MATERIAL AND EQUIPMENT STANDARD

FOR

TRANSMISSION SYSTEMS

CONTENTS :

PAGE No.

1. SCOPE

This Standard discusses the general specifications for the materials, used for transmission systems. The following subjects are covered:

1) Instruments air signal lines (tubes).
2) Instruments and thermocouples extension wires and cables.
3) Junction boxes, terminals, conduits and trays.

It is intended to be used in oil, gas, and petrochemical industries.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Contractor.

ANSI (AMERICAN NATIONAL STANDARD INSTITUTE)

ANSI/B 31.3 "Petroleum Refinery Piping"
ANSI/B 2.1 "Pipe Threads"

API (AMERICAN PETROLEUM INSTITUTE)

RP-550 "Installation of Refinery Instruments and Control Systems Part-I, Process Instrumentation and Control, Sections 3&7"

ISA (INSTRUMENTATION SOCIETY OF AMERICA)

RP 12.6 "Installation of Intrinsically Safe Instrumentation Systems in Class I Hazardous Locations"

MC 96.1 "Temperature Measurement Thermocouples"

ANSI/NFPA (AMERICAN NATIONAL STANDARD INSTITUTE / NATIONAL FIRE PROTECTION ASSOCIATION)

70 "National Electric Code" (NEC)

ANSI/UL (AMERICAN NATIONAL STANDARD INSTITUTE/UNDERWRITER LABORATORIES)

UL 4 "Armoured Cable"
UL 44 "Rubber Insulated Wires and Cables"
UL 83 "Thermoplastic Insulated Wires"
UL 719 "Non Metallic-Sheathed Cables"

ICEA/NEMA (INSULATED CABLE ENGINEERS ASSOCIATION / NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION)

S-19-81 "Standard for Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy" (NEMA WC 3)

S-61-402 "Standard for Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy" (NEMA WC 5)

IPS (IRANIAN PETROLEUM STANDARDS)

M-IN-100, Part 2 "General-Factory Inspection and Testing of Instruments and Instrument Systems"

M-IN-100, Part 1 "General-Packaging, Marking, Shipping and Guarantee"

E-GN-100 "Units"

C-IN-200 "Installation Standard for Instruments Air System"

3. UNITS

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

4. INSTRUMENTS AIR SIGNAL LINES (TUBES)

4.1 General

Pneumatic signal lines to the instrument and/or final control element shall be made up from tubing and compression fittings as described later. The user shall be consulted for special applications such as fire safe design requirements.

4.2 General Specifications for Air Signal Lines

Pneumatic signal lines shall consist of ¼ in. OD PVC covered copper tubing and brass compression fittings. All components, the tubing and compression fittings, shall be suitable for use at 10 barg at 50°C.

Notes:

The application of tubing and compression fittings shall comply with the followings:

- The compression fittings shall be of the make, type and composition as specified for the project by the user and of which all parts of the fitting are made by one manufacturer.

- The tubing shall be in accordance with the specification supplied by the user.

- The fittings and tubing shall be installed by skilled personnel, strictly in accordance with the manufacturer's instructions.

- The instrument air lines shall be pressure tested after installation, refer to installation standard for instruments air system (C-IN-200).

4.2.1 All threaded tube connections shall be tapered.

4.2.2 Connections for, pneumatic transmission, and control signals shall normally be internally threaded ¼ inch NPT.

4.2.3 Plastic tubing may only be applied in control room and basement.

4.2.4 Plastic multicore tubing for under ground use shall only be considered when there is absolutely no possibility of deterioration of cables due to solvents, acids or other aggressive media being present in the soil.

4.2.5 Main tubing runs from junction boxes to the control room shall be made with polyethylene multi-tube bundles sheathed in PVC. A maximum of 19 tubes per bundle shall be used. Approximately 15% spare tubing shall be provided.

4.2.6 In the control room and the basement, individual plastic tubing shall be color-coded as follows:

Red	- air supply	
Orange	- transmitted measurement to receiving element	
Yellow	- controller output to valve (or slave controller)	
Purple	- seal	
Black	- set	
Natural (uncolored)	- all others	to field-mounted controllers

4.3 Special Applications

4.3.1 General

To ensure efficient operation of the instrument air lines under all operational and climatic conditions, certain applications require provisions in addition to or in deviation from those given in previous para. for example the use of special material.

4.3.2 Corrosive atmospheres

For corrosive atmospheres, where PVC covered copper tubing may not be suitable, other materials such as AISI 316 stainless steel or aluminum bronze, etc., shall be used for all components.

However application of these alternative materials requires the written approval of the user.

Note:

The material of construction of compression fittings shall be compatible with the material of the tubing.

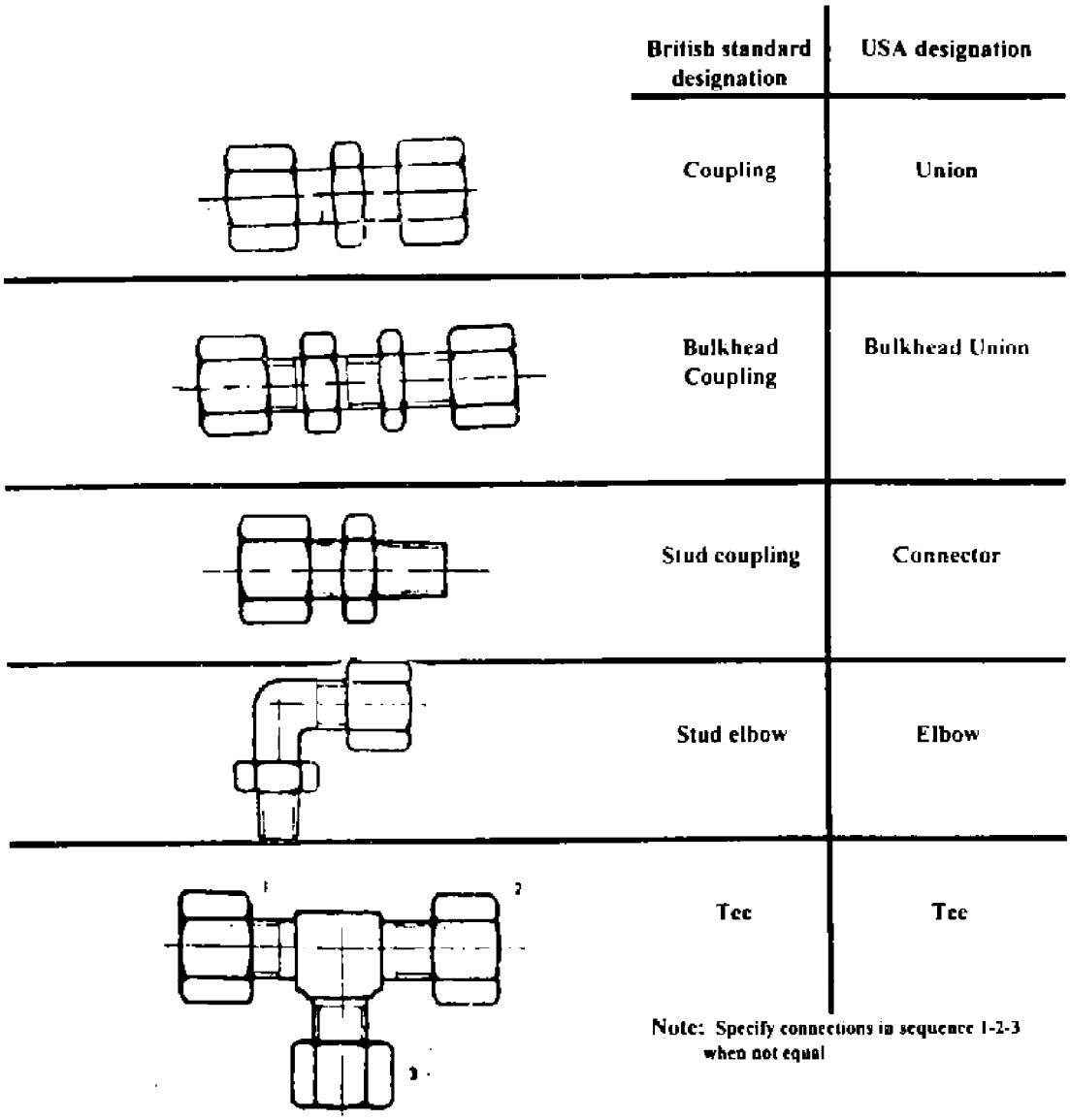
4.4 Inspection and Testing

Refer to IPS-M-IN-100, Part 2 "General-Factory Inspection and Testing of Instruments and Instrument Systems".

4.5 Preparation for Shipment

Refer to IPS-M-IN-100, Part 1 "General-Packaging, Marking, Shipping and Guarantee".

4.6 Designation of Compression Fittings



5. INSTRUMENTS AND THERMOCOUPLES EXTENSION WIRES AND CABLES

5.1 General Specifications for Instruments Wires and Cables

5.1.1 Conductors for instrument signal wire shall be soft annealed copper.

5.1.2 Insulation and overall jackets of instrument signal and thermocouple extension wire and cable shall be PVC or polyethylene, having relative density of 1.33 kg/dm^3 at 20°C suitable for conductor temp. of at least 75°C, per NEMA WC5.

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

5.1.4 The insulation shall be coded with color which is unique for each single conductor in the cable, or by a combination of colors which is unique for each pair of conductors in the cable.

5.1.5 The minimum thickness of insulation on single wires shall be 0.38 mm suitable for a test voltage of 500 volt DC.

5.1.6 Overall jackets

The minimum thickness of overall jackets shall be as follows:

NUMBER OF CONDUCTORS	WIRE DIAMETER	JACKET THICKNESS, min	
		SIGNAL WIRE	THERMOCOUPLE EXTENSION WIRE
SINGLE PAIRS	ALL mm	0.875 mm	0.50 mm
MULTICONDUCTOR CABLE	0.00 - 5.00	0.875	
	5.03 - 7.50	1.000	
	7.53 - 12.50	1.250	
	12.55 - 18.75	1.500	
	18.78 - 27.50	1.750	
	27.53 - 36.25	2.000	
	36.28 - 45.00	2.250	

5.1.7 Metal cladding

Material and type of metal cladding for signal wire and thermocouple extension wire will be specified. Metal cladding shall be limited to the following types:

a) Armor types:

1) Flat metal tape armor.
2) Interlocked metal tape armor.
3) Round steel wire armor.
4) Flexible steel armor, either seamless or welded construction, and impervious to liquids. Minimum thickness of armor shall be as follows:

CABLE DIAM. (UNDER ARMOR) mm	ARMOR WALL THICKNESS, min mm
0 - 25	0.30
> 25 - 45	0.41
> 45 - 75	0.51

5) Round copper wire armor covered by a helix of copper tape.

b) Sheath Types

1) Lead sheath.
2) Copper and steel sheath (for MI type cables).

5.1.8 Special exposure conditions

5.1.8.1 Exposure to high temperature

Wire and cables passing close to high temperature equipment or piping shall have insulation and jacket materials suitable for the highest ambient temperature expected.

Vendor's proposed insulation and jacket types, and the temperature ratings of these materials shall be submitted to purchaser for approval by user Engineer.

5.1.8.2 Exposure to contaminated environments

Vendor shall confirm that wire and cable construction and materials specified are suitable for the intended service.

5.1.9 Limitations for vendors (alternative proposals)

Signal wire

Proposals to use materials and thicknesses for insulation and jackets, alternative to those specified, shall conform to the followings:

a) Classes of materials are limited to:

1) Moisture resistant rubber.
2) Moisture resistant thermoplastic.
3) Mineral insulation, if copper sheathed.

b) Insulation rating of single wires shall be not less than 300 volts.
c) Vendor's proposals shall state insulation thickness and overall jacket thickness.

5.1.10 Instrument signal wire

5.1.10.1 Specifications for signal wire proposed for special electronic equipment such as DCS, PLC, data loggers, computers, and multiplexers, shall be submitted by the equipment manufacturer to the purchaser for approval by the user Engineer.

5.1.10.2 Single pairs

Single pairs of instrument signal wires shall be as follows:

a) Wire size shall be 15 AWG (1.5 mm^2) stranded copper, and insulated (normally 7 strands).

b) Pairs of wire shall be twisted at least 18 times per meter and have total coverage electrostatic shield with copper drain wire extending the length of the conductors. An overall jacket shall be provided for each pair.

c) individual wires shall be color coded.

5.1.10.3 Multiconductor cable

Multiconductor signal wire shall be as follows:

a) Wire size shall be 20 AWG (0.5 mm^2) stranded copper, and insulated.

b) Pairs of wire shall be twisted at least 18 times per meter.

c) Individual pairs of wires shall have number identification.

d) Multiple pairs shall be twisted at least 6 times per meter and shall have total coverage of electrostatic shield with 20 AWG (0.5 mm^2) stranded copper drain wire extending the length of the conductors.

e) An overall jacket shall be provided for the cable.

f) An insulated communication wire shall be provided within each cable.

g) Where shields are specified for individual pairs of wires, each shield shall be insulated from other shields and from the overall cable shield.

5.1.11 Thermocouple extension wire

5.1.11.1 Single pairs

Single pairs of extension wires shall be as follows:

a) Wire size shall be 15 AWG (1.5 mm^2), and insulated.

b) Pairs of wires shall be twisted at least (18 times per meter) and shall have total coverage electrostatic shield with copper drain wire.

c) An overall jacket shall be provided for each pair.

5.1.11.2 Multiconductor cable

Multiconductor extension wires shall be as follows:

a) Wire size shall be 20 AWG (0.5 mm^2), and insulated.

b) pairs of wires shall be twisted at least (18 times per meter) and shall have total coverage electrostatic shield with copper drain wire.

c) Individual pairs of wires shall be numbered.

d) Multiple pairs shall be twisted at least (6 times per meter), and shall have total coverage electrostatic shield with copper drain wire extending the length of the conductors.

e) An insulated communication wire shall be provided within each cable, if specified.

f) An overall jacket covering shall be provided for the cable.

5.2 Details of Construction-Signal Wire and Cables as a Typical Example

5.2.1 Single pair instrument cable for standard applications

Conductor, 2/c 1.5 mm^2 nominal stranded annealed copper conductors twisted pair.

Primary insulation, 0.5 mm nominal thickness, 105°C PVC, with 1 layer of polyester tape 0.023 mm thick helically applied over the twisted pair.

Pair jacket, 1.15 mm nominal 80°C PVC.

Color Code Black and White.

Lay of Twist, 50 mm.

Jacket Color Code, Black.

5.2.2 Single pair or triad instrument cable for critical applications

Conductor, 1.5 mm^2 nominal stranded annealed copper conductors twisted pair or triad.

Primary insulation, 0.5 mm nominal thickness, 105°C PVC.

Color Code, single pair-black and white triad-black, white and red.

Lay of twist, 50 mm.

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 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. A 100% coverage of 1 layer of polyester tape 0.023 mm thick shall be applied over the aluminum mylar tape shield.

Pair jacket, 1.15 mm nominal 80°C PVC.

Jacket color code, black.

5.2.3 Multi-pair instrument cable with overall lead sheath for standard applications

Conductor, 0.5 mm^2 nominal stranded annealed copper conductors twisted pair.

Primary insulation, 0.5 mm nominal thickness 105°C PVC.

Insulation color code (each pair), black and white.

Group identification, each pair numbered.

Lay of twist, 40 mm to 50 mm staggered.

Cable shield, 2 layers of polyester tape each to be 0.023 mm thick over the cores with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.050 mm. mylar polyester tape helically applied over the polyester tape. The aluminum shall be on the inside and in continuous contact with a bare, 0.5 mm^2, 7-strand tinned copper cable drain wire. Two layers of polyester tape and foam insulation each 0.20 mm thick shall be applied over the polyester tape to provide complete isolation between drain wire and lead sheath. Lead sheath of 1.3 mm minimum average radial thickness. Cable armor shall be single galvanized steel wire having 90% nominal coverage.

Communication Wire, 0.5 mm^2 nominal stranded annealed copper conductors with 0.5 mm PVC insulation.

Inner Cable Jacket (over pairs, drain wire and communication wire and lead sheath) and overall cable jacket. 80°C PVC, thickness as listed below:

DIAMETER OF CABLE	THICKNESS
6.4 to 10.8 mm (0.251 to 0.425 inch)	1.143 mm (45 mils)
10.82 to 17.8 mm (0.426 to 0.700 inch)	1.524 mm (60 mils)
17.8 to 38 mm (0.701 to 1.500 inch)	2.000 mm (80 mils)
38 to 63.5 mm (1.501 to 2.500 inch)	2.800 mm (110 mils)

Jacket Color Code, Jacket over lead sheath-black Overall jacket-black.

Communication wire-orange.

5.2.4 Multi-pair instrument cable with overall lead sheath for critical applications

Conductor, 0.5 mm^2 nominal stranded annealed copper conductors.

Primary Insulation, 0.5 mm nominal thickness 105°C PVC. Insulation Color Code (each pair), Black and White.

Group Identification, each pair numbered on pair jacket. Lay of Twist, maximum 50 mm.

Pair Shield, 2 layers polyester tape each to be 0.023 mm thick over the pair with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.012 mm mylar polyester tape, helically applied over the twisted pair with the aluminum on the inside in continuous contact with a bare minimum 0.5 mm^2, 7-strand tinned copper drain wire. A 100% coverage of 1 layer of polyester tape 0.023 mm thick shall be applied over the aluminum mylar tape shield.

Pair jacket, 0.5 mm nominal thickness 80°C PVC (Color Code - see below).

Cable shield, 2 layers of polyester tape each to be 0.023 mm thick over the twisted pairs with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.050 mm mylar polyester tape helically applied over all pairs and the communication wire. The aluminum shall be on the inside and in continuous contact with a bare, 0.5 mm^2, 7-strand tinned copper cable drain wire.

Two layers of polyester tape and foam insulation each 0.20 mm thick shall be applied over the polyester tape. There shall be complete isolation between drain wire and the lead sheath. Lead sheath of 1.3 mm minimum average radial thickness. Cable armor shall be single galvanized steel wire having 90% nominal coverage.

Communication Wire, 0.5 mm^2 nominal 7-strand copper 0.5 mm PVC insulation.

Inner Cable Jacket (over pairs, drain wire, communication wire and lead sheath) and overall cable jacket. 80°C, PVC thickness as listed below:

DIAMETER OF CABLE	THICKNESS
6.4 to 10.8 mm (0.251 to 0.425 inch)	1.143 mm (45 mils)
10.82 to 17.8 mm (0.426 to 0.700 inch)	1.524 mm (60 mils)
17.8 to 38 mm (0.701 to 1.500 inch)	2.000 mm (80 mils)
38 to 63.5 mm (1.501 to 2.500 inch)	2.800 mm (110 mils)

Jacket Color Code (Pair and cable) Black, Jacket over lead sheath-black, communication wire-orange.

5.2.5 Details of construction (Thermocouple extension wire and cables)

5.2.5.1 Single pair thermocouple extension cable

Conductor, 1.5 mm^2 nominal solid type JX (iron/constantan) and /or type KX (chromel/alumel) alloy wire matched and calibrated per ANSI C96, latest edition for thermocouple extension wire.

Primary insulation, 0.5 mm nominal thickness 105°C PVC.

Insulation color code, see chart below:

Lay of twist, 50 mm.

Shield, 2 layer polyester each to be 0.023 mm thick over the pair with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.012 mm mylar polyester tape, helically applied over the twisted pair with the aluminum on the inside in continuous contact with a bare minimum 0.75 mm^2, 7-strand tinned copper drain wire. A 100% coverage of one layer of polyester tape 0.023 mm thick shall be applied over the aluminum mylar tape shield.

Pair jacket, 1.15 mm nominal. 80°C PVC.

COLOR CODE CHART			
TYPE	PAIR	CONDUCTOR	
	JACKET	POSITIVE (+)	NEGATIVE (-)
JX	BLACK	WHITE	RED
KX	YELLOW	YELLOW	RED

5.2.5.2 Multi-pair thermocouple extension cable with overall lead sheath for critical applications

Conductor, 0.5 mm^2 nominal solid type JX (iron constantan) and/or type KX (chromel/alumel) alloy wire matched and calibrated per ANSI C96, latest edition, Thermocouple Extension Wire.

Primary Insulation, 0.4 mm nominal thickness, 105°C PVC. Insulation Color Code, see chart below.

Pair Identification, each, pair numbered on pair jacket, Lay of Twist, maximum 50 mm.

Pair Shield, 2 layers polyester each to be 0.023 mm thick with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.012 mm mylar polyester tape, helically applied over the twisted pair with the aluminum on the inside in continuous contact with a bare minimum 0.5 mm^2, 7-strand tinned copper drain wire. A 100% coverage of 1 layer of polyester tape 0.023 mm thick shall be applied over the aluminum mylar tape shield.

Pair Jacket, 0.5 mm nominal thickness 80°C PVC. (Color Code- see below).

Cable shield, 2 layers of polyester tape each to be 0.023 mm thick over the twisted pairs with 100% coverage by a tape shield of 0.012 mm aluminum laminated with 0.050 mm mylar polyester tape helically applied over all pairs and the communication wire. The aluminum shall be on the inside and in continuous contact with a bare, 0.5 mm^2, 7-strand tinned copper cable drain wire. Two layers of polyester tape and foam insulation each 0.20 mm thick shall be applied over the polyester tape. There shall be complete isolation between drain wire and the lead sheath. Lead sheath of 1.3 mm minimum average radial thickness. Cable armor shall be single galvanized steel wire having 90% nominal coverage. Communication Wire, 0.5 mm^2 nominal 7-strand copper conductor with 0.5 mm PVC insulation.

Inner Cable Jacket (over pairs, drain wire, communication wire and lead sheath) and overall cable Jacket, 80°C, PVC thickness as listed below:

DIAMETER OF CABLE	THICKNESS
6.4 to 10.8 mm (0.251 to 0.425 inch)	1.143 mm (45 mils)
10.82 to 17.8 mm (0.426 to 0.700 inch)	1.524 mm (60 mils)
17.8 to 38 mm (0.701 to 1.500 inch)	2.000 mm (80 mils)
38 to 63.5 mm (1.501 to 2.500 inch)	2.800 mm (110 mils)

Jacket Color Code, communication wire-orange. See chart below.

COLOR CODE CHART					
TYPE	PAIR JACKET	LEAD SHEATH JACKET	CABLE JACKET	POSITIVE (+)	NEGATIVE (-)
JX	BLACK	BLACK	BLACK	WHITE	RED
KX	YELLOW	BLACK	BLACK	YELLOW	RED

5.2.6 Physical properties of insulation and jacket materials

	PRIMARY INSULATION	JACKET
Maximum Operation Temperature	105°C	80°C
Tensile Strength, Minimum	(2500 psi)	(200 psi)
Elongation Minimum	200%	200%
Cold Bend Qualification Test ICEA S-61-402	-35°C	-35°C

Note:

Only cable per paragraphs 5.2.1, 5.2.2 and 5.2.5.1 with a bending radius of ten times diameter or less shall be required to meet the Cold Bend Qualification Test.

Specific Gravity	1.34	1.37
Accelerated Heat Aging Test ICEA S-61-402	168 hours at 121°C	5 days at 100°C
Tensile Strength after Aging, % of unaged	Min. 85%	Min. 85%
Elongation after Aging % of unaged	Min. 75%	Min. 60%
Heat Shock Test		
Primaries Wrapped 6 turns around its own diameter examined after one hour at 121°C		No cracks

5.2.7 Electrical specifications

Nominal conductor resistance in Ohms per 1000 meters at 20°C.

0.5	mm^2	36.6	
0.75	mm^2	24.6	
Insulation integrity verified by spark test		6000	VAC
Finished product given dielectric test conductor to conductor and conductor to shield for one minute		1500	VAC
Insulation resistance constant at 15.6°C (Natural Material)		3000	Ohm

Notes:

- Critical applications mean shutdown, computer, digital data handling equipment.
- Standard applications mean other normal wires, i.e., alarm circuits, pressure switches .... etc.

5.3 Inspection & Testing

The following tests shall be performed on each reel of completed cable in addition to those listed under section 5.2.7.

a) Continuity of conductors and shields.

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

c) The insulation resistance between shields shall be a minimum of 10 megohms per 300 metres of cable corrected to 15.6°C.

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

c) For more details refer to: IPS-M-IN-100 "General-Factory Inspection and Testing of Instruments and Instrument Systems".

5.4 Preparation for Shipment

a) Each reel shall have a weatherproof (metal or plastic) tag firmly attached containing the number of cable pairs, cable description, length on reel, manufacture's name, Purchase Order Number and Item Number.

b) Splices in individual conductors of single and multipair cables, drain wire, communication conductor or shielding are not acceptable.

c) Actual lengths of cable on a reel shall be -0, +3%.

d) 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 jobsite.

e) The manufacturer shall be solely responsible for the adequacy of the preparation for shipment provisions employed with respect to materials and their application to insure that the cable reaches its destination in excellent working condition when handled by commercial carrier systems.

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

g) The manufacturer shall submit with his quotation, his standard "Packaging" of reels.

h) For more details refer to IPS-M-IN-100, Part 1 "General-Packaging, Marking, Shipping and Guarantee".

5.5 Specific Requirements

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

6. JUNCTION BOXES, TERMINALS, CONDUITS, AND TRAYS

6.1 Junction Boxes

6.1.1 Junction boxes shall be cast iron or cast aluminum alloy (0.4% copper maximum) where available. Sheet steel enclosures when used shall be hot-dip galvanized, with a minimum thickness of 0.063 in. (1.6 mm) [Equivalent weight of coating approx. 2 oz/ft^2 (610 g/m^2) of sheet]. Boxes shall be weatherproof and watertight. Doors shall be provided with gaskets.

6.1.2 Proposals to use junction boxes made from other suitable materials shall be submitted to the user Engineer for approval. Such proposals shall include test data documenting the explosion proof, fire resistance, corrosion resistance, and mechanical strength of the proposed boxes.

6.1.3 Junction box installation shall be with the centerline of the box about 1200 mm above grade or platform.

6.1.4 Cables shall enter junction boxes from the bottom.

6.2 Terminals

6.2.1 The size of terminal blocks and screws shall be consistent with the wire size used with them. Terminations shall be either.

a) "Captive" screw terminal strips used with spade type wire ends, or;
b) "Modular" (or "Stacked") snap-in terminal block assemblies of the screwed, pressure clamp type. For stranded wire, crimp-on wire-end pins or sleeves are required. Screws shall be "captive" and shall not contact the wire, sleeve or end pin.

6.2.2 Terminal blocks shall be non-hygroscopic.

6.2.3 Spring type terminals are not acceptable.

6.2.4 Terminals shall be either tinned or silver plated.

6.2.5 Facility for terminal identification shall be provided.

6.2.6 Terminations for intrinsically safe wiring

Terminals for intrinsically safe circuits shall be segregated or separated form non-intrinsically safe terminals by one of the following methods:

a) Locating intrinsically safe and non-intrinsically safe terminals in separate enclosures.
b) Using an insulating or grounded metal partition between terminals.
c) Separating intrinsically safe and non-intrinsically safe terminals by a minimum distance of 50 mm.

6.2.7 Terminal strips in enclosures containing different intrinsically safe circuits shall be the type with insulating or grounded metal partitions between terminals i.e., "Barrier Type".

6.2.8 Wiring methods shall prevent contact between circuits, should a wire become disconnected from its termination.

Wire tie-downs are acceptable for this purpose.

6.2.9 Control house entry

All multiconductor wire and conduit entering the control house shall be sealed at the point of entry as follows:

a) Direct burial cable shall be sleeved using metal conduit or pipe, and the space between cable and sleeve sealed so as to be liquid tight at the point of entry.

b) Cable in conduit entering form underground shall be sealed with an explosion-proof seal, at the point of entry.

c) Cable in conduit entering above ground shall be sealed with an explosion-proof seal outside the building wall at the point of entry.

d) Explosion-proof seals shall be made with a compound which can be poured around the wires in the cable to form a dense, strong mass which is insoluble in water, is not attached by petroleum products, and has a melting point not less than 93°C.

e) Liquid tight seals may be made with a compound similar to that described in sub-par.-d above. The compound shall be poured to a depth equal to the nominal cable size, but not less than 16 mm.

6.3 Conduits

6.3.1 Electrical conduit connections for locally mounted instruments and devices shall be internally threaded.

6.3.2 Conduit shall be steel, galvanized. Size of conduit shall depend on the number of cables as follows:

CONDUIT SIZE		APPROX. NUMBER OF CABLES	
NOMINAL DIA. mm	INSIDE DIA. mm	STANDARD 2-CORE THERMOC. CABLE WITH OD. APPROX. 8 mm	STANDARD SIGNAL CABLE 1 × 4 × 1.2 mm WITH OD. APROX. 10 mm
25	21.8	2	1
40	34	6	4
50	46	10	8

Note:

When cables with other ODs are used, care shall be taken that not more than 60% of the max. possible number of cables in each conduit is applied.

6.3.3 Conduit fittings shall be steel or malleable iron, galvanized.

6.4 Trays

Trays, ladder, separators, their supports and other fittings shall be made of mild galvanized steel. Perforated across, each row of slots to be shifted with regard to the preceding row, diameter of holes and slots approximately shall be 7.14 mm (9/32 inch) in lengths of 2.438 m (8 feet).

Width:	Shall be as specified in data sheet.
Thickness:	Shall be either 1.65 mm (16 SWG) or 2.00 mm (14 SWG), as specified.
Flange depth:	Shall be either 12.7 mm (½ inch) or 19.00 mm (¾ inch), as specified.

6.5 Inspection & Testing

Refer to IPS-M-IN-100, Part 2 "General-Factory Inspection and Testing of Instruments and Instrument Systems".

6.6 Preparation for Shipment

Refer to IPS-M-IN-100, Part 1 "General-Packaging, Marking, Shipping and Guarantee".