ENQUIRY SPECIFICATION
FOR
Power, Control and Instrument cables

Rev no	Date	Revision	Approvals					
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1. GENERAL

1.1 Tata Steel is in process of execution several expansion projects at many locations. For execution of these projects, TSL requires Power, control and instrument cables of many sizes. This document covers the requirement of cables for which TSL is planning to have ARC (Annual rate contract).

1.2 The specification covers the design, engineering, manufacture, inspection and testing at the TENDERER'S works, packing, forwarding, delivery to site/TATA STEEL Stores of power, control and instrument cables.

1.3 Tenderer shall quote unit rates for supply in the bill of quantities.

1.4 The intent is to sign off technical parameters of the cables under BOQ with the vendor. Thereafter direct orders will be released on the vendor for supply of cables. The technical parameters once frozen will be valid for a period of 3 years.

1.5 The vendors are to send us their GTP (guaranteed technical parameters along with maximum deviation (if applicable) in the data sheets attached with the BOQ. The GTP once approved will be valid for a period of three years.

1.6 The tenderer shall study the specification and satisfy himself thoroughly regarding the workability of the technical specifications and shall take full responsibility for the guaranteed operation and performance of the equipment as regards output, performance and smooth, reliable and safe working.

1.7 If the tenderer feels that any dimension and/or design data furnished in this specification are in his opinion not suitable, he shall indicate this specifically and submit an alternative proposal on the basis of the data he considers suitable and capable of meeting the required operating and duty requirements. However, such alternatives shall be subject to the approval of TATA STEEL.

2. **SCOPE :** This technical specification covers the power , control and instrument cables for use at the project sites of Tata Steel.

3. **CODES AND STANDARDS**

3.1 The design, construction, manufacture and performance of cables shall comply with all currently applicable statutes, regulations and safety codes. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

3.2 Unless otherwise specified cable shall conform to the latest applicable standards as on the date of tender submission unless otherwise indicated.

REFERENCES:

3.3 TISCO Standard 02040/3.0: Specification of Electric cable

3.4 IS: 694-1990 - Specification for PVC insulated cables for working voltage up to and including 1100 volts.

3.5 IS: 1554 (Part-I)-1988 - Specification for PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.

3.6 IS: 1554 (Part-II)-1988- Specification for PVC insulated(heavy duty) electric cables for working voltages from 3.3kV upto and including 11kV.

3.7 IS: 3975-1988 (Reaffirmed in 1992) – Specification for mild steel wires, strips and tapes for armouring of cables.

3.8 IS: 5831-1984(Reaffirmed in 1991) - Specification for PVC insulation and sheath of electric cables.

3.9 IS: 6380-1984(Reaffirmed in 1991) - Specification for elastomeric insulation and sheath of electric cables.

3.10 IS: 7098 (Part-I)-1988 – Specification for cross linked polyethylene insulated PVC sheathed cables. Part-I For working voltages up to and including 1100 volts.(Second revision) (Amendment No.1).

3.11 IS:7098(Part-II)-1985 (Reaffirmed in 1988) –Specification for cross linked polyethylene insulated PVC sheathed cables for working voltages from 3.3kV up to and including 33 kV.

3.12 IS: 8130-1984 (Reaffirmed in 1991) – Specification for conductors for insulated electric cables and flexible cords.

3.13 IS: 9857-1981- Specification for welding cables.

3.14 IS: 9968(Part-I)-1988 – Specification for elastomer insulated cables for working voltages up to and including 1100V.

4. Detail technical specifications

Cable type –A: LV XLPE single core un-armored power cable

I. Type: LV XLPE Cable
II. Voltage Grade: 1.1KV
III. Conductor details:

- Material: Cu/Al
- Note: Conductor shall be composed of plain copper or aluminium wires complying with IS: 8130-1984 (Refer IS 7098(Part-1): 1988, Clause 3.1.
- Construction of conductor: Stranded
- Flexible Class: 2

IV. Insulation: XLPE insulation applied by extrusion.

Note: Properties of XLPE insulation shall be as per As per IS 7098(Part-1)- 1988, Clause 4.1, Table-1.

- Min. Nominal Thickness(mm): As per Table-3 of IS 7098(Part-1)-1988, Clause 9.2
- Tolerance on Thickness of Insulation: As per IS 7098(Part-1)-1988,Clause
  9.3 smallest of measured values of thickness of insulation shall not fall below the nominal value (ti) specified in Table 3 by more than 0.1 mm + 0.1 (ti).

V. Conductor Temperature(°C): 90 (As per IS 7098(Part-1)-1988,Clause 1.4)
VI. Ambient Temperature(°C): 50
VII. Inner Sheath: NA
VIII. Armoring: Un-armored
IX. Outer Sheath: The outer sheath applied by extrusion shall be of

polyvinyl chloride (PVC) compound conforming to the requirements of type ST 2 compound of IS : 5831-1984. Thickness of the outer sheath shall be as per clause 14.3, table-8 of IS: 7098(Part-1)-1988.

X. Core Identification: Black or as specified in the PO.

XI. Manufacturer's identification: The Following Shall be embossed on outer sheath throughout the length at an interval of ONE meters.

a. Manufacturer's name,
b. Manufacturer Identification Number for traceability at manufacturer end (e.g. Drum number, lot number etc.)
c. Voltage grade,
d. year of manufacturing,
e. No of Cores, Core size,
f. Length marking

XII. Packing and marking:

a. The cable shall be wound on a wooden drum (see IS: 10418-1982*) and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material and should be clearly visible from outside. The wooden drum should be coal-tar painted.

b. Drum length should be 500 metre .

c. The cable shall carry the following information either stenciled on the drum or contained in a label attached to it.

- Reference to this Indian Standard, for example, Ref IS: 7098 (Part 1);
- Manufacturer’s name or trade-mark
- Type of cable and voltage grade
- Number of cores
- Nominal cross-sectional area of conductor
- Cable code
- Length of cable on the drum
- Number of lengths on the drum (if more than one)
- Direction of rotation of drum (by means of an arrow)
- Gross mass
- Country of manufacture
- Year of manufacture

Cable Type –B: LV XLPE multi core armoured power cable

I. Type: LV XLPE Cable
II. Voltage Grade: 1.1KV
III. Number of core and size: To be specified by user in attached BOQ
IV. Conductor details:
   a. Material: Cu/Al

      Note: Conductor shall be composed of plain copper or aluminum wires complying with IS: 8130-1984 (Refer IS 7098(Part-1): 1988, Clause 3.1.

   b. Construction of conductor: Stranded
   c. Flexible Class 2
      Size of Neutral Conductor (mm2): Same as another conductor

V. Insulation: XLPE Insulation applied by extrusion.
   Note: Properties of XLPE insulation shall be as per IS 7098(Part-1)-1988, Clause 4.1, Table-1.

   - Min. Nominal Thickness(mm): As per Table-3 of IS 7098(Part-1)-1988, Clause 9.2
   - Tolerance on Thickness of Insulation: As per IS 7098(Part-1)-1988,Clause
     9.3 smallest of measured values of thickness of insulation shall not fall below the nominal value (ti) specified in Table 3 by more than 0.1 mm + 0.1 (ti).

VI. Conductor Temperature(°C): 90 (As per IS 7098(Part-1)-1988,Clause 1.4)
VII. Ambient Temperature(°C): 50
VIII. Filler: Fillers wherever applicable shall be of Vulcanized or unvulcanized rubber or Thermoplastic material as per clause no 5 of IS: 7098 (Part-1)-1988.The material should be compatible with temperature rating of cable and shall have no harmful effect on any other component of the cable.
IX. Inner Sheath: Inner sheath applied by extrusion shall be of Vulcanized or unvulcanized rubber or Thermoplastic material and not be harder than XLPE used for insulation as per clause no 5 of IS: 7098 (Part-1)-1988.Minimum thickness of Inner sheath shall be as per table-5 of IS: 7908(Part-1)-1988.
X. Armoring: Galvanized
   Galvanised steel Flat Strip / Round wire
   Note:
   - Galvanized round steel wire used for armoring shall confirm

to IS: 3975- 1999.

- The dimensions of galvanized steel wires shall be as specified in Table 6 of IS: 7098(Part-1)-1988.

XI. Outer Sheath: The outer sheath applied by extrusion shall be of polyvinyl chloride (PVC) compound conforming to the requirements of type ST 2 compound of IS : 5831-1984. Minimum thickness of the outer sheath shall be as per clause 14.3, table-8 of IS: 7098(Part-1)-1988.

XII. Core Identification: For three core (Red, Yellow and Blue)

For four core (Red, Yellow, Blue and Black)

XIII. Manufacturer's identification: The Following Shall be embossed on outer sheath throughout the length at an interval of ONE meter.

a. Manufacturer's name,
b. Manufacturer Identification Number for traceability at manufacturer end (e.g. Drum number, lot number etc.)
c. Voltage grade,
d. year of manufacturing,
e. No of Cores, Core size,
f. Length marking

XIV. Packing and marking:

a. The cable shall be wound on a wooden drum (see IS: 10418-1982*) and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material and should be clearly visible from outside. The wooden drum should be coal-tar painted.
b. Drum length should be 500 meter or as specified by the customer.
c. The cable shall carry the following information either stenciled on the drum or contained in a label attached to it.
    - Reference to this Indian Standard, for example, Ref IS: 7098 (Part 1);
    - Manufacturer’s name or trade-mark
    - Type of cable and voltage grade
    - Number of cores
    - Nominal cross-sectional area of conductor
    - Cable code

- Length of cable on the drum
- Number of lengths on the drum (if more than one)
- Direction of rotation of drum (by means of an arrow)
- Gross mass
- Country of manufacture
- Year of manufacture

Cable Type –C: HV XLPE Single core Un-armored power cable (3.3KV to 33KV)

I. Type: HV XLPE Cable

II. Number of core and size: To be specified by user

III. Voltage Grade (UE)/(E) (KV):
1.9/3.3 kV, 3.8/6.6 kV, 6.35/11 kV,12.7/22 kV and 19/33 kV

IV. Conductor: CU/AL

- Aluminum: Stranded compacted circular H4 grade aluminum conductors confirming to class 2 as per clause no 3.1 and 5.3 of IS: 8130-1984
- Copper: Stranded compacted circular conductor made from high conductivity copper conforming to class 2 as per clause no 3.2 and 5.3 of IS: 8130-1984

V. Conductor screening: Extruded semi conducting compound

VI. Conductor Insulation: Cross link polyethylene (XLPE) applied by Extrusion. The XLPE cable should be manufactured through Continuous Catenary Vulcanization (CCV)/ Vertical Continuous Vulcanization (VCV) / MDCV and subsequently undergone through N2 / dry curing.
Note: - The XLPE insulation should confirm the requirement as per clause no 4.1 IS 7098 (Part-2)

VII. Nominal thickness of XLPE insulation: Thickness of insulation and tolerance on thickness should be as per clause no 11.2 & 11.3 of IS 7098 (PART-2) respectively.

VIII. Insulation screening: Freely strippable (with heat) type extruded non-metallic semi conducting compound as per clause no 5.1 b) of IS: 7098 (Part-2)-1985 followed by copper metallic tape with minimum 25 % overlapping and thickness as per standard.

IX. Conductor temperature: 90ºC
X. Ambient temperature: 50 ºC
XI. Fillers: NA
XII. Inner Sheath: NA
XIII. Armouring: NA
XIV. Outer Sheath: Extruded PVC with thickness & tolerances given in clause no
17.3.2 of IS 7098 (Part-2). The outer sheath shall be PVC compound confirming to the requirement of type ST2 (Cause no 1.2 of IS 5831).

XV. Manufacturer's identification: The Following Shall be embossed on outer sheath throughout the length at an interval of ONE meter.

a. Manufacturer's name,
b. Manufacturer Identification Number for traceability at manufacturer end (e.g. Drum number, lot number etc.)
c. Voltage grade,
d. year of manufacturing,
e. No of Cores, Core size,
f. Length marking

XVI. Packing and marking:

a. The cable shall be wound on a steel drum and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material and should be clearly visible from outside.
b. Drum length should be 500 metre or as specified by the customer.
c. The cable shall carry the following information either stencilled on the drum or contained in a label attached to it.

- Reference to this Indian Standard, for example, Ref IS: 7098 (Part 2);
- Manufacturer’s name or trade-mark
- Type of cable and voltage grade
- Number of cores
- Nominal cross sectional area of conductor
- Cable code
- Length of cable on the drum
- Number of lengths on the drum (if more than one)
- Direction of rotation of drum (by means of an arrow)
- Gross mass
- Country of manufacture

- Year of manufacture

XVII. Routine tests: Conductor resistance test, partial discharge test (on full drum length) and high voltage test should be carried out on all finished cable lengths at the factory as per Clause no. 18.3 of IS 7098 (Part-2) and tests certificates to be supplied along with cables.

XVIII. Acceptance test: It is to be carried out on samples taken from a lot. Number of samples should be selected as per the clause no. A2.2, Appendix-A of IS 7098 (Part-2). Tests to be carried out are: Tensile test (for aluminum), Wrapping test (for aluminum), Conductor resistance test, test for thickness of insulation and

sheath, Hot test set for insulation, Tensile strength & elongation at break test for insulation & sheath, partial discharge test (on full drum length), high voltage test, and Insulation resistance (Volume resistivity) test as per Clause no. 18.2 of IS 7098 (Part-2).All tests certificates to be supplied along with cables.

Cable Type –D: HV XLPE Single core armoured power cable (3.3KV to 33KV)

I. Type: HV XLPE Cable

II. No of core and size: Specified in BOQ

III. Voltage Grade (UE)/(E) (KV): 1.9/3.3 kV, 3.8/6.6 kV, 6.35/11 kV,12.7/22 kV and 19/33 kV

IV. Conductor: CU/AL

- Aluminum: Stranded compacted circular H4 grade aluminum conductors confirming to lass 2 as per clause no 3.1 and 5.3 of IS: 8130-1984
- Copper: Stranded compacted circular conductor made from high conductivity copper conforming to class 2 as per clause no 3.2 and 5.3 of IS: 8130-1984

V. Conductor screening: Extruded semi conducting compound

VI. Conductor Insulation: Cross link polyethylene (XLPE) applied by Extrusion. The XLPE cable should be manufactured through Continuous Catenary Vulcanization (CCV)/ Vertical Continuous Vulcanization (VCV) / MDCV and subsequently undergone through N2 / dry curing.

Note: - The XLPE insulation should confirm the requirement as per clause no 4.1 IS 7098 (Part-2)

VII. Nominal thickness of XLPE insulation: Thickness of insulation and tolerance on thickness should be as per clause no 11.2 & 11.3 of IS 7098 (PART-2) respectively.

VIII. Insulation screening: Freely strippable (with heat) type extruded non-metallic semi conducting compound as per clause no 5.1 b) of IS: 7098 (Part-2)-1985 followed by copper metallic tape with minimum 25 % overlapping and thickness as per standard.

IX. Conductor temperature: 90ºC

X. Ambient temperature: 50ºC

XI. Fillers: NA

XII. Inner Sheath: Extruded PVC and its material should not be harder than XLPE and PVC used for insulation and outer sheath respectively.

Note: - Thickness of inner sheath should be as per clause no 15.3 of IS 7098 (Part-2)

XIII. Armouring:

a. The armoring shall be of non-magnetic material

b. Armouring shall be applied over the insulation or protective barrier or non- metallic part of insulation screening, in case of single core cables or inner sheath in case of screened and armoured single core cables.

c. The armour wires/strips shall be applied as closely as practicable the direction of lay of the armour shall be left hand. For double wires/strips armoured cables, this requirement shall apply to the inner layer of wires/strips. The outer layer shall, except in special cases, be applied in the reverse direction to the inner layer, and there shall be a separator of suitable non-hygroscopic material; such as plastic tape, bituminized cotton tape, bituminized hessian tape, rubber tape, proofed tape between the inner and outer layers of armour wires strips.

d. A binder tape may be applied on the armour.

e. The joints in armour wires of strips shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire/strip shall be at least 300 mm from the nearest joint in any other armour wire/strip in the

completed cable, Number of joint in a single wire to be limited.

XIV. Outer Sheath: Extruded PVC with thickness & tolerances given in clause no
17.3.2 of IS 7098 (Part-2). The outer sheath shall be PVC compound confirming to the requirement of type ST2 (Clause no 1.2 of IS 5831).

XV. Manufacturer's identification: The Following Shall be embossed on outer sheath throughout the length at an interval of ONE meters.

a. Manufacturer's name,
b. Manufacturer Identification Number for traceability at manufacturer end (e.g. Drum number, lot number etc.)
c. Voltage grade,
d. year of manufacturing,
e. No of Cores, Core size,
f. Length marking

XVI. Packing and marking:

a. The cable shall be wound on a steel drum and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material and should be clearly visible from outside.
b. Drum length should be 500 metre or as specified by the customer.
c. The cable shall carry the following information either stenciled on the drum or contained in a label attached to it.

- Reference to this Indian Standard, for example, Ref IS: 7098 (Part 2);
- Manufacturer’s name or trade-mark
- Type of cable and voltage grade
- Number of cores
- Nominal cross sectional area of conductor
- Cable code
- Length of cable on the drum
- Number of lengths on the drum (if more than one)
- Direction of rotation of drum (by means of an arrow)
- Gross mass
- Country of manufacture
- Year of manufacture

XVII. Routine tests: Conductor resistance test, partial discharge test (on full drum length) and high voltage test should be carried out on all finished cable lengths at the factory as per Clause no. 18.3 of IS 7098 (Part-2) and tests certificates to be supplied along with cables.

XVIII. Acceptance test: It is to be carried out on samples taken from a lot. Number of samples should be selected as per the clause no. A2.2, Appendix-A of IS 7098 (Part-2). Tests to be carried out are: Tensile test (for aluminum), Wrapping test (for aluminum), Conductor resistance test, test for thickness of insulation and sheath, Hot test set for insulation, Tensile strength & elongation at break test for insulation & sheath, partial discharge test (on full drum length), high voltage test, and Insulation resistance (Volume resistivity) test as per Clause no. 18.2 of IS 7098 (Part-2).All tests certificates to be supplied along with cables.

Cable Type –E: HV XLPE multi core armored power Cables (3.3KV to 33KV)

I. No of core and size: Specified by user

II. Voltage Grade (UE)/(E) (KV): 1.9/3.3 kV, 3.8/6.6 kV, 6.35/11 kV,12.7/22 kV and 19/33 kV

III. Conductor temperature: 90ºC

IV. Conductor: CU/AL

- Aluminum: Stranded compacted circular H4 grade aluminum conductors confirming to class 2 as per clause no 3.1 and 5.3 of IS: 8130-1984
- Copper: Stranded compacted circular conductor made from high conductivity
  copper conforming to class 2 as per clause no 3.2 and 5.3 of IS: 8130-1984

V. Conductor screening: Extruded semi conducting compound

VI. Conductor Insulation: Cross link polyethylene (XLPE) applied by Extrusion. The XLPE cable should be manufactured through Continuous Catenary Vulcanization (CCV)/ Vertical Continuous Vulcanization (VCV)/MDCV and subsequently undergone through N2 / dry curing.
Note: - The XLPE insulation should confirm the requirement as per clause no 4.1 IS 7098 (Part-2)

VII. Nominal thickness of XLPE insulation: Thickness of insulation and tolerance on thickness should be as per clause no 11.2 & 11.3 of IS 7098 (PART-2) respectively.

VIII. Insulation screening: Freely strippable (with heat) type extruded non-metallic semi conducting compound as per clause no 5.1 b) of IS: 7098 (Part-2)-1985 followed by copper metallic tape with minimum 25 % overlapping and thickness as per standard.

IX. Fillers: Solid round fillers of Vulcanized or vulcanized rubber or Thermoplastic material as per clause no 6 of IS: 7098 (Part-2)-1985.The material should be compatible with temperature rating of cable and shall have no harmful effect on any other component of the cable.

X. Inner Sheath: Extruded PVC and its material should not be harder than XLPE and PVC used for insulation and outer sheath respectively.

Note: - Thickness of inner sheath should be as per clause no 15.3 of IS 7098 (Part-2).

XI. Armoring:

a. Armouring shall be galvanized round steel wires/formed steel wires (strips)
b. The galvanized round steel wires/formed steel wires (strips) used for Armouring shall conform to IS : 3975-1999
c. Armouring shall be applied over the inner sheath.
d. The armour wires/strips shall be applied as closely as practicable.
e. The direction of lay of the armour shall be left hand. For double wires/strips armored cables, this requirement shall apply to the inner layer of wires/strips.

   The outer layer shall, except in special cases, be applied in the reverse direction to the inner layer, and there shall be a separator of suitable non- hygroscopic material; such as plastic tape, bituminized cotton tape, bituminized hessian tape, rubber tape, proofed tape between the inner and outer layers of armour wires strips. Galvanized Steel Strip wires of dimension as per Clause no 16.3 of IS 7098 (Part-2).

f. A binder tape may be applied on the armour.
g. Where the calculated diameter below Armouring does not exceed 13 mm, the armour shall consist of galvanized round steel wires. The armour of cables having calculated diameter below armouring greater than 13 mm shall consist of either alvanized round steel wires or galvanized steel strips.

h. The dimensions of galvanized steel wires or strips shall be as specified in Table 4. Of IS 7098 part-2, The tolerance on nominal dimensions shall be as per IS : 3975-1999.

i. The joints in armour wires of strips shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire/strip shall be at least 300 mm from the nearest joint in any other armour wire/strip in the completed cable, Number of joint in a single wire to be limited.

XII. Outer Sheath: Extruded PVC with thickness & tolerances given in clause no

17.3.2 of IS 7098 (Part-2). The outer sheath shall be PVC compound confirming to the requirement of type ST2 (Clause no 1.2 of IS 5831).

XIII. Core Identification: By numbering or coloring (Red, yellow, Blue) on semi conducting insulation screen on cores as per Clause no. 13.1 of IS 7098 (Part-2).

XIV. Manufacturer's identification: Manufacturer's name, Voltage grade, year of manufacturing, No of Cores, Core size, Length and Drum Number /Identification Number marking should be embossed on outer sheath throughout the length at an interval of ONE meters.

XV. Packing and marking: Cable should be supplied in Steel drum. Cable piece length should be of 500 meter length or as specified by the customer at the time of order. The end of the cable should be sealed by means of non-hygroscopic sealing material. The cable drum should carry the information: Reference to IS/Manufacturer's name/Type of cable & voltage grade/ Number of cores/Nominal

cross sectional area of conductor/cable code/Length of cable on drum/No of length on drum as per Clause no. 21 of IS 7098 (Part-2).

XVI. Routine tests: Conductor resistance test, partial discharge test (on full drum length) and high voltage test should be carried out on all finished cable lengths at the factory as per Clause no. 18.3 of IS 7098 (Part-2) and tests certificates to be supplied along with cables.

XVII. Acceptance test: It is to be carried out on samples taken from a lot. Number of samples should be selected as per the clause no. A2.2, Appendix-A of IS 7098 (Part-2). Tests to be carried

out are: Tensile test (for aluminium), Wrapping test (for aluminium), Conductor resistance test, test for thickness of insulation and sheath, Hot test set for insulation, Tensile strength & elongation at break test for insulation & sheath, partial discharge test (on full drum length), high voltage test, and Insulation resistance (Volume resistivity) test as per Clause no. 18.2 of IS 7098 (Part-2).All tests certificates to be supplied along with cables.

Cable Type F: Single core/Multicore flexible power cable (Un-armored)

I. Type : Single/Multicore trailing power cable(Un-armoured)
II. Voltage Grade: 1.1KV
III. Number of core and size: Specified in BOQ
IV. Conductor details :

- Material : Annealed high conductivity tinned copper
- Note: As per IS: 8130, clause 3.2 conductors shall be made from high conductivity copper rods complying with IS: 613-1964*
- Construction of conductor: Stranded
- Flexible Class : class 5, confirming to IS: 8130-1984

V. Insulation : The insulation shall be of elastomer compound conforming to Type IE 2 of IS : 6380-1984
VI. Maximum Conductor Temperature(°C): 90 ,As per IS 9968(Part-1)-1988,Clause 1.4
VII. Ambient Temperature(°C): 50
VIII. Sheath: The sheath shall consist of elastomeric compound complying with the requirement of type SE-4 of IS 6380-1984
IX. Core Identification: The core shall be identified by coloured insulation.
For three core (Red, Yellow and Blue)
For four core (Red, Yellow, Blue and Black)
X. Manufacturer's identification: The Following Shall be embossed on sheath throughout the length at an interval of ONE meters.
a. Manufacturer's name,
b. Manufacturer Identification Number for traceability at manufacturer end (e.g. Drum number, lot number etc.)
c. Voltage grade,
d. year of manufacturing,
e. No of Cores, Core size,
f. Length marking.
XI. Packing and marking:

a. The cable shall be either wound on a wooden drums (see IS: 10418-1982) or reels or supplied in coils and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material and should be clearly visible from outside. The wooden drum should be coal-tar painted.
b. Drum length should be 100 metre or as specified by the customer.
c. The cable shall carry the following information either stencilled on the drum or contained in a label attached to it.
   - Reference to this Indian Standard, for example, Ref IS 9968(Part-1)-1988.
   - Manufacturer's name or trade-mark.
   - Type of cable and voltage grade.
   - Number of cores.
   - Nominal cross sectional area of conductor.
   - Cable code.
   - Length of cable on the drum/reel/coil.
   - Number of lengths on the drum, reel or coil (if more than one).
   - Direction of rotation of drum (by means of an arrow).
   - Gross mass.
   - Country of manufacture.
   - Year of manufacture.

Cable Type G: LV XLPE Control Cables

I. Type : LV XLPE Multicore Control Cable
II. Voltage Grade: 1.1KV
III. Number of core and size: To be specified at the time of enquiry
IV. Conductor details :
   - Material : Cu, Conductor shall be composed of plain copper wires complying with IS: 8130-1984† (Refer IS 7098(Part-1): 1988, Clause 3.1.
   - Construction of conductor: Stranded.
   - Flexible Class : 2

V. Insulation: XLPE applied by extrusion.
Note: Properties of XLPE insulation shall be as per As per IS 7098(Part-1)-1988, Clause 4.1, Table-1.

a. Min. Nominal Thickness(mm):
b. Tolerance on Thickness of Insulation: As per IS 7098(Part-1)-1988,Clause 9.3 smallest of measured values of thickness of insulation shall not fall below the nominal value (ti) specified in Table 3 by more than 0.1 mm + 0.1 (ti).

c. Laying Up Of Cores :

- In twin, three and multi-core cables, the cores shall be laid up together with a suitable lay, the outermost layer shall have right-hand lay and the

  successive layer shall be laid with opposite lay. Where necessary, the interstices shall be filled with non-hygroscopic material.

- The recommended plan for lay-up of multicores up to 100 shall be in accordance with IS 7098(Part-1)-1988, Table 4.

VI. Conductor Temperature(°C): 90 (As per IS 7098(Part-1)-1988,Clause 1.4)

VII. Ambient Temperature(°C): 50

VIII. Filler: Not required.

IX. Inner Sheath: Inner sheath applied by extrusion shall be of Vulcanized or unvulcanized rubber or Thermoplastic material and not be harder than XLPE used for insulation as per clause no 5 of IS: 7098 (Part-1)-1988.Thickness of Inner sheath shall be as per table-5 of IS: 7908(Part-1)-1988.

X. Armouring: Galvanized round steel wire/Galvanised steel Flat Strip

- Galvanized round steel wire/ Galvanised steel Flat Strip used for armouring shall confirm to IS: 3975- 1999.
- The nominal diameter of galvanized steel wires shall be as specified in Table 6 of IS: 7098(Part-1)-1988.

XI. Outer Sheath: The outer sheath applied by extrusion shall be of polyvinyl chloride (PVC) compound conforming to the requirements of type ST 2 compound of IS : 5831-1984. Minimum thickness of the outer sheath shall be as per clause 14.3, table-8 of IS: 7098(Part-1)-1988.

XII. Colour of the Outer Sheath: Yellow with UV protection.

XIII. Core Identification:

- Core Identification shall be done only by numbers irrespective of number of cores.
- Colour of insulation of core shall be grey.

XIV. Manufacturer's identification: The Following Shall be embossed on outer sheath throughout the length at an interval of ONE meters.

a. Manufacturer's name,

b. Manufacturer Identification Number for traceability at

manufacturer end (e.g. Drum number, lot number etc.)

c. Voltage grade,
d. year of manufacturing,
e. No of Cores, Core size,
f. Length marking

XV. Packing and marking:

a. The cable shall be wound on a wooden drum (see IS: 10418-1982*) and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material and should be clearly visible from outside. The wooden drum should be coal-tar painted.

b. Drum length should be 500 metre or as specified by the customer.

c. The cable shall carry the following information either stencilled on the drum or contained in a label attached to it.

- Reference to this Indian Standard, for example, Ref IS: 7098 (Part 1);
- Manufacturer's name or trade-mark
- Type of cable and voltage grade
- Number of cores
- Nominal cross-sectional area of conductor
- Cable code
- Length of cable on the drum
- Number of lengths on the drum (if more than one)
- Direction of rotation of drum (by means of an arrow)
- Gross mass
- Country of manufacture
- Year of manufacture

- Flexible Class : class 5, confirming to IS: 8130-1984

II. Insulation : The insulation shall be of silicone rubber conforming to Type IE 5 of IS
: 6380-1984

III. Conductor Temperature(°C): 150 (IS 9968(Part-1)-1988,Clause 1.4)
IV. Ambient Temperature(°C): 50
V. Colour of Insulation: Black or as specified in the PO.
VI. Manufacturer's identification: The Following Shall be embossed on insulation throughout the length at an interval of ONE meters.

a. Manufacturer's name,
b. Manufacturer Identification Number for traceability at manufacturer end (e.g. Drum number, lot number etc.)

c. Voltage grade,
d. year of manufacturing,
e. No of Cores, Core size,
f. Length marking.

VII. Packing and marking:

a. The cable shall be either wound on a wooden drums (see IS: 10418-1982) or reels or supplied in coils and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material and should be clearly visible from outside. The wooden drum should be coal-tar painted.
b. Drum length should be 100 metre or as specified by the customer.
c. The cable shall carry the following information either stenciled on the drum or contained in a label attached to it.

- Reference to this Indian Standard, for example, Ref IS 9968(Part-1)-1988.
- Manufacturer's name or trade-mark.
- Type of cable and voltage grade.
- Number of cores.
- Nominal cross sectional area of conductor.
- Cable code.
- Lengt of cable on the drum/reel/coil.

- Number of lengths on the drum, reel or coil (if more than one).
- Direction of rotation of drum (by means of an arrow).
- Gross mass.
- Country of manufacture.

Cable Type H: Paired Instrument Cables

Type : PVC Multipair instrument Cable
Voltage Grade: 500V
Number of core and size: Specified at the BOQ
Conductor details :
Material: Annealed tinned electrolytic Copper
Construction of conductor: Multi-Stranded
Cross sectional area 1.0 Sq.mm
Number of Strands 7
Insulation Material
HRPVC Type C
Material reference standard IS 5831 / 1984 & BS 5308 Part-II
Insulation thickness min (mm) 0.6
Core colour Blue & White

Core Identification Blue & White with Numbering
Min. no.of twists per mtr. 10 to 12

Individual screening
Individual Al mylar tape thickness 0.05 with 100 % coverage and 25% Overlapp
Drain wire material Annealed Tinned Copper
Drain wire size (sqmm) 0.8

Overall screening
Overall Al mylar tape thickness 0.05 with 100 % coverage and 25% Overlapp
Drain wire material Annealed Tinned Copper
Drain wire size (sqmm) 0.8

Inner Sheath
Material Extruded FRLS ST2
Minimum Thickness (mm) As per Table-4 of IS 1554 Part-I
Material reference standard IS 5831 / 1984
Sheath Colour Black

Armouring
Material Galvanised Steel
Type of Armour Round Wire
Nominal dimensions (mm) Table 2 of BS 5308 Part-II

Outer Sheath
Material Extruded FRLS PVC ST2
Thickness (Nominal / Minimum) (mm) As per Table-7 of IS 1554 Part-I
Material reference standard IS 5831 / 1984
Sheath Colour Grey

Dimensional parameters
Dia. Over inner sheath Vendor to Specify
Dia. Over Armour Vendor to Specify
Dia. Over outer sheath Vendor to Specify
Each drum length (mtr) Vendor to Specify
Minimum bending radius 10 x Cable Diameter

Electrical Data
Conductor resistance at 20 Deg C (Ohm/km) Vendor to Specify
Insulation resistance at 20 Deg. C (min) M ohm/km Vendor to Specify
L/R Ration (Max) Micro H / Ohm Vendor to Specify
Mutual Capacitance @ 1 kHz (max) pF/m Vendor to Specify
HV test (core to core) KV for 1 minute Vendor to Specify
HV test (core to screen) KV for 1 minute Vendor to Specify
Printing on Outer sheath
As per Vendor standard

Cable Type I: Triad Instrument Cables

Type : Multi Triad Instrument Cables
Voltage Grade: 500V
Number of core and size: Specified at the BOQ
Conductor details :

- Material: Annealed tinned electrolytic Copper
- Construction of conductor: Multi-Stranded
- No of strands 7
- Cross sectional area 1 sq.mm

Insulation Material
HRPVC Type C
Material reference standard IS 5831 / 1984 & BS 5308 Part-II
Insulation thickness min (mm) 0.6
Core colour Blue & White
Core Identification Blue & White with Numbering
Min. no.of twists per mtr. 10 to 12

Individual screening
Individual Al mylar tape thickness 0.05 with 100 % coverage and 25% Overlapp
Drain wire material Annealed Tinned Copper
Drain wire size (sqmm) 0.8

Overall screening
Overall Al mylar tape thickness 0.05 with 100 % coverage and 25% Overlapp
Drain wire material Annealed Tinned Copper
Drain wire size (sqmm) 0.8

Inner Sheath
Material Extruded FRLS ST2
Minimum Thickness (mm) As per Table-4 of IS 1554 Part-I
Material reference standard IS 5831 / 1984
Sheath Colour Black

Armouring
Material Galvanised Steel
Type of Armour Round Wire
Nominal dimensions (mm) Table 2 of BS 5308 Part-II

Outer Sheath
Material Extruded FRLS PVC ST2
Thickness (Nominal / Minimum) (mm) As per Table-7 of IS 1554 Part-I
Material reference standard IS 5831 / 1984
Sheath Colour Grey

Dimensional parameters
Dia. Over inner sheath Vendor to Specify

Dia. Over Armour Vendor to Specify
Dia. Over outer sheath Vendor to Specify
Each drum length (mtr) Vendor to Specify
Minimum bending radius 10 x Cable Diameter

Electrical Data
Conductor resistance at 20 Deg C (Ohm/km) Vendor to Specify
Insulation resistance at 20 Deg. C (min) M ohm/km Vendor to Specify
L/R Ration (Max) Micro H / Ohm Vendor to Specify
Mutual Capacitance @ 1 kHz (max) pF/m Vendor to Specify
HV test (core to core) KV for 1 minute Vendor to Specify
HV test (core to screen) KV for 1 minute Vendor to Specify
Printing on Outer sheath
As per Vendor standard

5. GUARNTEED PERFORMANCE

5.1 The MANUFACTURER shall guarantee the successful and satisfactory operation of the cables furnished under this contract and shall meet the ratings and performance requirements as stipulated in this specification.

5.2 The Manufacturer shall further guarantee that the material provided by him shall be free from the defects in design, material and workmanship and shall upon written notice from the PURCHASER, fully rectify, free of expenses to the PURCHASER such defects as developed under the normal use of the said equipment within the period of guarantee / warranty.

6. PACKING FOR SHIPMENTS

6.1 The equipment complete with its accessories, spares, special tools and tackles shall be suitably protected by respective packing for shipment considering handling during transit, distance and weather conditions involved. The Vendor shall submit the packaging method for shipment to be adopted by him, if so desired by Tata Steel.

6.2 Each consignment shall be marked with equipment name, Tata Steel's name & address, Project details, handling instruction etc. It shall be completed with part list and identification details. The copies

of the part list of each consignment shall also be furnished to Tata Steel after dispatch.

6.3 Each shipping unit, after passing all specified production tests, shall be sealed in a clean dry condition with leak-tight shipping covers securely mounted for shipment. All covers to be removed during installation shall be clearly marked. Each shipping section shall be carefully sealed to prevent the entrance of moisture and contamination.

6.4 Equipment shall be packaged for transportation so as to meet the space and weight limitation of transport facilities. The Vendor shall obtain approval from concerned authorities for transportation of over dimensioned consignment/package, if any, before starting manufacture of such equipment.