

SCOPE

- 1.1 This practice covers the design, installation and testing of transmission systems for process instruments.
- 1.2 **An asterisk (*)** indicates that a decision by the Owner's Engineer or Purchaser is required, that additional information is to be furnished by the Owner's Engineer, or that information for approval by the Owner's Engineer is to be supplied by the vendor or Purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- 2.1 **Table 1** lists the practices and standards which shall be used with this practice.
- * 2.2 **Table 2** lists the practices and standards which shall be used with this practice, as specified by the Purchaser.

TABLE 1

PRACTICES			
IP 14-3-1	Fireproofing	IP 15-12-1	Instrument Wire and Cable
IP 15-6-1	Electronic and Pneumatic Instruments	IP 16-3-1	Wiring Methods and Material Selection
IP 15-6-2	Environmental Protection for Instruments	IP 16-4-1	Grounding and Overvoltage Protection
IP 15-7-2	Protective Systems	IP 16-13-1	Field Installation and Testing of Electrical Equipment
IP 15-11-1	Instrument Control Panels		
STANDARDS			
API		ASTM	
RP 552	Transmission Systems	A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

TABLE 2

PRACTICES			
IP 15-2-1	Temperature Instruments	IP 19-6-1	Facilities for Corrosion Monitoring in Process Equipment
STANDARDS			
ANSI / ISA		CENELEC	
S12.6	Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations	EN 50014	Electrical Apparatus for Potentially Explosive Atmospheres - General Requirements
S12.12	Electrical Equipment for Use in Class I, Division 2 Hazardous (Classified) Locations	EN 50016	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous Locations
S12.4	Instrument Purging for Reduction of Hazardous Area Classification	EN 50018	Flameproof Enclosures for Electrical Equipment in Hazardous Locations
API		EN 50020	Intrinsic Safety (Apparatus)
RP500	Classification of Areas for Electrical Installations at Petroleum Facilities	EN 50039	Intrinsic Safety (Systems)
RP540	Electrical Installations in Petroleum Processing Plants	EN 50529	Degrees of Protection Provided by Enclosures (IP Code)
NFPA		CSA	
70	National Electrical Code (NEC)	22.1	Canadian Electrical Code - Part 1
493	Intrinsically Safe Apparatus in Division 1 Hazardous Locations	NEMA	
496	Purged and Pressurized Enclosures for Electrical Equipment	250	Enclosures for Electrical Equipment: 1 kV Max.

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(This practice is appropriate for attachment to Inquiry or Purchase Document)

DEFINITIONS

- I 3.1 **Transmission Systems:** The set of equipment and devices required to send information, supply motive power or permit control between process instruments in the plant and remote control centers. Such transmission systems may be electric, pneumatic, or fiber optic.
- I 3.2 **Wiring Systems:** Electrically-based transmission systems comprising signal, thermocouple, or network communications wiring, their junction boxes, fittings, conduits, cable trays, termination equipment, etc.,. Such systems may be designed to be energy-limiting (intrinsically safe or non-incendive).
- I 3.3 **Signal wiring** covers wiring systems dedicated to measurement and control of process facilities. It may include the following **types** of circuits, among others:
 - a. High level analog (4 - 20 mA or 10 - 50 mA),
 - b. Low level analog (thermocouple, magnetic flow meters),
 - c. Discrete (controls, alarms and protective systems up to 120 volts DC),
 - d. Network communications (data highways, field bus, vendor-specific digital protocols, LAN's),
 - e. Pulse trains (turbine meters, densitometers),
 - f. Fiber optic.
- I 3.4 **Power wiring**, for the purpose of this practice, covers wiring dedicated to supplying electrical energy to operate process facilities or equipment. It may include the following **types** of circuits, among others:
 - a. DC buses (greater than 120 volts),
 - b. AC buses,
 - c. AC loads (alarms, panel lights, convenience outlets, certain protective system devices).

Wiring where DC loop power is provided over the signal wires is considered **signal** wiring.

WIRING SYSTEMS

- O 4.1 **Continuity of signal wire shields** shall be as follows:
 - a. Shielding shall be continuous from the signal source to the receiver.
 - b. Continuity of shields shall be maintained through junction boxes by means of individual terminals for each shield. Insulation and shield coverage shall extend to within 1 in. (25 mm) of terminal connections.
 - c. Continuity and integrity of shield shall be maintained through explosion proof seals.
- R * 4.2 **Splicing of wires** is not permitted unless approved by the Owner's Engineer.
- R * 4.3 **Multi-conductor cable** to junction boxes **within process unit areas** and multi-conductor cables run to **control centers or remote instrument buildings** shall preferably be **underground in accord of IP 16-3-1**.
- R 4.4 **Outdoor above ground installation** shall be either:
 - a. Wire or cable in rigid metal conduit systems. Conduit drains and seals shall be provided in accordance with **IP 16-3-1**.
 - b. Cable in continuous rigid support systems of ventilated cable trays. Cable shall not be permitted to sag below the support system.
- R 4.5 **Cable tray sections** shall be **continuously bonded** to one another and to the plant structure at intervals not exceeding 30 ft (10 m).

ROUTING

- R 4.6 **For underground installations**, a **route** shall be **selected to avoid** locations where **hydrocarbon, corrosive, or hot fluids** may permeate the ground, and to avoid close proximity to hot [greater than 200°F (93°C)] underground lines.
- R * 4.7 The **underground** route shall be **identified with concrete markers** at every point where the trench changes direction, and at intervals not greater than 50 ft (15 m) within process unit limits and 150 ft (45 m) outside process unit limits. **Concrete markers** shall be identified by metallic plates fixed by fully grouted screws/pins to the top of the concrete markers. Plates shall identify the cable type (instrument, electrical and voltage) and shall be marked with deep engraved lettering. The final route selected and the design of the concrete markers shall be approved by the Owner's Engineer.



Documents

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EXXON INTERNATIONAL PRACTICE	Instrument Transmission Systems (This practice is appropriate for attachment to Inquiry or Purchase Document)	IP 15-10-1	
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- O,R 4.8 When **direct-buried cable** is used, an extra **12 feet** (4 meters) **minimum** of each cable shall be available at each junction box to facilitate reconnection of the cables after a fire.
- R 4.9 All **direct buried instrument home run cable installations** shall incorporate two **copper conductors**, (50 mm²/0.08 in²) one at each side of the trench. These conductors shall be **bonded to the plant ground network** in the field and to the control house building (or safety) ground.
- R 4.10 **Above ground wiring systems** shall be **routed**, wherever possible, at least 25 ft (7.5 m) **horizontal** distance **from** equipment with **high fire potential** or outside a **fire hazardous area**, whichever distance is greater.
- R 4.11 Routing of **above-ground** wiring systems shall avoid **exposure to high temperature** [greater than 200°F (93°C)] and areas where hydrocarbon, corrosive or hot fluids may spill onto the wiring systems.
- O 4.12 **The selection, routing, and installation of signal wiring** with respect to other sources of electro-magnetic energy (electrical systems, lightning conductors) shall be carefully considered to **prevent the introduction of spurious signals** by any of the following:
- Electrostatic or capacitive coupling.
 - Electromagnetic or inductive coupling.
 - Leakage current or ground loops.
- O 4.13 **Signal wiring** shall **not** be **run** closer than **5 feet (1.5 meters)** from **electrical noise generating equipment**, e.g., transformers, generators, large motors, etc., Within control centers, instrument system cabinets or wiring shall not be located closer than 5 feet (1.5 meters) from any lightning conductor fixed to the external wall of the building.

SEGREGATION OF WIRING SYSTEMS

- R,C * 4.14 **Multi-conductor cables** shall contain only **one type of circuit** (e.g., high level analog, low level analog, discrete, etc.) An exception is that digital inputs/outputs (≤ 28 VDC) may be run in the same multi-conductor cable as high level analog signals with the Owner's Engineer approval.
- R,C 4.15 **Minimum parallel separation** between **power** and **signal wiring systems** of different **groups** shall be per **Table 3**, depending on the installation methods listed below:
- Both power and signal cable groups run in separate metal conduit or enclosed metal trays.
 - Either power or signal cable groups run in separate metal conduit or enclosed metal trays with the other cable type run in open cable trays.
 - Both power and signal cable groups run in open cable trays or both buried without metal conduit.
- O,R ♦ 4.16 **Cable crossings** that bring different cable groups closer than the requirements of **Table 3** shall be made at right angles. Crossovers of signal wiring by Groups 5 and 6 cables shall be separated by 12 in. (300 mm).

CONNECTIONS TO INSTRUMENTS

- R * 4.17 To prevent entrance of water, the **cable entry point into a field mounted instrument or thermocouple head** shall be **from the bottom (or side)** wherever practicable. Where top entry must be used, conduit shall have electrical code approved seal and drain fittings and shall be approved by the Owner's Engineer.
- R,M 4.18 Series-connected devices (e.g., milliammeters) in instrument loops shall be provided with a silicon diode shunt such that failure or removal of the device will allow the loop to remain in service.

JUNCTION BOXES

- R 4.19 The preferred material of construction for **Junction boxes** shall be **stainless steel, hot-dip galvanized steel** per **ASTM A 123**, **cast aluminum alloy** (0.4% copper maximum), or **cast iron**. **Proposals to use junction boxes made from other suitable materials** shall be submitted to the Owner's Engineer for approval. Such proposals shall include test data documenting the fire resistance, corrosion resistance, and mechanical strength of the proposed boxes
- R ♦ 4.20 **Outdoor junction boxes** or enclosures shall have **conduit/cable entries** at the **bottom** and be **weatherproof** and **watertight** to **NEMA 4X** per **NEMA 250** or **IP65** per **EN50529** and sealed to prevent the ingress of moisture and gases per **IP 15-6-2**. Use of side entry shall require approval by the Owner's Engineer.
- M 4.21 **Junction boxes** shall be provided with a **door pocket** for holding wiring documentation