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NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY
NATIONAL IRANIAN OIL ENGINEERING
& CONSTRUCTION COMPANY

NIOEC SP

NIOEC SPECIFICATION
FOR

INSTRUMENTATION CONTROL CABLES, CABLE TRAYS, CONDUITS, JUNCTION BOXES AND CABLE GLANDS

SECOND EDITION

DECEMBER 2009

THIS SPECIFICATION IS THE PROPERTY OF NATIONAL IRANIAN OIL ENGINEERING & CONSTRUCTION COMPANY. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED TO THE OWNER. NEITHER WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF THE NATIONAL IRANIAN OIL ENGINEERING & CONSTRUCTION COMPANY.

IN THE NAME OF GOD**FOREWORD**

By their very nature, technical Specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such Specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international Standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant Specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the ongoing projects.

In response to the initiative of the Design and Engineering Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design and Engineering Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and complied.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design and Engineering Director of NIOEC for evaluation and approval.

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NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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1. SCOPE

This specification defines NIOEC's minimum requirements for instrumentation wires and cables, the related cable trays and conduits, junction boxes and cable glands.

Deviations from this specification will only be permitted on obtaining written approval from NIOEC.

Resolution on cases not explicitly stipulated in this Specification, or on cases where conflicts may arise among the requirements of the referenced IPS and the international standards, shall be made through written consent and approval of NIOEC.

2. REFERENCES

The following standards, codes, and specifications, to the extent specified hereinafter, shall constitute a part of this NIOEC Specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the Vendor/Contractor.

ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)

ANSI/NEMA WC 70	"Power Cables Rated 2000 Volts or Less for the
ICEA S-95-658	distribution of Electrical Energy"

API (AMERICAN PETROLEUM INSTITUTE)

API-RP-552	"Transmission System"
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BSI (BRITISH STANDARDS INSTITUTION)

BS EN 50288-7	"Multi-Element Metallic Cables used Analogue and Digital Communication and Control: Part 7: Sectional specification for instrumentation and control cables"
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IEC (INTERNATIONAL ELECTRO-TECHNICAL COMMISSION)

IEC 60079	"Electrical Apparatus for Explosive Gas Atmospheres"
IEC 60331	"Test for Electric Cables under Fire Conditions"
IEC 60332	"Test on Electric and Optical fiber cables under Fire Conditions"
IEC 60502	"Power cables with Extruded Insulation and Their Accessories for Rated Voltages from 1 KV (Um=1.2 KV) up to 3 KV (Um=3.6 KV)"
IEC 60529	"Classification of Degrees of Protection Provided By Enclosures"
IEC 60584-3	"Thermocouples, Part-3 Extension and Compensation Cables, Tolerance and Identification System"
IEC 60751	"Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors"
IEC 61158-2	"Industrial Communication Networks – Fieldbus Specifications– Part 2: Physical Layer Specification and Service Definition"

IPS (IRANIAN PETROLEUM STANDARD)

IPS-C-IN-190	"Installation and Construction Standard for Transmission systems"
IPS-E-IN-190	"Engineering Standard for Transmission systems"
IPS-M-IN-190	"Material and Equipment Standard for Transmission systems"

ISA (The Instrumentation, Systems and Automation Society)

ISA MC 96.1	"Temperature Measurement Thermocouples"
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NIOEC-SIP (NIOEC SHOP INSPECTION PROCEDURE)

NIOEC-SIP-70-01	"Shop Inspection Procedure for Instruments"
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NIOEC-SP (NIOEC SPECIFICATIONS)

NIOEC-SP-00-10	"Specification for Units"
NIOEC-SP-80-02	"Specification for Painting"

3. UNITS

International System of Units (SI) shall be used in accordance with NIOEC-SP-00-10, unless otherwise specified.

4. DEFINITIONS

Throughout this specification, the following definitions shall apply:

4.1. Standard application is defined as follows:

- Solenoid valves
- Discrete signals

4.2. Critical application is defined as follows:

- Thermocouple signal
- Resistance bulb signal
- Pulse signal
- 4 to 20 mA DC signal
- Digital communication based on HART protocol or field bus

5. ENVIRONMENTAL PROTECTION

5.1. Temperature range shall be based on the project site ambient conditions.

5.2. Cable outer sheath material has generally been specified as PVC type in this document. However alternative materials shall be selected if PVC cannot provide adequate resistance to the chemicals.

- 5.3. Insulation and jackets shall be made of high quality materials and have excellent resistance to chemicals, oils, heat and aging.
- 5.4. Field Cables on cable trays shall be flame retardant to IEC 60332 and the outer jacket resistant to UV exposure. Cables used for Safe guarding Systems, such as ESD, shall be fire resistant according to IEC 60331.
- 5.5. At the time of plant commissioning, approximately 20% of the signal lines in the installed multicore cables shall still be available as spares for modifications, unless otherwise specified.

6. CABLES DESIGN AND SPECIFICATIONS

6.1. Instrumentation Signal Cables

Cable type designation, type II to type VI, is in accordance with API-RP-552.

Suffix **A** will designate “Armored” type, and suffix **M** will indicate overall “Moisture” barrier for direct burial applications.

6.1.1. Cable Type II –Single Twisted Pair Instrument Cable for Standard Application

A. APPLICATIONS

To be used only in Conduits outdoor, Or without conduit indoor.

B. CONSTRUCTION

Conductor	2/c 1.5 mm ² nominal stranded annealed copper conductors twisted pair
Primary Insulation	1-0.5 mm nominal thickness, 105°C PVC. 2- One layer of polyester tape 0.023 mm thick helically applied over the twisted pair
Pair Colour Code	Black and white
Lay of Twist	50 mm
Pair Jacket	1.15 mm nominal 80°C PVC
Jacket Colour Code	Light blue for intrinsically safe Black for Non-IS and/or Digital

6.1.2. Cable Type III – Single Twisted Pair or Triad Instrument Cable for Critical Application**A. APPLICATIONS**

Outdoor Usage: Only in Conduits
Indoor Usage: With or without Conduits

B. CONSTRUCTION

Conductor	1.5 mm ² nominal stranded annealed copper conductors twisted pair or triad
Primary Insulation	0.5 mm nominal thickness, 105°C PVC
Colour Code	Single twisted pair - black and white, triad-black, white and red
Lay of Twist	50 mm
Shield	1- One layer of polyester tape of 0.023 mm thick over the cores 2- 100% coverage by a tape shield of 0.012 mm aluminium laminated with 0.012 mm Mylar polyester tape, helically applied over the polyester tape with the aluminium on the inside in continuous contact with a bare minimum 0.75 mm² 7-strand tinned copper drain wire. 3- 100% coverage of 1 layer of polyester tape 0.023 mm thick shall be applied over the Aluminium Mylar tape shield.
Pair Jacket	1.15 mm nominal 80°C PVC
Jacket Colour Code	Light blue for intrinsically safe

6.1.3. Cable Type II A- Single Twisted Pair Instrument Cable with Armour for Standard Application

A. APPLICATIONS

To be used in Proper vertical cable trays, or to be used in trenches where no hydrocarbons/chemicals threat is probable.

B. CONSTRUCTION

Conductor	2/c 1.5 mm ² nominal stranded annealed copper conductors twisted pair						
Primary Insulation	1-0.5 mm nominal thickness, 105°C PVC. 2- One layer of polyester tape 0.023 mm thick helically applied over the twisted pair						
Lay of Twist	50 mm						
Colour Code	Black and white						
Pair Jacket	1.15 mm nominal 80°C PVC						
Cable Armour	Cable armour shall be single galvanized steel wire having 90% nominal coverage. (Round type, diameter of cable armour wire based on IEC 60502)						
Overall Cable Jacket (minimum thickness)	80°C PVC, thickness as listed below: <table> <tr> <th><u>Diameter-Cable Core</u> (under the jacket)</th><th><u>Jacket Thickness</u></th></tr> <tr> <td>6.38 to 10.80 mm</td><td>1.143 mm</td></tr> <tr> <td>10.81 to 17.78 mm</td><td>1.524 mm</td></tr> </table>	<u>Diameter-Cable Core</u> (under the jacket)	<u>Jacket Thickness</u>	6.38 to 10.80 mm	1.143 mm	10.81 to 17.78 mm	1.524 mm
<u>Diameter-Cable Core</u> (under the jacket)	<u>Jacket Thickness</u>						
6.38 to 10.80 mm	1.143 mm						
10.81 to 17.78 mm	1.524 mm						
Pair jacket	Black						
Overall Jacket Colour Code	Light blue for intrinsically safe Black for Non-IS and/or Digital						

6.1.4. Cable Type II AM- Single Twisted Pair Instrument Cable with Armour and Overall Moisture Barrier for Standard Application

A. APPLICATIONS

To be used in direct burial trenches

B. CONSTRUCTION

Conductor	2/c 1.5 mm ² nominal stranded annealed copper conductors twisted pair						
Primary Insulation	1-0.5 mm nominal thickness, 105°C PVC. 2- One layer of polyester tape 0.023 mm thick helically applied over the twisted pair						
Lay of Twist	50 mm						
Colour Code	Black and white						
Pair Jacket	1.15 mm nominal 80°C PVC						
Moisture barrier	Aluminium copolymer bonded to the outer sheath to render moisture barrier thickness						
Cable Armour	Cable armour shall be single galvanized steel wire having 90% nominal coverage. (Round type, diameter of cable armour wire based on IEC 60502)						
Overall Cable Jacket (minimum thickness)	80°C PVC, thickness as listed below: <table border="1"> <thead> <tr> <th><u>Diameter-Cable Core</u> (under the jacket)</th><th><u>Jacket Thickness</u></th></tr> </thead> <tbody> <tr> <td>6.38 to 10.80 mm</td><td>1.143 mm</td></tr> <tr> <td>10.81 to 17.78 mm</td><td>1.524 mm</td></tr> </tbody> </table>	<u>Diameter-Cable Core</u> (under the jacket)	<u>Jacket Thickness</u>	6.38 to 10.80 mm	1.143 mm	10.81 to 17.78 mm	1.524 mm
<u>Diameter-Cable Core</u> (under the jacket)	<u>Jacket Thickness</u>						
6.38 to 10.80 mm	1.143 mm						
10.81 to 17.78 mm	1.524 mm						
Pair jacket	Black						
Overall Jacket Colour Code	Light blue for intrinsically safe Black for Non-IS and/or Digital						

6.1.5. Cable Type III A – Single Twisted Pair or Triad Instrument Cable with Armour for Critical Application

A. APPLICATIONS

To be used in cable trays

B. CONSTRUCTION

Conductor	1.5 mm ² nominal stranded annealed copper conductors twisted pair or triad						
Primary Insulation	0.5 mm nominal thickness, 105°C PVC						
Colour Code	Single twisted pair - black and white, triad-black, white and red						
Lay of Twist	50 mm						
Shield	1- One layer of polyester tape of 0.023 mm thick over the cores 2- 100% coverage by a tape shield of 0.012 mm aluminium laminated with 0.012 mm Mylar polyester tape, helically applied over the polyester tape with the aluminium on the inside in continuous contact with a bare minimum 0.75 mm² 7-strand tinned copper drain wire. 3- 100% coverage of 1 layer of polyester tape 0.023 mm thick shall be applied over the Aluminium Mylar tape shield. There shall be complete isolation between drain wire and cable armour.						
Pair Jacket	1.15 mm nominal 80°C PVC						
Cable Armour	Cable armour shall be single galvanized steel wire having 90% nominal coverage. (Round type, diameter of cable armour wire based on IEC 60502)						
Overall Cable Jacket (minimum thickness)	80°C PVC, thickness as listed below: <table> <tr> <th><u>Diameter-Cable Core</u> (under the jacket)</th><th><u>Jacket Thickness</u></th></tr> <tr> <td>6.38 to 10.80 mm</td><td>1.143 mm</td></tr> <tr> <td>10.81 to 17.78 mm</td><td>1.524 mm</td></tr> </table>	<u>Diameter-Cable Core</u> (under the jacket)	<u>Jacket Thickness</u>	6.38 to 10.80 mm	1.143 mm	10.81 to 17.78 mm	1.524 mm
<u>Diameter-Cable Core</u> (under the jacket)	<u>Jacket Thickness</u>						
6.38 to 10.80 mm	1.143 mm						
10.81 to 17.78 mm	1.524 mm						
Jacket Colour Code	Light blue for intrinsically safe Black for Non-IS and/or Digital						