STYRENE PARK OFFSITE

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Instrumentation Cable Specification

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1 GENERAL INTRODUCTION

1.1. INTRODUCTION

Creation and development of chain units of Styrene Monomer is the mission of Gohar Ofogh Industrisl Park. This Company joint investment of 4 companies including JPC, Asaluyeh Sadaf Chemical, Kimia Sanaye Dalahoo and Entekhab Group and is located in Assaluyeh.

Feed and utility lines and network construction, a Styrene Monomer tank construction, Peroxide and its sidelong equipment warehouse are among this company's missions.

Some of the ongoing Projects of this company are:

- ABS-Rubber project
- ESBR project
- EPS project
- Poly Styrene

1.2. SCOPE

This specification covers the minimum requirements for design, supply and manufacturing of Instrument Cable. All components, as far as mechanical characteristics and performances are concerned, shall conform to the present general specification and to the specifications issued for each components. Any deviation from the present specification at any stage of the project shall be subject to CLIENT approval.

1.3. REFERENCE DOCUMENTS STANDARD & CODE

The following international codes and standards shall be the referenced documents defining the minimum requirements for the manufacturing and testing of instrument cables.

BS 6387	Performance requirements for cables required to maintain circuit integrity under fire condition.
IEC 60028	International standards of resistance of copper
IEC 60092-3	Cables (construction, testing and installations)
IEC 60092-375	General instrumentation control communication cables
IEC 60228	Nominal cross sectional area and composition of conductors of insulated cables.
IEC 60331	Fire resisting characteristics of electrical cables
IEC 60332	Tests on electrical cable under fire condition
IEC 60344	Guide to the calculation of resistance of plain and coated copper conductors of low-frequency cables and wires
IEC 60245-1to4	Rubber insulated cables of rated voltages up to and including 450/750 V

IEC 60754	Test on gases evolved during combustion of materials from cables
IEC 60649	Calculation of maximum external diameter of cable for indoor installations
IEC 60801	Electro-magnetic compatibility for industrial process measurements and control equipment
IEC 60811	Common test method for insulating & sheathing materials of electric cables
IEC 60885	Electrical test methods for electric cable
IPS-C-IN-190	Construction and installation for Transmission systems
IPS-E-IN-190	Engineering and design for Transmission systems
IPS-M-IN-190	Material and equipment for Transmission systems
IPS-M-EL-271	Material and equipment for Low voltage cables and wires

1.4. DISCREPANCIES AND DEVIATIONS FROM SPECIFICATION

All discrepancies and deviations between the requirement of these specification, standards and codes shall be referred to "Contractor" in proposal and after order before proceeding with the manufacturing of the concerned item.

2. CABLE CONSTRUCTION

2.1. CABLE TYPE

Ø Cable Type I - Single Pair Instrument Cable for Analogue Signals (From Instrument to Junction Box)

Construction

Conductor	1.5 mm^2 nominal stranded annealed copper conductor's twisted pair. Pair of wire shall be twisted at least 20 times per meter and have total coverage electrostatic shield with copper drain wire extending the length of the conductors.
Insulation	High quality insulation and jacket with high resistance to chemical, heat, , moisture and aging with on outer PVC heat resistant sheath. At least 0.5 mm nominal thickness. Insulation rating of single wires shall not be less than 300 volts.
Color Code	Single pair: black and white.
Lay of Twist	50mm
Shield	2 layers polyester tape each to be 0.023 mm thick over the cores with 100% coverage by a tape shield of 0.012 mm aluminum Mylar foil wrapped laminated with 0.012 mm Mylar polyester tape, helically applied over the polyester tape with the aluminum on the inside in continuous contact with a

	bare minimum 0.75 mm^2, 7- strand tinned copper drain wire A100% coverage of 1 layer of polyester tape 0.023mm thick shall be applied over the aluminum Mylar tape shield.
Pair Jacket	1.15mm nominal 80°C PVC (Overall cable jacket)
Armor	Cable armor shall be single galvanized steel wire having 90% nominal coverage. (Round type, diameter of cable armor wire based on IEC 60502)
Jacket Color Code	Blue for Intrinsicaly Safe & Grey for Non- Intrinsically Safe Instrument Cables and Red for F&G Cables

- **Cable Type II - 2 Core with ground wire for Digital (On-Off) Signals (From Instrument to Junction Box)**

Construction

Conductor	1.5 mm^2 nominal stranded for 24 VDC equipment for digital outputs & power supplies and 1.5 mm^2 for 24 V DC equipment for digital inputs
Insulation	Same as cable type I
Color Code	Black – White and for ground wire green / yellow
Shield	Same as cable type I
Armor	Same as cable type I
Jacket Color Code	Blue for Intrinsicaly Safe & Grey for Non- Intrinsically Safe Instrument Cables and Red for F&G Cables

- **Cable Type III - Multi-Pair Instrument Cable for Analogue Signals (Analogue Junction Box to Marshalling Cabinet)**

Construction

Conductor	1 mm^2 nominal stranded annealed copper conductors twisted pair. Pair of wire shall be twisted at least 20 times per meter. Multiple pairs shall be twisted at least 6 times per meter and shall have total coverage of electrostatic shield with 20 AWG (0.5 mm2) stranded copper drain wire extending the length of the conductors.
Insulation	Same as cable type I
Insulation Color Code	Pairs: black and white (each pair)
Group Identification	Each pair numbered on pair jacket as well as primary insulation
Lay of Twist	Maximum 50mm
Pair shields	2 layers polyester each to be 0.023mm thick over the pair with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.050mm Mylar polyester tape, helically applied over the twisted pair with the

	aluminum on the inside in continuous contact with a bare minimum 0.9 mm^2, 7-strand tinned copper drain wire. 100% coverage of 1 layer of polyester tape 0.023 mm thick shall be applied over the aluminum Mylar foil wrapped tape shield.
Pair Jacket	0.5mm nominal thickness 80°C PVC (Color Code-See below)
Communication Wire	0.5mm^2 nominal, 7 stranded annealed copper conductors with 0.5mm PVC insulation.
Cable Shield (Overall)	2 layers of polyester tape each to be 0.023mm thick over the twisted pairs with 50% coverage by a tape shield of 0.012 mm aluminum laminated with 0.050mm Mylar polyester tape helically applied overall pairs and the communication wire. The aluminum shall be on the inside and in continuous contact with a bare, 0.9mm^2, 7 strand tinned copper cable drain wire. Two layers of polyester tape and foam insulation or other suitable insulation each 0.2mm thick shall be applied over the aluminum laminated polyester tape.
Inner Cable Jacket	80°C, PVC, thickness of inner cable jacket shall be in (over pairs, drain wire, accordance with IEC standards communication wire)
Cable Armor	Cable armor shall be single galvanized steel wire having 90% nominal coverage. (Round type, diameter of cable armor wire based on IEC 60502)
Overall Cable Jacket	Same as inner cable jacket
Jacket Color Code	Pairs and inner cable: black
Overall jacket	Blue
Communication wire	
Jacket Color Code	Blue for Intrinsicaly Safe & Grey for Non- Intrinsically Safe Instrument Cables and Red for F&G Cables

- **Cable Type IV- Multi Core Cable with ground wire for Digital And Power Signals (From Digital Junction Box to Marshaling Cabinet)**

Construction

Conductor	1.5 mm^2 nominal stranded for 24 VDC equipment for 24 VDC digital signals & power supplies
Insulation	Same as cable type I
Color Code	black core with white numbers
Inner Cable Jacket	80°C, PVC, thickness of inner cable jacket shall be in accordance with IEC standards.

Cable Shield (Overall)	Same as cable type III
Cable Armor	Cable armor shall be single galvanized steel wire having 90% nominal coverage. (Round type, diameter of cable armor wire based on IEC 60502)
Overall Cable Jacket	Same as inner cable jacket
Jacket Color Code	Blue or Grey or Red…
Group Identification	Each 2 core Black-White and numbered (Cores should be identified by numbers and all of them will have same colors (Black jacket with white numbers)
Communication Wire	0.5mm^2 nominal, 7 stranded annealed copper conductors with 0.5mm PVC insulation.

- **Cable Type V- Single Pair Thermocouple Extension Cable (From Thermocouple to Junction Box)**

Construction

Conductor	1.5 mm2 nominal solid type JX (iron constantan) and/or type KX (Chromel / Alumel) alloy wire matched and calibrated per ISA MC 96.1, latest edition, Thermocouple Extension Wire. Conductors twisted pair. Pair of wire shall be twisted at least 20 times per meter and have total coverage electrostatic shield with copper drain wire.
Insulation	Primary insulation: 0.5 mm nominal thickness 105°C PVC. Insulation and overall jackets of instrument signal and thermocouple extension wire and cable shall be PVC or polyethylene and it shall not contain asbestos.
Color Code	Conductor positive (+): White, Conductor negative (-): Red. (JX type Pair jacket: black; KX type Pair jacket: yellow)
Lay of Twist	50mm
Shield	2 layers polyester tape each to be 0.023 mm thick over the pairs with 100% coverage by a tape shield of 0.012mm aluminum Mylar foil wrapped laminated with 0.012 mm Mylar polyester tape, helically applied over the polyester tape with the aluminum on the inside in continuous contact with a bare minimum 0.75 mm^2, 7-strand tinned copper drain wire 100% coverage of 1 layer of polyester tape 0.023mm thick shall be applied over the aluminum Mylar tape shield.

Pair Jacket	1.15mm nominal 80°C PVC
Armor	Cable armor shall be single galvanized steel wire having 90% nominal coverage. (Round type, diameter of cable armor wire based on IEC 60502)

Jacket Color Code Blue for Intrinsicaly Safe & Grey for Non- Intrinsically Safe Instrument Cables and Red for F&G Cables

Cable Type VI-Multi-Pair Thermocouple Extension Cable (Junction Box to Marshalling Cabinet)

Construction

Conductor	0.5 mm^2 nominal solid type JX (iron constantan) and/or type KX (Chromel / Alumel) alloy wire matched and calibrated per ISA MC 96.1, latest edition, Thermocouple Extension Wire. Conductors twisted pair.
Insulation	Same as cable type I
Insulation Color Code	Conductor positive (+): White, Conductor negative (-): Red. (JX type Pair jacket: black; KX type Pair jacket: yellow)
Group Identification	Each pair numbered on pair jacket
Lay of Twist	Maximum 50mm
Pair shields	2 layers polyester each to be 0.023mm thick over the pair with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.012mm Mylar polyester tape, helically applied over the twisted pair with the aluminum on the inside in continuous contact with a bare minimum 0.9 mm^2, 7-strand tinned copper drain wire. 100% coverage of 1 layer of polyester tape0.023 mm thick shall be applied over the aluminum Mylar foil wrapped tape shield.
Pair Jacket	0.5mm nominal thickness 80°C PVC (Color Code-See below)
Communication Wire	0.5mm^2 nominal, 7 stranded annealed copper conductors with 0.5mm PVC insulation.
Cable Shield (Overall)	2 layers of polyester tape each to be 0.023mm thick over the twisted pairs with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.050mm Mylar polyester tape helically applied overall pairs and the communication wire. The aluminum shall be on the inside and in continuous contact with a bare, 0.9mm^2 (#18AWG), 7 strand tinned copper cable drain wire. Two layers of polyester tape and foam insulation or other suitable insulation each 0.2mm thick shall be applied over the aluminum laminated polyester tape.

Inner Cable Jacket	80°C, PVC, thickness of inner cable jacket shall be in (over pairs, drain wire, accordance with IEC standards communication wire)
Cable Armor	Cable armor shall be single galvanized steel wire having 90% nominal coverage. (Round type, diameter of cable armor wire based on IEC 60502)
Overall Cable Jacket	Black

All outdoor cables shall be armored, Armor is not necessary for indoor cable.

3. SPECIFICATION AND ENGINEERING REQUIREMENTS

Cables shall be rated for:

- 300/500 V insulation for single pair and multi-pairs cables
- 600/1000 V insulation for digital and power cables

Conductors for instrument signal wire shall be soft annealed copper in accordance with IEC 60228 class 2.

The physical properties of insulation and jacket material shall comply with the flame retardant properties of IEC 60332.

Insulation and overall jackets of instrument signal and thermocouple extension wire and cable shall not contain asbestos.

Briefly the color of outer sheath shall be considered as follow:

- I.S. cable: Blue
- N.I.S. cable: Grey
- F&G Cables : Red

3.1. PHYSICAL PROPERTIES OF INSULATION AND JACKET MATERIALS

- Physical properties of insulation and jacket material shall comply at minimum with flame retardant properties (according to IEC 60332-1) temperature class 90°C.
- Cables for "Intrinsic Safety(IS)" signals shall be with the following characteristic:
  - Mutual capacitance between cores 0.13 µF/Km (maximum)
  - Capacitance between any core and screen 0.13 µF/Km (maximum)
  - Inductance/resistance ratio 30 µH/Ohm (maximum)
  - The cable section for "Intrinsic Safety(IS)" will be as follows:
    - 1 mm^2 for multiple cable
    - 1.5 mm^2 for either single pair/triple/quad

F&G cables shall be fire resistant Type.

3.2. ELECTRICAL SPECIFICATIONS

All cables, either single or multiple and including the instrumentation supply cables shall be with 300/500 V voltage grade.

Nominal Conductor Resistance in Ohms per 1000 meters at 20°C shall be in accordance with IEC 60028

Insulation Integrity Verified by Spark Test	6000 VAC
Finished product given dielectric test	1500VAC
(Conductor to conductor and conductor to shield for one minute)	
Insulation Resistance Constant at 15.6°C	3000
(Natural Material)	

3.3. CABLE TESTS

The following tests shall be performed on each reel of completed cable in addition to those listed under "ELECTRICAL SPECIFICATIONS".

i) Continuity of conductors and shields

ii) Shield isolation jackets shall withstand a dry test of 2000VAC between shields for one minute

iii) The insulation resistance between shields shall be a minimum of 10 mega ohms per 300m of cable corrected to 15.6°C

iv) Test of gases evolved during combustion of cables (IEC 60754).

v) Visual and dimensions inspection

vi) Flame retardant test (IEC 60332-3).

Vii) High voltage test & Dielectric test.

Note: All tests shall be in accordance with IEC 60811 and other relevant IEC standard. Corticated of the type test is required.

Three copies of certified test reports shall be submitted for each reel of cable.

3.4. CABLE REELS

- **Reel Cable Lengths**

Actual lengths of cable on a reel shall be ±3%.

Maximum Length for single pair cable shall be 500 meters.

3.5. SPECIFIC REQUIREMENTS

- **Purchase Order**

Specific requirements of each type cable, number of pairs, lengths, etc., shall be shown on the "Request for Quotation" and/or "Purchase Order".

- **Data Sheet**

Vendor shall complete the data indicated in data sheet.

Vendor shall submit complete data sheet to the purchaser with his quotation.

In case of conflict between this specification and these data sheets, the later shall govern.

- **Cable Marking**

Single core cables shall be marked with painting and multi core cable shall be embossed marking type.

Cable drum shall be marked by weatherproof stenciling at last one on each flange to display the following data:

a) Manufacturer's identification

b) Voltage rating

c) Number of pairs and core size

d) Cable type by abbreviation letter

e) Length of cable

f) Drum weight

g) Directional arrow for movement of drum

h) Requisition with item number

The markings shall be repeated every 3 m, along the cable entire length.

i) Reference standard

j) Cable type & size

k) Special features such as (UV resistant, Fire resistant,…),The vendor shall provide certificates and test result/reports of all applicable fire resistance testes performed in accordance with IEC60331.

l) Year of manufacture

m) Metric incremental length

4. PREPARATION FOR SHIPMENT

Unless otherwise specified, preparation for shipment shall be in accordance with the manufacturer's standard. The manufacturer shall be solely responsible for the adequacy of the preparation for shipment employed with respect to materials and applications, and provide materials to their destination in ex-works condition when handled by commercial carrier systems. Splices in individual conductors of single and multi-pair cables, drain wire, communication conductor or shielding are not acceptable.

Watertight seals shall be applied to the ends of the cable to prevent entrance of moisture during shipment or out-of-doors storage at the job site.

All reels shall have lagging to prevent damage to the finished cable.

The manufacturer shall submit with his quotation, his standard "packaging" of reels.