

SECTION 27 11 16 – CABINETS, RACKS, FRAMES, AND ENCLOSURES

1.01 SUMMARY:

- A. ^{A17}**Scope:** Scope of work shall be in accordance with Paragraph 1.01 D. of Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), as required, for electrical and electronic equipment for the Works. This Section of the Employer's Requirements shall be read in conjunction with the Sections listed in Table 27 11 16-1.^{A17}
- B. **Related Sections:**

TABLE 27 11 16-1: ^{A9} Related Sections ^{A9}			
1.	Section 01 81 26	-	Communications, Control, Safety, and Security Systems.
2.	Section 11 52 14	-	Video Walls.
3.	Section 25 11 00	-	Data Processing Equipment.
4.	Section 26 33 00	-	Direct Current Equipment.
5.	Section 26 33 43	-	Battery Chargers.
6.	Section 26 43 13	-	Transient Voltage Surge Suppressors.
7.	Section 27 10 00	-	Structured Cabling Systems for Communications Inside Plant.
8.	Section 27 21 00	-	Data Communications Equipment.
9.	Section 27 31 23	-	IP-based Telephone Systems.
10.	Section 27 37 00	-	Mobile Radio communications Systems.
11.	Section 27 51 16	-	Public Address Systems.
12.	Section 27 53 13	-	Time Synchronization Systems.
13.	Section 28 23 00	-	Closed Circuit Video Systems.
14.	Section 28 23 19	-	Video Recording Systems.
15.	Section 40 70 00	-	Electrical Supervisory Control and Data Acquisition System.
16.	Section 40 94 43	-	Programmable Logic Controllers.
17.	Section 40 95 13	-	Process Control Hardware.
18.	Section 48 19 16	-	Inverters.

1.02 REFERENCE:

- A. **Applicable Publications:** Refer to Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), ^{A9}Paragraph ^{A9} 1.02.
- B. **Employer Standards:**
1. **Standard Design of PLC and RIO Cabinet for Process Control Systems (PCSs):**
 - a. Control cabinets shall be furnished as enclosures for the programmable logic controllers, remote input-output devices, control circuit devices, power supplies, interconnection terminals, main control "On-Off" manual disconnect switch.

- b. The enclosures shall be heavy-duty, dust-tight, watertight, corrosion resistant NEMA 4X per NEMA 250, designed to house electrical control equipment, constructed of code gauge steel sheet metal, with all seams welded and all doors neoprene gasketed.
- c. The enclosures shall be provided with angles, back plates or sub-panels for the proper mounting of terminal connection strips, module racks, and all necessary equipment.
- d. Doors shall be provided with padlocking handles. The door must have a see through window to see the status lights on the enclosed PLC or RIO unit, and hold an industrial operator interface suitable for NEMA 4X enclosures per NEMA 250.
- e. Doors shall have continuous hinges. Each door section shall be maximum 610 mm (24") wide.
- f. The control cabinet dimensions shall be determined by the Contractor. However, all efforts shall be made to minimize the number and size of electrical components so as to minimize cabinet size.
- g. Cabinets shall be for wall mounting and no more than 914 mm (36") high and 305 mm (12") deep.
- h. All control cabinets and wiring boxes shall be supplied with a dry heater for operation from 1 phase, 120 volts, 60 Hz, with a suitable watt rating to keep humidity from condensing.
- i. Separate circuits, with "On-Off" control, shall be provided for the indoor control cabinets and the outdoor control cabinets and wiring boxes. Whenever possible, component DIN rail TS35 mounting option shall be selected.
- j. All control signals leaving or entering the control cabinet shall have voltage suppression electronics in terminal blocks.
- k. All control relay contacts shall have arc suppression to extend contact life in terminal blocks. All relay coils and other inductive loads connected to PLC or RIO system I/O shall have voltage suppression electronics in terminal blocks.
- l. All terminal blocks shall be of the same form factor (shape type) whenever possible.
- m. All alarm or diagnostic outputs of supplied components shall be connected to PLC and RIO inputs for alarm reporting.
- n. The control cabinet shall include the necessary hardware and layout distribution in the following group areas:
 - 1) **Incoming Cabinet Power:** Main breaker, voltage suppression stage, power distribution circuit breakers, and individual distribution terminal blocks per circuit. This physical area with in the cabinet shall be protected from human touch by an acrylic plastic supported by standoffs and shall show a plastic covered

- warning label sticker with an adequate high voltage danger icon and 480VAC text.
- 2) **Power Outlet:** 120 VAC utility power, surge protected, dual outlet, 15 amp, 35mm DIN rail mount, with independent circuit breaker.
 - 3) **DC Power:** 24 VDC Power supply, voltage suppression, power distribution circuit breakers, and individual distribution terminal blocks per circuit. Power supply diagnostic inputs shall be connected to PLC or RIO for monitoring.
 - 4) **Electrical Control System:** this basic 24 VDC based system shall run as a limited function, redundant backup to the PLC or RIO control system, including relays, timers, control signal distribution terminal blocks and limit switches as needed.
 - 5) **PLC/RIO and Fiber Optics Transceiver:** Both units shall have independent breakers. If optical transceiver requires external power via a power transformer, cabinet shall include and its own single power outlet for transformer plug-in.
 - 6) **Temperature Control:** Control cabinet shall include a PLC/RIO controlled cabinet temperature control loop using a thermostat for temperature sensing, a heat exchanger, to cool down the cabinet to acceptable levels and the normal intrinsic heat of each component shall be used to keep humidity uncondensed. However, a dry heater shall be used whenever the temperature falls below 30°C, by a means of a PLC/RIO independent electrical circuit, if the cabinet power is removed. This physical area with in the cabinet shall be protected from human touch by an acrylic plastic supported by standoffs and shall show a plastic covered warning label sticker with an adequate heat and electrical danger icon and 120VAC Secondary Source warning text. The setpoint temperature level is 35°C, for processor backup battery extended life. The maximum acceptable temperature is 42°C. An internal fan at the top of the cabinet shall be used to maintain homogenous temperature throughout the cabinet. Independent breaker(s) shall be used to power the heater(s).
 - 7) **Ground Bar:** A suitable ground bar shall be provided for cabinet grounding. This bar shall be connected to Isolation Transformer ground.

1.03 REQUIREMENTS

A. General Requirements:

1. The Contractor shall meet all applicable requirements of Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), ^{A9}Paragraph ^{A9} 1.03.

2. All closed cabinets taller than 1,524 mm (5') shall have light(s) operable on 120 VAC.
3. ^{A3}Items furnished under this Section shall consider requirements for equipment protection and heat dissipation.^{A3}
4. ^{A3}Racks and cabinets shall have fully welded frames, and shall be pre-assembled and ready to populate with equipment.^{A3}

B. Equipment and Materials:

1. Accessories:

- a. Units shall be furnished as required and shall include, but not be limited to, the following, as required: grounding terminal, power bars, sliding shelves, and utility shelves.
- b. Where NEMA 4 or 4X is not required, closed cabinets shall also have air filters, fans, and louvers coordinated with the air flow direction and ventilating requirements of the equipment to be installed inside.
- c. Each rack shall have surge protected power bar(s) in accordance with Section 26 43 13 (*Transient Voltage Surge Suppressors*).

2. Cable Ties: Shall be of removable and reusable type.

3. Fiber Optic Cabinet/Enclosures:

a. Backbone and Self Healing Rings Enclosures:

- 1) These enclosures shall contain and protect all the backbone and self healing rings fiber optic cable slacks, patch panels and their interconnections, installed outside of the equipment room in weather protected areas.
- 2) Units shall be double-hinged wall-mounted cabinets, designed for protection of fiber optic termination equipment from falling dirt, splashing water, dust, and other likely contaminants.
- 3) Patch Panels Enclosures shall have the following or better characteristics:
 - i. Doors and body made of 14 gauge steel.
 - ii. Finish with phosphatized steel, coated with corrosion and scratch resistant powder paint, matching patch panel finishes.
 - iii. Front access to center body hinging and back section latches
 - iv. Fully welded and ground body and door construction for long- term good appearance and durability.

- v. Front doors with clear window made of 6 mm (0.25 inch) scratch and impact resistant safety glass, and a locking wing knob with two keys.
 - vi. Accessory panels for mounting additional accessories at the back of the cabinet, including tie down points and predrilled holes.
 - vii. Latch on front of door to eliminate need to access sides to open door or back section latches.
 - viii. Latch free sides to permit cabinet to be installed tightly into a corner if required.
 - ix. Foam-in-place seamless gasket around door, to seal against outdoor air infiltration, non-absorbing and chemical resistant.
- 4) Units shall comply with IEC 60529 (IP55), NEMA/EEMAC type 12, and UL508A.
- 5) ^{A9} (Reserved) ^{A9}
- b) **Machinery Enclosures:**
 - 1) These enclosures shall contain and protect all fiber optic interconnections between the Self Healing Rings and the PLC/RIO cabinets, located on weather protected areas near the machinery.
 - 2) Units shall be wall mounted enclosures having the following or better characteristics:
 - i. Doors and body made of 16 gauge steel.
 - ii. Finish with phosphatized steel, coated with corrosion and scratch resistant powder paint.
 - iii. Two separated compartments for network and distribution terminations.
 - iv. Top and bottom feeder cable entrances with 25mm (1 inch) conduit installation capability.
 - v. Single access primary door with keyed lock.
 - vi. Spools and cable tie down bracket included on the inside compartment.
- 4. **Frames for Video Walls:** Shall be made of metal and shall include adequate enclosed space for maintenance in the back of the video walls.
- 5. **Open Racks:**
 - a. Unless otherwise specified, height shall be no less than 2,134 mm (7'), and rack spacing shall have nominal width of 483 mm (19").
 - b. The base of racks shall have no less than two mounting holes on each side.

- c. Racks shall meet the requirements of EIA 310 without requiring any other hardware or modification.
- d. Each side rail shall be at least 165 mm (6.5”) deep, with evenly distributed holes and slots for Velcro tie wraps along its length in both front and back. Construction shall facilitate access from front, back or through the sides.
- e. Racks shall be equipped with wire managers. Top cable management shall be no less than 356 mm (14”) and shall provide fiber optic and UTP cable bend radius management, and slots for Velcro tie wraps.
- f. Racks shall be made of aluminum with black finish. Weight shall not exceed 22.7 kg (50 lb).

6. **PLC and RIO Cabinets:**

- a. PLC and RIO cabinets shall reutilize latest Employer standard design at the moment of the bid, per ^{A9}Subparagraph 1.02 B.1. ^{A9} above, and shall have the appropriate IP rating in accordance with IEC 60529.
- b. Cabinets shall include gland plates for the securing of cables as they enter the cabinet. NEMA 4X requirements shall be preserved.
- c. Internal air conditioning equipment is unacceptable for cabinet cooling.

7. **Server Cabinets:**

- a. Front panel shall be mesh type ensuring visibility of all light indicators as well as ventilation.
- b. Rear door and side panels shall be easily removable and made of metal.
- c. The inside volume shall have means to facilitate cabling and surge protected power bars for a total of 10 or more 120 VAC outlets, in accordance with Section 26 43 13 (*Transient Voltage Surge Suppressors*).
- d. The top surface shall have fans to ensure forced air circulation.
- e. The bottom surface shall have easy access for cabling coming below raised access floor.
- f. Finish color shall be black.

C. Installation:

1. General:

- a. Clearances shall be at least 1.5 m for front and back of cabinets and racks, and 1 m sideways with respect to the first and last unit in a row.

2. Cables:

- a. All cables entering cabinets shall be terminated using the appropriate cable glands.
- b. All cabling and wiring in, out, and through the racks or cabinets shall be orderly and neatly arranged.

3. Enclosures for Fiber Optic Patch Panels: (reserved)

4. Grounding:

- a. All units shall have a safety ground.
- b. Whenever possible, all units shall be grounded and bonded to a single point ground.

5. Open Racks:

- a. Units shall be furnished as required in communications equipment rooms and at guard houses.
- b. Racks shall be bolted to the floor and to adjacent racks.

6. PLC and RIO Cabinets: Cabinets shall be furnished for PLCs and RIOs in machinery rooms.

7. Server Cabinets: Cabinets shall be installed for servers in equipment rooms and above raised access floor.

1.04 DESIGN CRITERIA/SYSTEM PERFORMANCE

A. General:

1. Problem to be Solved: Cabinets, enclosures, frames, and racks shall solve the following business needs:

- a. Provide adequate space for rack and cabinet mounting various electronic equipments. Cabinets also need to provide adequate physical environment and protection for equipment.

2. Provide adequate support as required for mounting large equipment.
3. All cabling and wiring shall be orderly and neatly arranged, showing high quality workmanship, using a color code system to quickly identify circuit types and to promote ease of maintenance.

2. **Restrictions to be Considered:** (reserved)

B. **Design Criteria:** Units shall facilitate installation, operation, maintenance, and protection of various electronics equipment.

C. **System Performance:** (reserved)

1.05 SUBMITTALS: The following shall be submitted for substantiation purposes:

A. **Design:** The following shall be in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), ^{A9}Subparagraph 1.05 D: ^{A9}

1. CPM diagram, with monthly updates.
2. Descriptive literature.
3. Drawings.
4. Protection methods for corrosion, ESD, fungus/humidity, thermal, and vibration.
5. Specifications.
6. Any other data required for review.

B. **Re-submittals Just Prior to Purchasing Materials:** All items in A. above that have changed from original submittal shall be resubmitted in a Design Conference in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), ^{A9}Paragraph ^{A9} 1.05.

C. **Upon Receipt of Shipped Items in Panama:**

1. Packing lists.

D. **Prior to Issuance of Taking Over Certificate:**

1. As-built drawings.

1.06 QUALITY ASSURANCE: Shall include the following in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), ^{A9}Paragraph ^{A9} 1.06:

- A. Factory Quality Control Tests (FQCT).
- B. Warranty.

END OF SECTION