

SCOPE

- I 1.1 This practice covers the specification and selection of instrument signal wire, thermocouple extension wire, and multi-conductor cables; including fiber-optic cables used for interfacing between control equipment and systems, which is suitable for service in transmission of low level analog, discrete, and digital signals.
- I * 1.2 This practice does not cover control systems coax, or pre-terminated duplex fiber-optic cables used within buildings. Fiber-optic cables used for telecommunications systems are also not covered by this practice. Type and materials of construction, installation details, electrical characteristics, and insulation needs for these others will be defined by equipment or systems vendor, and approved by the Owner's Engineer.
- I * 1.3 **An asterisk (*)** indicates that a decision by the purchaser is required, or that additional information is to be supplied by the purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I * 2.1 **Table 1** lists the practices and standards which shall be used with this practice as specified by the Owner's Engineer and/or the purchaser, and which shall be applied to the purchase of instrument signal wire and cable, and to thermocouple extension wire and cable.

TABLE 1

PRACTICE	
IP 16-1-3	Protection of Electrical Equipment in Contaminated Environments
IP 16-3-1	Wiring Methods and Material Selection
STANDARDS	
ANSI / ISA Standard	
MC 96.1	Temperature Measurement Thermocouples
ANSI / NFPA Standard	
70	National Electric Code (NEC)
UL and CSA Standards for Safety	
UL 4	CSA C22.2 #51 Armored Cable
UL 44	----- Rubber-Insulated Wires and Cables
UL 83	CSA C22.2 #75-M Thermoplastic-Insulated Wires and Cables
-----	CSA C22.2 #38 Thermoset Insulated Wires and Cables
-----	CSA C22.2 #124-M Mineral Insulated Cable
UL 719	CSA C22.2 #48 Nonmetallic-Sheathed Cables
-----	CSA C22.2 #123 Aluminum Sheathed Cables
UL 1651	CSA C22.2 #232 Optical Fiber Cables
-----	CSA C22.2 #239 Control and Instrumentation Cables
UL 13	Requirements for Power-Limited Circuit Cables for Class 2 and Class 3 Circuits (power-limited tray cable - Type PLTC)
UL 2250	Requirements for Instrumentation Tray Cable (Type ITC)
CSA Standard	
C22.1	Canadian Electrical Code (CEC) - Part 1
IEC / CENELEC Standards	
IEC 584-3 / HD 446.3	Thermocouples: Part 3 Extension and Compensating Cables - Tolerance and Identification System (BS 4937)
IEC 794	Optical Fiber Cables: Part 1 & Part 2
IEC 1515 / EN 61515	Mineral Insulated Thermocouple Cables and Thermocouples
BSI Standard	
BS 5308	Instrument Cables: Part 1 & Part 2

- I *2.2 The purchase and use of **instrument signal wire and cable**, and **thermocouple extension wire and cable**, shall conform to nationally recognized codes and standards which are specified by the Owner's Engineer, and which are acceptable within the country where the equipment and materials will be used.
- I 2.3 **Cable** shall be shipped in **continuous lengths** as specified in the material purchase order. Splices in the cable, shield, or individual conductors are not permitted to achieve these lengths.

MATERIALS FOR FIBER-OPTIC CABLES, INSTRUMENT SIGNAL WIRE AND THERMOCOUPLE EXTENSION WIRE

- I,R 3.1 **Conductor** requirements shall be as follows:
- a. Conductors for instrument signal wire shall be copper.
 - b. Conductors for thermocouple extension wire shall be in accordance with ISA - MC 96.1 or applicable national standards.
 - c. Optical fiber for fiber-optic cable shall be glass on glass, graded index fiber.

INSULATION AND JACKET REQUIREMENTS

- C,R 3.2 a. Acceptable **classes of insulation materials** are limited to:
- 1. Moisture resistant rubber.
 - 2. Moisture resistant thermoplastic, or thermosetting.
 - 3. Mineral insulation, if copper or stainless steel sheathed.
- b. Insulation rating of single wires shall not be less than 300 volts.
- c. For acceptable fire resistant cable insulation and construction, refer to [IP 16-3-1](#).
- R 3.3 **Overall insulation and jackets** of instrument signal and thermocouple extension wire and cable, and fiber-optic cable, shall be polyvinyl chloride (PVC) or chlorinated polyethylene (CPE), suitable for temperature of at least 90°C (194°F).
- E [3.4](#) Instrument signal and thermocouple extension wire and cable, and fiber-optic cable, shall not contain asbestos.
- R 3.5 The **minimum thickness of insulation** on single wires shall be as follows:

MINIMUM INSULATION THICKNESS		SINGLE WIRE SIZES	
in.	mm	AWG	mm ²
0.012	0.30	22 - 20	0.35 - 0.50
0.015	0.38	19 - 16	1.00 - 1.30

- S [3.6](#) Insulation and jacketing of wires and cables used in control centers or remote instrument buildings shall be resistant to the spread of fire.
- R 3.7 The **minimum thickness of jackets** for instrument wire and cable, shall be as follows:

NUMBER OF CONDUCTORS	WIRE DIAMETER	JACKET THICKNESS, MIN.	
		SIGNAL WIRE	THERMOCOUPLE EXTENSION WIRE
Single Pairs	All	0.035 in. (0.875 mm)	0.020 in. (0.50 mm)
Multi-conductor Cable	in.	in.	mm
	0 - 0.200	0.035	0.875
	0.201 - 0.300	0.040	1.000
	0.301 - 0.500	0.050	1.250
	0.501 - 0.750	0.060	1.500
	0.751 - 1.100	0.070	1.750
	1.101 - 1.450	0.080	2.000
	1.451 - 1.800	0.090	2.250