufacturing plant engaged in the manufacture of the cable, to carry out necessary inspection at any stage of work.

7.1.2 Inspection may include the visit to quality control laboratories, work shops, testing bay etc.

7.1.3 The supplier shall make available technical data, test pieces and samples that the purchaser's representative may require for verification in conjunction with pertinent equipment. If required the supplier shall forward the same to any person or location that the purchaser's representative may direct.

7.2 Quality Records

7.2.1 The supplier shall maintain appropriate inspection and test records to substantiate conformance with specified requirements, and made available on request by purchaser.

7.2.2 Quality record shall be legible and relevant to the product involved.

7.2.3 The supplier shall establish and maintain procedure for identification, collection, indexing, filing, storage, maintenance and disposition of quality records.

7.2.4 Supplier shall submit to purchaser: reports, test schedules, and test certificates (in ..... copies) on completion of tests.

8. TESTS AND CERTIFICATION

8.1 General Requirements for Tests

8.1.1 Purchaser may require witnessed tests to be carried out in the presence of his nominated representative who should be informed at least ..... weeks in advance of the date of the tests and confirmed..... weeks before the tests.

8.1.2 Test certificates and test reports shall refer to the serial No. of the cable drum tested and must bear the purchaser's name, order No. and manufacturer's name and seal.

The certificates shall be approved by the purchaser before shipment instruction are given.

8.1.3 Approval by the purchaser's inspector or representative shall not relieve the vendor of his commitments under the terms of this specification or any associated order.

8.1.4 The cable drum may be rejected if measurement and inspection reveal any discrepancies between quoted figures resulting in purchase order and those measured actually.

8.2 Requirements for Test

The following tests shall be performed by the manufacturer on cables made to comply with the requirements of IEC.

8.2.1 Type tests

Manufacturer shall submit documentary evidence to requirements of IEC 502 (clause 16) or IEC 540 (clause 16) for relevant type tests.

Where necessary, type test shall be performed on samples from each type of cables according to IEC 502. The test results and certificates shall be submitted to purchaser.

8.2.2 Routine tests

The cables shall be subject to routine tests in accordance to current relevant IEC standard carried out at manufacturer work. These shall include at least the following on each finished length of cable where applicable.

- Resistance measurement of each cable.
- Insulation resistance measurement.
- High voltage test.
- Partial discharge tests.
- Armour resistance measurement.
- Spark tests on conductor (during manufacture) and over sheath.

8.2.3 Special tests

When agreed between purchaser and manufacturer or supplier, the following special tests may be carried out:

- Conductor examination
- Check of dimension
- Electrical test of cables of rated voltage above 3.6 / 6 kV.
- Test certificates shall be submitted for approval of purchaser or their appointed representative.

9. SEALING AND DRUMMING, PACKING AND SHIPMENT

9.1 Sealing and Drumming

Before dispatch the manufacturer shall seal and cap both end of all cables so that to prevent the ingress of water during transportation and storage, projecting end of cables shall be protected from mechanical damage.

9.2 Packing

9.2.1 The cables shall be supplied on non returnable drums with mild steel reinforced hub plates, with the inner end of cable brought out through the side of the drum(s).

9.2.2 Each drum shall be durably marked with a distinguishing number on the outside of the flange, and particulars of cable i.e. voltage, length, conductor size, and cable type.

The gross mass shall be shown and the direction rolling shall be indicated by arrow.

9.3 Shipment

9.3.1 Cable drums shall be provided with a permanently attached readily visible identification tag(s). Identification should remain intact from the time of initial dispatch at work to the final destination.

9.3.2 The greatest care must be taken to ensure that shipping and associated documents with exact description for custom release are accompanied with the shipment.

10. INFORMATION FOR MANUFACTURER / SUPPLIER

See data sheet in Appendix A.

11. GUARANTEE

11.1 All cables shall be guaranteed by the vendor against defective material, poor design and workmanship.

11.2 The vendor shall guarantee the cables performance under specified conditions.

11.3 If any defects are discovered during the d.c voltage test performed after the cable installation as per IEC 502 recommendation, the vendor shall be responsible for replacements of the cables free of charge.

12. LANGUAGE

12.1 All correspondence, drawings, documents, certificates, including testing, installation procedure etc. shall be in English. Offers in other languages will not be considered.

APPENDICES

APPENDIX A

EXAMPLE OF TYPICAL DATA SHEET FOR POWER CABLES

PROJECT NAME .....

Supply voltage .....

System frequency .....

Neutral earthing system .....

Maximum rated current for continuous operation .....

Maximum currents which may flow during short circuit both between phases and phase and earth .....

DETAILS OF CABLE:

Material of conductor .....

Stranded.....solid .....

Size of conductor .....

Number of cores..... Color of cores .....

Lead sheath required..... Not required .....

Armour required..... Not required .....

Over sheath required..... Not required .....

Color of over sheath .....

APPENDIX B

DATA TO BE GIVEN BY MANUFACTURER PRIOR TO PURCHASE

Type of cable .....
Design voltage of cable "Uo/U" .....
No. of cores .....
Color of cores .....
Color of over sheath .....
Type and size of conductor .....
Conductor .....
Conductor screen .....
Type of insulation .....
Type of screen on insulation .....
Type of filler .....
Material of binder .....
Type of sheath .....
Type of bedding .....
Type of armour .....
Type of over sheath .....
Overall outside diameter .....

CHARACTERISTICS:

d.c. resistance of conductor in Ω/km .....
a.c. resistance of conductor in Ω/km .....
Inductance of conductor in mh/km .....
Reactance of conductor in Ω/km .....
Impedance of conductor in Ω/km .....
Insulation resistance of cable in meg Ω/km .....
Capacitance of single core cables in F / km .....
Capacitance of three core cables in F / km .....
Dielectric power factor in watt/km per phase .....
Descriptive illustrated cross section of cable with dimensions .....
.....
No. of standard with which the cable complies .....
.....
.....
Manufacturer standard length of cable per drum: .....
.....
Weight of each drum with cable: .....
.....
.....
Maximum bending radius of cable: .....
.....