

 <b>NISOC</b>	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Instrument/F&G Cables								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0060	Rev. D05	Page 1 of 25

## Specification for Instrument/F&G Cables

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Status:

- IDC: Inter-Discipline Check
- IFC: Issued For Comment
- IFA: Issued For Approval
- IFR: Issued for Review
- AFD: Approved For Design
- AFC: Approved For Construction
- AFP: Approved For Purchase
- IFI: Issued For Information
- AB-R: As-Built for COMPANY Review
- AB-A: As-Built –Approved



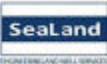
  
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## 1. INTRODUCTION

National Iranian South Oil Company (NISOC) plans to conduct an integrated project includes several sub-projects to preserve and increase production of Gachsaran oil fields located in south of Iran Khuzestan and Bushehr provinces as follow:


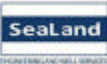

- 1) Revamping of Production and Desalting Units of Bibi Hakimeh 1&2
- 2) Fabrication & Installation a Preheater, Stripping Column and Related Equipment for Nargesi Production Unit

The purposes of first sub-project are equipping and extension of Bibihakime-2 desalting unit to achieve 110,000 SBPD desalted crude oil, and necessary modifications in Bibihakime-2 desalting & production units and Bibihakime-1 production unit so that the new plants will be able to process crude oil with 22% water cut and transfer waste water from Bibihakime-1 production unit to waste water treatment facilities in Bibihakime-1 desalting unit via installation of a none-metal pipe. Therefore, National Iranian South Oil Company (NISOC) has announced this project.

The purpose of second sub-project is crude oil sweetening in Nargesi plant by new design and necessary modifications in existing facilities. National Iranian South Oil Company (NISOC), on behalf of the National Iranian Oil Company (NIOC) is responsible to exploit oil and gas from onshore fields in the south district of Iran. According to management of planning & international affairs of National Iranian Oil Company (NIOC) pronouncement, H<sub>2</sub>S content and RVP specification of exported oil shall be in the specified allowable range; Accordingly, NISOC has decided to fulfil a project, investigating and probing required equipment and operational conditions to meet the desired crude oil specifications of sulphur content and RVP for Nargesi production units.

## 2. SCOPE

This specification defines the minimum technical requirements for the instrument cables of “Revamping of Production and Desalting Units of Bibi Hakimeh 1&2” and “Fabrication & Installation a Preheater, Stripping Column and Related Equipment for Nargesi Production Unit” sub-projects.

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### 3. DEFINITIONS

Within the context of this document, the following definitions are applicable

Owner/Client	: National Iranian south oil company (NISOC)
Title	: Development Plan of 28 Reservoirs/ BIBI HAKIMEH Oilfield (EPC)
Contractor	: Mashin Sazi Arak/ Sealand Engineering and Well Services JV
Consultant	: <u>Tehran Raymand Consulting Engineers</u>
Will:	Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.
May:	Is used where a provision is completely discretionary
Should:	Is used where a provision is advisory only.
Shall:	Is used where a provision is mandatory.

### 4. ENVIRONMENTAL CONDITIONS




#### 4.1. Site Condition

All the environmental data used in this document and is expected to be considered, shall be obtained from “Process Design Basis for Bibi Hakimeh Production Unit No.1\_BH-17-SM-100-PR-DB-0158”, “Process Design Basis for Bibi Hakimeh No.2\_BH-17-SM-100-PR-DB-0564” and “Process Design Basis for Nargesi\_BH-18-SM-100-PR-DB-0002”.

### 5. CONFLICTS AND DEVIATIONS

Any conflicts between this specification and other applicable specifications, engineering standards, industry standards, codes, etc., shall be resolved in writing by the Owner or Owner's Representative.

  
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## 6. REFERENCES

### 6.1. Project Documents

Instrument & Control/Safety System Design Criteria: BH-17-SM-100-IN-DC-0052

Process Design Basis for Bibi Hakimeh Production Unit No.1\_BH-17-SM-100-PR-DB-0158

Process Design Basis for Bibi Hakimeh No.2\_BH-17-SM-100-PR-DB-0564




Process Design Basis for Nargesi\_BH-18-SM-100-PR-DB-0002

### 6.2. References Standards



The Instrument Cables and their accessories (if any) shall be in accordance with the requirements of this specification and the documents referred here in. The Instrument Cables shall be suitable for operation in environmental conditions stated in this specification.

International Electro Technical Commission (IEC)

IEC- 60245	Rubber insulated cables and rated voltage up to and including 450/750 V
IEC-60332	Test on electrical cable under fire condition.
IEC-60227	PVC insulated cables up to and including 450/750 V.
IEC-60228	Conductor of insulated cables
IEC-60811	Common test methods for insulating and sheathing materials of electric cables
IEC-60028	International standard of resistance for copper
IEC-60331	Test for electric cables under fire conditions
IEC-60189-1~7	Low Frequency cables & wires with PVC insulation and PVC sheath
IEC-60304	Standard colour s for insulation for low frequency cables& wires
IEC-61000-4-3	EMI and RFI immunity
IEC-61034	Measurement of smoke density of cables burning under defined conditions

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IEC-60584-3	Thermocouples; part 3: extension and compensating cables; tolerances and identification system
IEC-60754	Test on gases evolved during combustion of electrical cables
IEC-TR61917	Cables, Cable Assemblies and Connectors
IEC-61935	Generic Cabling system Specification for the Testing
IEC-60230	Impulse Tests on Cables and their Accessories
Iranian Petroleum Standard (IPS)	
IPS-M-IN-190	Material and equipment standard for transmission systems
IPS-E-N-190	Engineering standard for transmission systems
IPS-C-N-190	Installation and Construction. Standard. for. Transmission Systems.
IPS-M-EL-271	Material and equipment standard for low voltage cables and wire.
International Standards Organization (ISO)	
ISO-4589	Plastics - Determination of flammability by oxygen index
Instrument Society of America (ISA)	
ISA MC96.1	Temperature measurement thermocouple cables
Underwriters Laboratories Inc	
UL4	Armour ed cable
UL44	Rubber insulated wires and cables
UL719	Non-metallic-sheathed cables
Other Standards	
BS 50288	Multi-element metallic cables used in analogue and digital communication and control
BS 6360	Specification for conductors in insulated cables and cords
BS 6746	Specification for PVC insulation and sheath of electric cables

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BS 10257 Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunication cables. Land cables

ICEA/NEMA S-19-81 Standard for rubber insulated wire & cable for the transmission and distribution of electric energy

In addition to above mentioned standards the following references shall be followed:




- NIOC Equipment Standards & Code (ESC)
- NIOC Standard Construction Specification (SCS)
- NIOC Engineering Practice Manual (EPM)

## 7. BASIC PRINCIPLES





### 7.1. Acronyms and Abbreviation

The following abbreviations are commonly used in this document:

AI	Analog Input
AO	Analog Output
ANSI	American National Standard institute
API	American Petroleum institute
ASTM	American Society for Testing and Material
ATEX	Atmosphere Explosible
AWG	American Wire Gauge
BMS	Burner Management System
BS	British Standards
CENELEC	European Committee for Electrical Standardization
CPU	Central processing Units
CCR	Central Control Room
dBA	Decibel Absolute
DC	Direct Current

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DCS	Distribute Control System
DI	Digital Input
DO	Digital Output
DPDT	Double Pole Double Throw
EEX	Europe Explosion Proof
EMC	Electromagnetic compatibility
EMI	Electromagnetic Interference
ESD	Emergency Shut Down
EWS	Engineering Work Station
FAT	Factory Acceptance Test
FGS	Fire and Gas System
F.S.	Full Scale
HMI	Human Machine Interface
I&C	Instrumentation and Control
IEC	International Electrotechnical Commission
I/O	Input/output
IP	Ingress Protection
IPC	Industrial Personal Computer
IPS	Iranian Petroleum Standard
I.S.	Intrinsically Safe
ISA	International Society of Automation
ISO	International Standard Organization
JB	Junction Box
MCC	Motor Control Center
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NACE	National Association of Corrosion Engineering
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association




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NPT	National Pipe Thread
OWS	Operator Work Station
OD	Outside Diameter
LED	Light Emitting Diode
P&ID	Piping and Instrumentation Drawing
PCS	Process Control System
PLC	Programming Logic Controller
RFI	Radio Frequency Interference
RTD	Resistance Temperature Detector
SI	System International of Units
SPDT	Single Pole Double Throw
UCP	Unit Control Panel
UPS	Uninterruptible Power Supply
UV	Ultra Violet

## 7.2. Units of Measurement

Generally, International System of units (SI) shall be used. All dimensions and ratings shall be metric. Except for the temperature, which shall be in degrees Celsius instead of Kelvin, and for pipes and fittings threads, which shall be in inches of NPT.

Variable	Units
Temperature	Celsius degree (°C)
Pressure Relative	Psig or Barg
Pressure Absolute	PsiA or barA
Level	m or mm, % of range
Flow	Liquid kg/h or m <sup>3</sup> /h Gas or vapor m <sup>3</sup> /h or Sm <sup>3</sup> /h(l) or kg/h Air or nitrogen m <sup>3</sup> /h or Sm <sup>3</sup> /h(l) or kg/h
Analysers	pH, molar%, ppm % LEL
Density Liquid Gas	Kg/m <sup>3</sup> kg/m <sup>3</sup> .Or.kg/Sm <sup>3</sup> (l)

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## 8. TECHNICAL REQUIREMENTS FOR INSTRUMENTS CABLES

Cable for external installation shall be armour ed.

Flame retardant cables according to IEC 60332.3 shall be used for instrument cables as a minimum requirement.

All FGS and ESD system Cables shall be fire resistance according to IEC 60331.

Cables for Intrinsic safety (IS) signals shall be with the following Characteristics:

Mutual capacitance between cores and any core and screen 0.13  $\mu$ F/Km (Maximum)

Inductance/Resistance ratio 30  $\mu$ H/Ohm (Maximum)

In addition to colour coding the cores of each pair shall be identified by Numbers starting according to IPS-M-IN-190.

All cables shall be suitable for carrying signals up to 330/500 Volts DC or AC.

Thermocouple compensating, cable shall be (type K) chromal-alumal colour coded in accordance with B.S.1843.

The EMF of thermocouple compensating cable shall conform to the relevant British Standard.

Material of the cables shall be according to standard IPS-M-IN-190 (Material standard for transmission system) and IPS-E-IN-190(Engineering standard for Transmission system).

Conductor sizing

Cross section of stranded copper conductors shall be in accordance with IEC, BS, IPS-E-IN-190 recommendations and as minimum shall be:

Multi-pair/Triple for analogue/digital instrument/Thermocouple & Control cables: 1mm<sup>2</sup>




Single-pair/Triple for analogue/digital instrument/cables, single-pair and Intercom system cables: 1.5 mm<sup>2</sup>

Two core cables for Digital signals (24 VDC Voltage level): 1.5 mm<sup>2</sup>

Multi core cable for Digital signals (24 VDC Voltage level): 1 mm<sup>2</sup>

Two core SV cable for Command to Solenoid valve: 2.5 mm<sup>2</sup>




Multi core SV cable for Command to Solenoid valve: 2.5 mm<sup>2</sup>

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## 9. INSTRUMENT SIGNAL CATEGORY

### 9.1. Single Pair / Triple Instrument Cable (Type I)

Conductor	1.5mm <sup>2</sup> nominal stranded plain tinned annealed copper conductors (in accordance with BS-6360 and BS-50288) twisted pair or triad. This size may be changed according to need.
Primary insulation	At least. 0.5mm nominal thickness PVC (PVC type shall be in accordance with BS-50288 and BS-6746 or IPS-M-IN-190).
Colour code	Single-pair black and white, triad black, white and red.
Lay of twist	Maximum 50mm
Triple/pair shield	Each pair/triple shall have a laminated screening tape applied with the metallic side down, in electrical contact with one or more tinned annealed copper wires (drain wire) of a total cross section of not less than 0.5mm <sup>2</sup> . The minimum overlap shall be 25%. The laminated tape shall be aluminium bonded to polyester having a minimum thickness of aluminium of 0.008mm and a minimum thickness of polyester of 0.01mm. Over the screening tape, either two laps of 0.05mm thick polyester tape shall be applied with a minimum overlap of 25%, or one tape with a minimum overlap of 50% shall be applied.
Cable armour	An extruded bedding of PVC shall be applied over the pair/triple shield (for type of PVC and dimensions refer to BS-6746 and BS-50288). A single layer of galvanized steel wire armour shall be Applied over the PVC (The galvanized steel armour shall comply with BS-10257, for armour thickness refer to BS-50288 or IPS-M-IN-190).

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Cable jacket

At least. 0.8mm nominal thickness PVC (PVC type shall be in accordance with BS-50288 and BS-6746 or IPS-M-IN-190, its thickness shall be in accordance with BS-50288 or IPS-M-IN-190) and also should be flame retardant in accordance with IEC 60331.

Jacket Colour Code

Black

## 9.2. Multi Pair / Triple Instrument Cable (Type II)

Conductor

1 mm<sup>2</sup> nominal stranded plain tinned annealed copper conductors (in accordance with IPS-M-IN-190) twisted pair or triad. This size may be changed according to need.

Primary insulation

At least. 0.5mm nominal thickness PVC (PVC type shall be in accordance with BS-50288 and BS-6746 or IPS-M-IN-190).

Insulation colour code

Pair black and white. (Triple: black, white and red.)

Lay of twist

Maximum 50mm

Triple/pair shield



Each pair/triad shall have a laminated screening tape applied with the metallic side down, in electrical contact with one or more tinned annealed copper wires (drain wire) of a total cross section of not less than 0.5mm<sup>2</sup>. The minimum overlap shall be 25%. The laminated tape shall be aluminium bonded to polyester having a minimum thickness of aluminium of 0.008mm and a minimum thickness of polyester of 0.01mm. Over the screening tape, either two laps of 0.05mm thick polyester tape shall be applied with a minimum overlap of 25%, or one tape with a minimum overlap of 50% shall be applied.

Group identification

By a numbered polyester film which shall also serve as part of the screen insulation.

Communication wire

0.5mm<sup>2</sup> nominal, stranded annealed copper, 0.5mm PVC insulation, colour: orange.

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**Binder** A non-hygroscopic tape of minimum thickness 0.023mm shall be applied with an overlap of 50% or two non-hygroscopic tapes each of minimum thickness 0.023mm shall be applied each with a minimum overlap of 25%.

**Cable shield** Laminated screening tape shall be applied with a minimum overlap of 25% and with the metallic side down in contact with a drain wire of a total cross section of not less than 0.5mm<sup>2</sup> run longitudinally over a non-hygroscopic binder tape.

**Cable armour** An extruded bedding of PVC shall be applied over the cable shield (for type of PVC and dimensions refer to BS-6746 and BS-50288). A single layer of galvanized steel wire armour shall be Applied over the PVC (The galvanized steel armour shall comply with BS-10257, for armour thickness refer to BS-50288 or IPS-M-IN-190).

**Overall cable jacket** At least. 0.8mm nominal thickness PVC (PVC type shall be in accordance with BS-50288 and BS-6746 or IPS-M-IN-190, its thickness shall be in accordance with BS-50288 or IPS-M-IN-190) and also should be flame retardant in accordance with IEC 60331.




### 9.3. Twisted Two Cores Cable with Ground Core (Type III)

**Conductor** 1.5mm<sup>2</sup> or 2.5mm<sup>2</sup> nominal stranded plain tinned annealed copper conductors (in accordance with BS-6360 and BS-50288). This size may be changed according to need.

**Primary insulation** At least. 0.5mm nominal thickness PVC (PVC type shall be in accordance with BS-50288 and BS-6746 or IPS-M-IN-190).

**Colour code** One core black, one core white, and ground core: green/yellow.

**Cable armour** An extruded bedding of PVC shall be applied over the cores (for type of PVC and dimensions refer to BS-6746 and BS-50288 single layer of galvanized steel wire armour shall be Applied c

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the PVC (The galvanized steel armour shall comply with BS-10257, for armour thickness refer to BS-50288 or IPS-M-IN-190).

**Cable jacket** At least. 0.8mm nominal thickness PVC (PVC type shall be in accordance with BS-50288 and BS-6746 or IPS-M-IN-190, its thickness shall be in accordance with BS-50288 or IPS-M-IN-190) and also should be flame retardant in accordance with IEC 60331.

**Jacket colour code** Black

#### 9.4. Twisted Multi Core Cable (Type IV)

**Conductor** 1mm<sup>2</sup> or 1.5 mm<sup>2</sup> nominal stranded plain tinned annealed copper conductors (in accordance with BS-6360 and BS-50288). This size may be changed according to need.




**Primary insulation** At least. 0.5mm nominal thickness PVC (PVC type shall be in accordance with BS-50288 and BS-6746 or IPS-M-IN-190).

**Insulation colour code** One core black, one core white, and ground core: green/yellow.

**Communication wire** 0.5mm<sup>2</sup> nominal, stranded annealed copper, 0.5mm PVC insulation, colour: orange.

**Cable armour** An extruded bedding of PVC shall be applied over the cores (for type of PVC and dimensions refer to BS-6746 and BS-50288). A single layer of galvanized steel wire armour shall be Applied over the PVC (The galvanized steel armour shall comply with BS-10257, for armour thickness refer to BS-50288 or IPS-M-IN-190).

**Overall cable jacket** At least 0.8mm nominal thickness PVC (PVC type shall be in accordance with BS-50288 and BS-6746 or IPS-M-IN-190). Thickness shall be in accordance with BS-50288 or IPS-M

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IN-190) and also should be flame retardant in accordance with IEC 60331.

#### 9.5. Fire and Gas Detection and ESD system Cables

All FGS and ESD Cables shall be fire resistance according to IEC 60331. The general requirements of cables are same as requirements as stated in section 6.1 to 6.4. The insulation of fire resistance cables shall be silicon type or XLPE with mica tapes. Also, the bedding and outer sheath shall be LSZH according to BS-50288.

The cable jacket colour shall be RED for non-intrinsically safe and blue with red strip for intrinsically safe.

#### 9.6. Underground Cables

Generally, Lead-sheathed cables are used in heavy-duty, anti-chemical cables. Lead, a metal possessing good anti-chemical characteristics, protects cable insulation completely from water and damaging substances.

Lead sheathing shall be specified for underground cables when considerable soil contamination by liquids aggressive to the cable insulation is anticipated. Lead sheath shall be applied over PVC bedding before the PVC bedding of armour.

Lead Sheaths have the inherent capacity for substantial electrical conductivity under short circuit conditions without requiring a separate ground.




Note: The lead sheath is not resistant to mechanical shocks.

#### 9.7. Thermocouple, I&C Cables, Single pair

Core:

- The conductor of the thermocouple extension cables consists of stranded extension material in compliance with applicable standards whichever applicable.
- "K" Type: Cable temperature range: - 25 °C up to + 200 °C
  - Positive: Nickel - Chromium
  - Negative: Nickel - Aluminium
- "T" Type: Cable temperature range: - 25 °C up to + 100 °


  
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- Positive: Copper - Copper

- Negative: Copper – Nickel

- Conductor Size: 1.5 mm<sup>2</sup> nominal solid type JX (iron/constantan) and /or type KX (chromel/alumel) alloy wire matched and calibrated per ISA MC 96.1, latest edition for Thermocouple Extension Wire (IPS-M-IN-190 article 5.2.5.1).
- Insulation: Polyethylene, wall thickness = 0.5 mm (min. average)
- Identification: The colour coding for thermocouple extension cables shall be the same as thermocouple standard.




Cable:

- Pair Shield (Screen): 2-layer polyester tape to be 0.023 mm thick over the pair with 100% coverage by a tape shield of 0.012 mm aluminium with 0.012 mm mylar polyester tape, helically applied over the twisted pair with the aluminium on the inside in continuous contact with a bare minimum 0.5 mm<sup>2</sup>, 7 - strands tinned copper drain wire, one layer of polyester tape 0.023 mm thick, shall be applied over the aluminium mylar tape shield. All tapes minimum overlap of 25%. (As per IPS-M-IN-190 sec.5.2.4)
- Inner sheath: Material: Polyvinyl chloride (PVC compound 90 °C) in compliance with IEC-60 502
- Colour: I.S. systems; Blue; N.I.S. systems; Acc.to relevant Thermocouple's Standard.
- Armour: Galvanized round steel wire in compliance with IEC-60 502.
- Outer sheath:
- Material: Polyvinyl chloride (PVC compound 90 °C) in compliance with IEC-60 502.
- Filler: Flame retardant Polypropylene (if necessary)
- Cables with lead sheath shall be used in cases that specified by IPS-M-IN-190.

#### 9.8. Thermocouple, I&C Cables, Multi Pair

Core:




- The conductors of the thermocouple extension / compensation cables consist of stranded extension / compensation material in compliance with ANSI MC 96.1.
- "K" Type: Cable temperature range: 0 °C up to + 1100 °C

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- Positive: Nickel - Chromium (Chromel)
- Negative: Nickel - Aluminium (Alumel)
- "T" Type: Cable temperature range: - 185 °C up to + 300 °C
  - Positive: Copper - Copper
  - Negative: Copper - Nickel (Constantan)
- "E" Type: Temperature range: 0°C up to +800°C
  - Positive: Nickel - Chromium
  - Negative: Copper - Nickel
- Conductor Size: AWG 18=1.0mm<sup>2</sup>
- Insulation: Polyethylene, wall thickness = 0.4 mm (min. average)
- Identification: The colour coding for thermocouple extension cables shall be the same as thermocouple standard.

#### Cable:

- Pair Shield (Screen): 2-layer polyester tape to be 0.023 mm thick over the pair with 100% coverage by a tape shield of 0.012 mm aluminium with 0.012 mm mylar polyester tape, helically applied over the twisted pair with the aluminium on the inside in continuous contact with a bare minimum 0.5 mm<sup>2</sup>, 7 - strands tinned copper drain wire, one layer of polyester tape 0.023 mm thick, shall be applied over the aluminium mylar tape shield. All tapes minimum overlap of 25%. (As per IPS-M-IN-190 sec.5.2.4)
- Overall screen: One layer of polyester tape to be 0.023 mm thick over the pair with 100% coverage by a tape shield of 0.012 mm aluminium with 0.050 mm mylar polyester tape, helically applied over all pairs with the aluminium on the inside in continuous contact with a bare minimum 0.5 mm<sup>2</sup>, 7 – strands tinned copper drain wire, one layer of polyester tape 0.20 mm thick, shall be applied over the aluminium mylar tape shield. All tapes minimum overlap of 25%.
- Inner sheath: Material: Polyvinyl chloride (PVC compound 90 °C) in compliance with IEC-60502
- Colour: I.S. systems; Blue, N.I.S. systems; Acc. to relevant Thermocouple's Standard
- Armour: Galvanized round steel wire in compliance with IEC-60502.

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- Outer sheath: Material: Polyvinyl chloride (PVC compound 90 °C) in compliance with IEC-60502
- Cables with lead sheath shall be used in cases that specified by IPS-M-IN-190.

## 10. SUPPLY

Cables shall be supplied in lengths as stated in requisition on drums of adequate strength for shipping purpose.

Drums to be identified prominently on both sides with drum numbers as detailed on requisition. One side of cable must come out of drum to identify the cable type.

## 11. INSPECTION AND TESTING

The work shall be inspected in accordance with an approved procedure and quality plan. This shall include but not be limited to routine, sample and random tests, and critical inspection points.

All cable types shall be subjected to type tests in accordance with the relevant IEC and/or BS standards.

All cables shall be subjected to routine tests by VENDOR before shipment in accordance with the relevant standard.

Routine tests shall be carried out on all cables produced and be in accordance with standards and norms. These tests shall be included:




- Continuity test, conductors, shields and armour,
- Dielectric test,
- Conductor and insulation resistance test,

Sample test shall be in accordance with standard and must be tested by:

- Visual and dimensions inspection
- Flame retardant test IEC 60332
- Fire resistant test IEC 60331

  
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The following values are typical for 28-volt barriers, but may only be used in preliminary work, or as in foregoing paragraph.

NEC 70 ARTICLE 500 GROUP	REPRESENTIVE	Max. PERMISSIBLE CABLE CAPACITANCE MICROFARADS	Max. PERMISSIBLE CABLE INDUCTANCE MILLIHENRIES	Max. PERMISSIBLE L/R RATIO OF CABLE
D	PROPANE	5.0	3.1	1000
C	ETHYLENE	1.9	1.2	380
B	HYDROGEN	0.4	0.25	80

According to the existing cables in the market and different vendors, for I&C cables L/R (ratio), will be for the following:

If conductor size  $\leq 1(0.5, 0.75, 1)$ , L/R ratio will be 25.

If conductor size equal 1.5, L/R ratio will be 40.

### 11.5. End Sealing

After testing, the ends of the cable shall be sealed by an approved method to prevent the ingress of moisture. Supplier shall state proposed method in his quotation.

### 11.6. Drum Lengths




Cable drum length shall have a positive tolerance only. Purchaser reserves the right to reject drums with a negative tolerance.

## 12. MARKING

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

- National standard and reference number
- Manufacturer
- Year of manufacture
- Rated voltage
- Number of pairs/conductors
- Size of conductor

  
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- Cable type

- Quality of overheat

This information shall be repeated every 300 mm along the cable entire sheath. The length of cable shall be marked on the outer sheath with 1000 mm intervals.

The marking colour shall be chosen to contrast with the sheath colour, marking shall be painted in permanent ink.

Cable drum shall be marked by weatherproof stencilling at least once on each flange to display the following terminal data as a minimum:

- Manufacturer's name and year of manufacturing
- Voltage grade
- Number of pairs and core size
- Cable type by abbreviation letter
- Length of cable on the drum (in meters)
- Drum weight (in kilogram)
- Directional arrow for movement of drum
- Purchase order item number
- Purchaser full name/client
- Drum number

Cable shall be delivered, if not otherwise specified, in maximum manufacturing drum/lengths.




All drum lengths shall be continuous.

### 13. DOCUMENTATION

Vendor shall provide the following technical data as a minimum:

- Maximum DC resistance of conductor in 40°C in OHM/Km
- Inductance between conductors with screen grounded in mH/Km
- Capacitance between conductors with screen grounded in F/Km
- Cable overall dimensions, above and under armour in mm

  
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- Weight in Kg/Km
- Minimum bending radius
- Production quality plan
- Description of manufacturer workshop tests for each type of cable

All documents shall be provided in English.

#### 14. SHIPPING

The shipping shall be done as per packing & shipping standard (IPS-G-GN-210).

Cables shall have both ends effectively sealed using a heat shrink type shroud.

Exposed cable ends on the drums shall be protected by suitable metal plates permanently fixed over the cable ends.

The reels shall be lagged or covered with suitable material to provide physical protection during transit and ordinary storage and handling operations.

Cable shall be supplied in continuous lengths.

Vendor shall submit with his quotation, his standard "Packaging" of reels.



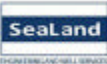

Vendor shall provide plates or inscription showing the following information which:

- Shall be secured on each drum
- Purchase order number, supplement and item number,
- Construction type and voltage grade,
- Number of conductors and conductor size,
- Cable length on drum.

#### 15. EXCEPTION AND DEVIATIONS

Vendor shall make his offer in detail, with respect to every item of the client's specifications.

The vendor may offer alternative designs based on experience and manufacturing and operation of similar instrument cables. In such case the vendor shall clearly identify in his proposal any deviation or exception to this specification and other referenced specifications. Failure to do

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will imply that the offered instrument cables are in complete conformance with the specified requirements.

  
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