PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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PUBLISHING HISTORY

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>September 2003</td>
<td>Issued</td>
</tr>
<tr>
<td>July 2009</td>
<td>Complete Revision</td>
</tr>
<tr>
<td>December 2014</td>
<td>Complete Revision</td>
</tr>
<tr>
<td>March 2020</td>
<td>Revision</td>
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</tbody>
</table>

Not printed with State funds
# PIP PCSCP001
## Control Panels Specification

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## Data Form

PCSCP01-D – Control Panels Data Sheet
1. **Scope**

This Practice describes the requirements for the design, fabrication, assembly, inspection and testing, and shipment of custom steel instrument control panels. There are occasional cases where other material may be required. This does not cover the fabrication using alternate materials.

2. **References**

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 **Process Industry Practices (PIP)**

- PCCEL001 - *Instrumentation Electrical Requirements*

2.2 **Industry Codes and Standards**

- American Welding Society (AWS)
  - D1.1 - *Structural Welding Code-Steel*
- The International Society of Automation (ISA)
  - ISA-RP60.6 - *Nameplates, Labels and Tags for Control Centers*
- International Electrotechnical Commission (IEC)
  - IEC 61000-4-3 - *Electromagnetic Compatibility (EMC) Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
  - IEC 60079-2 Explosive atmospheres – Part 2: Equipment protection by pressurized enclosure “p”
  - IEC 60529 – Degrees of protection provided by enclosures (IP Code)
- National Fire Protection Association (NFPA)
  - NFPA 70 - *National Electrical Code (NEC)*
  - NFPA 79 - *Electrical Standard for Industrial Machinery*
  - NFPA 496 - *Standard for Purged and Pressurized Enclosures for Electrical Equipment*
- National Electrical Manufacturers Association (NEMA)
  - NEMA ICS 6 - *Industrial Control and Systems: Enclosures*
  - NEMA 250 - *Enclosures for Electrical Equipment (1000 Volts Maximum)*
  - UL 508A Standard for Industrial Control Panels

3. **Definitions**

*benchboard:* A desktop or writing surface

*control panel:* Cabinet or surface with any combination of instruments; switches, indicators, gauges, controllers, recorders, etc., that are mounted for easy access and ease of operation (e.g., panels in control rooms on which instruments are mounted and used in controlling a process)
owner: The party who owns the facility wherein the control panel will be used

purchaser: The party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.

rub rail: A metal trim piece on the outside edge of a benchboard to protect the edge of the surface from damage

subpanel: A panel mounted inside a control panel that supports internally installed equipment

supplier: The party responsible for providing an assembled control panel

4. Requirements

4.1 General

4.1.1 All exceptions to this Practice shall be documented and submitted at the time of bid. Exceptions submitted after contract award may be rejected at the purchaser’s discretion, requiring full compliance with the contract documents without additional cost to the purchaser.

4.1.2 Control panels shall be complete assemblies, provided in accordance with purchaser’s PIP PCSCP001-D Data Sheet, and ready for installation on floors, walls, structural supports, or sills as specified by purchaser.

4.1.3 For control panels required to be shipped in sections, the size and makeup of the shipping assemblies shall be approved by the purchaser.

4.1.4 Panels shall be drilled and cut as required for installation, and provided with necessary mounting hardware.

4.1.5 Equipment shall be provided and installed in the control panel as specified on purchasers PIP PCSCP001-D Data Sheet.

4.1.6 Equipment and miscellaneous devices specified shall be mounted on or within the control panels in accordance with the drawings specified on purchaser’s PIP PCSCP001-D Data Sheet.

4.1.7 Drilling, cutouts, and connections shall be provided as required for equipment specified on purchaser’s PIP PCSCP001-D Data Sheet for field mounting by others.

4.1.8 Purchaser shall approve substitutions of control panel equipment items.

4.1.9 Equipment mounted on the rear of open panels or within control panels shall be easily accessible.

4.1.10 Each item of equipment, whether front or rear mounted, shall be readily removable without removal of other items.

4.1.11 Purchaser shall approve mounting equipment on panel doors.

4.1.12 All references to "steel" should have a purchaser specification of type (alloy). i.e., 304, 316, 4130, 4310, carbon, etc to remove ambiguity.
4.2 Mechanical Assembly

4.2.1 Panels and Supports

4.2.1.1 Detailed panel and framing designs shall be provided.

4.2.1.2 Panels, supporting structures, and panel-stiffening members shall be steel.

4.2.1.3 Connections

1. Welded construction shall be used, except that joints between panels and between shipping sections shall be bolted.

2. No welding, bolts, or bolt holes shall show from the front of the panels.

3. Corrosion-resisting bolts and hardware shall be used.

4. Bolts and hardware shall be furnished for field makeup of joints between sections at shipping breaks.

4.2.1.4 Framing

1. Internal framework shall be used as required to provide rigid, freestanding panels that are square and plumb.

2. Structural members shall be provided at the bottom for bolting or welding to owner’s floor or floor sills.

3. Stiffening members shall be used on the back of panels to prevent panel distortion.

4. Lifting eyes attached to a structural member capable of bearing the control panel load shall be provided for all floor-mounted (i.e., freestanding) panels and be aligned with center of gravity.

5. Duplex panels shall be provided with suitable cross bracing between front and rear panel frames.

6. If additional bracing for existing walls is required for open, single, freestanding panels, the purchaser shall furnish the bracing as shown on supplier’s drawings.

4.2.1.5 Plate

1. Bench and vertical sections of main control panels shall be constructed from cold-rolled steel plate 5 mm (3/16 inch) thick minimum.

2. Miscellaneous panels and sides, tops, doors, and other surfaces of main control panels shall be constructed from steel 3 mm (1/8 inch) thick minimum.

3. Steel shall be smooth, and shall be flat within a tolerance of 3 mm (1/8 inch) within 3 m (8 feet) of length.

4. Small, wall-mounted panels (i.e., less than 6,000 cm² [930 square inches] front surface area) shall be constructed from steel 2 mm (14 gauge) thick minimum.

5. Subpanels shall be constructed from steel with minimum thicknesses as follows:
a. If greater than 6,000 cm² (930 square inches) surface area, 3.5 mm (10 gauge).
b. If equal to or less than 6,000 cm² (930 square inches), 2.5 mm (12 gauge).
6. Corners shall be smoothly rounded and shall have a radius of curvature of 0.8 mm (1/32 inch) minimum.
7. Front panels shall be smooth, flat, and free from dents, cracks, or other imperfections.
8. Care shall be used to ensure that cutting and fabrication do not result in warping, buckling, or other distortion.
9. Consider accessibility issues of the location.

4.2.1.6 Openings
1. Cutouts for instruments shall be within the tolerances specified by the instrument manufacturers.
2. Unless performed on a special underwater jig to prevent buckling, torch-burned cutouts shall not be permitted.
3. If specified in the purchaser’s contract documents, enclosed panels shall be provided with removable panels, hinged panels, end closures, and doors for access to the interior.
4. Doors shall be 900 mm (36 inches) wide maximum.
5. Hinged panels and doors shall have three-point latches (except as permitted in Section 4.2.1.6.6) and shall have framing and stiffening members as required to ensure rigidity and freedom from distortion.
6. Two-point latches may be provided for small panels less than 6,000 cm² (930 square inches) front surface area.
7. Doors or hinged panels shall be the flush-gasketed type.
8. Screened or louvered openings with filter shall be provided for ventilation of enclosed panels as shown in purchaser’s contract documents.
9. Removable top panels for cable entry, if shown in purchaser’s contract documents, shall be gasketed.
10. Doors and hinged panels shall be equipped with mechanical locks and keyed as follows:
   a. Keys shall be removable in both the locked and unlocked positions.
   b. Each panel shall be keyed alike unless indicated by purchaser.
   c. Multiple doors on any one control panel assembly shall be keyed the same.
11. Drip edges above all enclosure openings, and rain and sun shields shall be considered for the front and back of panels installed in an outdoor environment.
4.2.1.7 Joints

1. Individual open panels shall be constructed and joined such that any panel may be removed and replaced without removal of, or interference with, adjacent panels.

2. If matching and lineup with existing equipment is specified in the contract documents, purchaser shall furnish details for the joints.

4.2.1.8 Benchboards

Control panels with benchboards shall have a stainless steel rub rail along the front edge as shown in the purchaser’s contract documents.

4.2.2 Space for Future Expansion

4.2.2.1 If space for future expansion is specified on the purchaser’s PIP PCSCP001-D Data Sheet, cutouts for the future equipment shall not be provided unless specifically authorized in the contract documents.

4.2.2.2 If cutouts are specified for future instruments, the cutouts shall be covered by removable steel plates 3 mm (1/8 inch) thick. The cover plates shall be finished and painted with the same paint as applied to the front panel.

4.2.2.3 Panel areas designated for future equipment shall be kept clear of stiffening members, rear-mounted equipment, wiring, and all other interferences.

4.2.2.4 If capability for future expansion is specified, panels shall be capable of extension at either end. If provided, end closures shall be suitable for future removal and relocation.

4.2.3 Welding

4.2.3.1 Welding procedures and welding procedure qualifications shall be in accordance with AWS D1.1 and shall be performed in accordance with supplier’s written procedures.

4.2.3.2 The qualification of the welders and welding operations shall be in accordance with AWS D1.1 and shall be subject to verification by the supplier.

4.2.3.3 Fabrication and verification inspections shall be in accordance with AWS D1.1, Section 7.8.

4.2.4 Surface Preparation and Painting

4.2.4.1 General

1. Outside color and paint type for control panels shall be in accordance with purchaser’s PIP PCSCP001-D Data Sheet.

2. All painting procedures shall be in accordance with the recommendations of the paint manufacturer.

3. Surfaces shall be prepared for painting by grinding welds smooth, removing scale, filling imperfections, etc.

4. All paint of any one color shall be from one lot.
5. If the finish is required to match an existing panel, a color chip of the proposed paint shall be submitted to the owner for approval.

6. One liter (quart) minimum of touch-up paint of each color used shall be provided.

   Comment: The amount of touch-up paint required should be determined based on the size and number of control panels.

7. All inside surfaces of the panels including welded seams and exposed surfaces of supporting and stiffening members, whether or not normally visible, shall be properly cleaned, primed, and painted.

8. Areas inaccessible to spray painting shall be brush-coated.

### 4.2.4.2 Primer Application

1. Suitable corrosion-resistant filling and priming coats shall be applied and sanded smooth.

2. Primer shall be as recommended by paint manufacturer.

### 4.2.4.3 Finish Coat Application

1. A minimum of primer, undercoat, and finishing coat of enamel or lacquer shall be applied.

   Comment: Electrostatically applied powder paint coatings that are then baked (e.g., polyester urethane) may be specified.

2. Interior cabinet color shall be white (preferred) or of a light color (e.g., light gray, off-white, etc.).

### 4.3 Electrical

#### 4.3.1 General

4.3.1.1 All wiring and devices shall be in accordance with PIP PCCEL001 and shall be in accordance with the IEC (NEC) for the classification shown on purchaser’s PIP PCSCP001-D Data Sheet, and with the electrical code of the locality in which the panels are to be installed.

4.3.1.2 Unless written approval for use of unapproved devices is received from the owner, all electrical materials (e.g., conduit, fittings, wireways, circuit breakers, etc.) shall be approved by Underwriters’ Laboratory (UL), Factory Mutual (FM), or owner-approved certification organization, or shall meet UL testing specifications if owner approval has not been obtained.

4.3.1.3 If specified on purchaser’s PIP PCSCP001-D Data Sheet, control panels shall be provided completely wired.

4.3.1.4 Wireways, terminal blocks with marking strips, and all necessary wire management devices shall be provided.

4.3.1.5 Control panels shall be designed for the environmental conditions of the installation location. If cooling or heating is specified on the purchaser’s PIP PCSCP001-D Data Sheet, the equipment provided shall be in
accordance with the specific NEMA rating required by *NEMA ICS 6* and *NEMA 250* or IEC 60529

4.3.1.6 Wiring installed across hinged panels shall be stranded flexible type, secured on each side of hinge, and formed with sufficient slack to minimize strand fatigue and breaking.

4.3.1.7 A nameplate showing the incoming power and Short Circuit Current Rating of the cabinet shall be affixed to the inside of the cabinet door.

4.3.1.8 Power for control shall be supplied from a distribution panel feeding only instrument and control logic circuits

### 4.3.2 Wire Tagging

4.3.2.1 Wire tagging shall be in accordance with owner’s requirements.

4.3.2.2 Each wire or cable within the control panel shall be permanently tagged and identified at both ends.

4.3.2.3 Wire markers, tubular heat shrink, or other permanently affixed markers shall be used to ensure permanence of the marking.

4.3.2.4 Wrap-around or self-adhesive markers shall not be permitted.

4.3.2.5 Machine printing shall be used for markers to ensure clarity.

4.3.2.6 Wire tagging shall be fully visible and shall not extend into the plastic wire duct. Additional spacing shall be provided between the wire duct and terminals if necessary to meet the visibility requirement.

### 4.3.3 Conductors

4.3.3.1 Conductors shall have sufficient ampacity, mechanical strength, thermal rating, and insulation characteristics to meet the circuit and installation requirements.

4.3.3.2 In selecting conductor size, consideration shall be given to derating factors used for ambient temperature correction and grouped conductors without maintained spacing.

4.3.3.3 Ungrounded conductors shall be insulated stranded copper.

4.3.3.4 Conductor insulation shall be selected from the followings types: MTW, THHN, THW, THWN, RHH, RHW, XHHW, and XHHW-2.

4.3.3.5 Minimum individual conductor sizes and insulation voltage ratings for the following systems shall be as shown

a. Control signals: 1 mm² (18 AWG), 300 V

   *Comment:* May not apply to manufacturers prefabricated cable assemblies.

b. Power circuits: 2.5 mm² (14 AWG), 600 V

c. Convenience outlets: 4 mm² (12 AWG), 600 V

d. Interior lighting: 2.5 mm² (14 AWG), 600 V for AC circuits

4.3.3.6 Conductor insulation shall be color coded in accordance with *NFPA 79.*
4.3.4 **External Wiring**

4.3.4.1 External wiring shall enter the control panel as shown in the purchaser’s contract documents.

4.3.4.2 Except for thermocouple extension cables and special cables, external wiring shall connect to terminal blocks.

4.3.4.3 Purchaser shall furnish the number, physical sizes, descriptions, and designations of all external cables for connection to terminal blocks.

4.3.4.4 Purchaser shall specify special cables.

4.3.4.5 Ample space shall be provided for the entrance of external cables into the panels and for routing the cables to terminating points within the panels.

4.3.5 **Thermocouple Cables**

4.3.5.1 Thermocouple extension cables shall be 1.5mm²(16 AWG), solid, insulated, ANSI color coded, and of the same material as the thermocouple.

4.3.5.2 Thermocouple cables from field locations shall terminate directly to individual temperature receiver instruments.

4.3.5.3 Separate wireways shall be provided for all thermocouple cables routed within panels and shall be spaced properly from other wireways.

4.3.5.4 Capacity of wireways shall be sufficient for all spare receiver points or 20 percent, whichever is greater.

4.3.5.5 Purchaser shall furnish and install all field-run thermocouple wiring at the installation location.

4.3.6 **Special Cables**

4.3.6.1 Special cables connect directly to panel-mounted instruments and devices without connection to terminal blocks and shall be provided and installed by others in the field.

4.3.6.2 Bulkhead connectors shall be provided for special cables entering environmentally controlled or classified area control panels.

4.3.6.3 The fabricator of the control panel shall provide adequate space and means of support for the cables.

4.3.6.4 The routing for special cables within the panels shall be separate from other cables or shall be as indicated on the drawings, including Ethernet cables directly connected to instruments.

4.3.7 **Terminal Blocks**

4.3.7.1 For all terminations, terminal block numbers and point identifications shall be permanently marked by marking strips on terminal strips. Identification shall be the terminal block numbers and point numbers shown on the wiring diagrams.

4.3.7.2 A sufficient number of spare terminal blocks shall be installed to provide 20 percent minimum unused terminal points of each kind.
4.3.7.3 Connections to panel-mounted equipment shall be made on one side of the terminal blocks, and two wires maximum shall be connected under a single terminal.

4.3.7.4 For rows having 48 terminals maximum, adjacent rows of terminal blocks shall have a clear, unused space between blocks of 150 mm (6 inches) minimum.

4.3.7.5 For rows having greater than 48 terminals, a proportionally greater space than specified in Section 4.3.7.4 shall be provided for wire routing.

4.3.7.6 Terminal blocks for transformer circuits and for 120 VAC and 125 VDC power supply circuits shall be configured as follows:
   a. Separate from each other and from terminal blocks for control wiring
   b. Of a type similar to control wiring terminal blocks
   c. Capable of accepting a 25 mm² (6 AWG) maximum wire size

4.3.7.7 Current transformer terminal blocks shall be the shorting type.

4.3.8 Internal Panel Wiring

4.3.8.1 Internal panel wiring shall be installed in a neat and orderly manner.

4.3.8.2 All DC, AC, serial communication and thermocouple wiring shall be routed in separate wireways to prevent signal interference.

4.3.8.3 If wire trough or gutter cannot be used, any two or more wires routed together shall be clamped or tied in straight lay bundles and fastened to the panel at intervals of 400 mm (15 inches) maximum.

4.3.8.4 Wire ties shall be nonmetallic.

4.3.8.5 Wiring shall be arranged to be readily accessible for inspection and maintenance.

4.3.8.6 The wiring arrangement shall not interfere with access to panel-mounted devices or spaces for future equipment.

4.3.8.7 Internal wiring shall be arranged to permit all corresponding external cables to terminate on the same vertical or horizontal row of terminal blocks. If possible, the conductors in each cable shall be terminated consecutively on the blocks.

4.3.8.8 Purchaser’s cables containing two or more conductors with the same wire number may be terminated on the same point, subject to the limitation of two wires maximum per terminal.

4.3.8.9 Wiring to control switches shall be provided with sufficient slack to permit physical removal of the switches for maintenance purposes without disconnecting any wiring.
4.3.8.10 Wiring between shipping sections shall be arranged to require a minimum of field wiring.

4.3.8.11 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

4.3.8.12 Shipment of any panel having shortages of equipment shall be approved in writing by the owner.

4.3.9 Overcurrent Protection

4.3.9.1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.

4.3.9.2 For circuit breaker and/or fused control circuits, routing of control wires shall avoid locating positive or line wires, and negative or neutral wires on adjacent points on a terminal block.

4.3.9.3 Individual fusing shall be provided on AC and DC power to instrument devices. The fuses shall be on the positive side of the circuit. These fuses shall be located adjacent to the terminal strips in the panel.

4.3.10 Ground Bus

4.3.10.1 Safety Ground (Grounded)

1. If specified on the purchaser’s PIP PCSCP001-D Data Sheet, a copper ground bus shall be installed at the bottom and across the full width of each panel.

2. The ground bus shall have a minimum cross section size of 6 mm (1/4 inch) by 25 mm (1 inch).

3. The ground bus shall be drilled at each end for extension.

4. A suitable indent/compression-type lug shall be bolted to the bus near each end for the purchaser’s 35mm² (2 AWG) ground cable.

5. A flexible strap or bar link, equivalent to 6-mm (1/4-inch) by 25-mm (1-inch) bar, shall be provided at each shipping split.

6. The ground bus shall be connected to all the panel steel (i.e., non-insulated).

4.3.10.2 Instrument Ground System – IGS (Isolated)

1. If specified on the purchaser’s PIP PCSCP001-D Data Sheet, a second similar ground bus shall be installed above the bus specified in Section 4.3.10.1.

2. The second ground bus shall be insulated from all the panel steel. Ensure grounds are clearly labeled.

3. If instrument loop diagrams require signal points or cable shields to be grounded, or if elementary diagrams require special grounding, the IGS bus shall be used.
4. All other grounds shall be connected to the safety ground bus.

### 4.3.11 Plug-in Strips

- **4.3.11.1** Polarized, grounded, 120-VAC plug-in strips shall be provided where required.
- **4.3.11.2** The plug-in strips shall provide for the number of supply circuits specified on purchaser’s *PIP PCSCP001-D* Data Sheet.
- **4.3.11.3** Power cords with polarized, grounded, plugs and flame-resistant insulation or jacket shall be provided for connection of instruments and devices to the plug-in strips.
- **4.3.11.4** The plug-in strips shall be located inside the control panel immediately adjacent to the equipment served.

### 4.3.12 Internal Lighting

- **4.3.12.1** If specified on purchaser’s *PIP PCSCP001-D* Data Sheet, internal lighting shall be provided for enclosed panels.
- **4.3.12.2** Lighting fixtures shall not be greater than 1.5 m (5 feet) apart along the panels.
- **4.3.12.3** Lamp fixtures shall be protected from accidental contact with personnel.
- **4.3.12.4** For panels equal to or greater than 1.5 m (5 feet) long, a switch shall be installed at each end.
- **4.3.12.5** For panels less than 1.5 m (5 feet) long, a switch shall be installed at one end.
- **4.3.12.6** LED lighting fixtures may be substituted for incandescent or fluorescent lights.
- **4.3.12.7** Difficulties resulting from electrical noise generated by fluorescent lamps shall be corrected. Consider replacing with LED.
- **4.3.12.8** Ensure lighting meets electrical area classification and temperature requirements.

### 4.3.13 Convenience Outlets

- **4.3.13.1** If specified on purchaser’s *PIP PCSCP001-D* Data Sheet, duplex 120-VAC convenience outlets shall be provided.
- **4.3.13.2** Convenience outlets shall be fed from Class A rated GFCI breakers.
- **4.3.13.3** Convenience outlets shall be spaced approximately 1.5 m (5 feet) apart and located in the rear, near the bottom of vertical panels, and under any benchboard sections.
- **4.3.13.4** Power wiring to lighting and convenience outlets shall be routed and terminated on terminal blocks for the receipt of owner’s 120-VAC power source.
- **4.3.13.5** Instrument power shall be fed from a separate panel from convenience outlet.
4.3.14 Purging and Pressurization Requirements

4.3.14.1 If specified on purchaser’s PIP PCSCP001-D Data Sheet, panel shall be provided with purging, pressurization, ventilation, or dilution.

4.3.14.2 The control panel shall be designed for pressurization or type of purging (i.e., X, Y, or Z) in accordance with NFPA 496 or IEC 60079-2.

4.3.14.3 The purging or pressurization system shall include warning nameplates, instrumentation, and alarms.

4.4 Pneumatic

The design of pneumatic control panel systems shall be in accordance with owner specifications and requirements.

4.5 Nameplates

4.5.1 Unless otherwise specified on purchaser’s PIP PCSCP001-D Data Sheet, engraved nameplates of black lettering on white background shall be provided.

4.5.2 Nameplates shall be located on panels where specified in the contract documents.

4.5.3 Unless otherwise specified on purchaser’s PIP PCSCP001-D Data Sheet, nameplate sizes and the size and style of lettering shall be in accordance with ISA RP-60.6.

4.5.4 A complete list of designations for engraving shall be provided by the purchaser.

4.5.5 Double-face tape shall not be used for affixing nameplates to panel.

4.6 Inspection and Tests

4.6.1 In-Production Control Testing

4.6.1.1 Standard test procedures shall be used to progressively check the assembly and wiring systems of control panels during fabrication and assembly.

4.6.1.2 The in-production test procedures shall be submitted to the purchaser for approval.

4.6.2 Testing

4.6.2.1 General

1. The tests described in Section 4.6.2 shall be performed after the complete assembly of each panel.

2. All test procedures shall be submitted to the purchaser for approval.

3. The test procedures shall include the acceptance criteria for each test performed.

4.6.2.2 Wiring Check

1. A point-to-point check with wiring diagrams shall be performed.

2. Wire and terminal block markings shall be verified.

3. All connections shall be verified to be correct and tight.
4. All wiring terminations shall be verified to be connected to the correct device terminals in accordance with the approved wiring diagrams.

5. An electrical continuity test shall be performed on each conductor.

6. Nonconformance to the contract documents shall be corrected.

4.6.2.3 Resistance Tests

Low-voltage wiring shall be tested with an ohmmeter to ensure that no unintended grounds exist.

4.6.2.4 Functional Tests

1. Unless otherwise specified in the contract documents, functional tests shall be performed to ensure fabrication quality.

2. Functional tests shall confirm the following:
   a. Instruments are functioning individually within design parameters.
   b. Instrument loops are functioning within design parameters.
   c. Loop alarm or control output signals are within design parameters.

3. Functional tests shall be as complete as possible.

4. If all components of a loop are not available for testing, the functions of the unavailable components shall be simulated to permit the performance of as realistic a test as possible.

5. All devices shall be protected from exposure to overvoltage or other hazards during testing.

6. Testing shall include confirmation of programming to ensure proper functionality.

7. Testing shall ensure compliance with the radio frequency interference (RFI) requirements of IEC 61000-4-3, Level 3, to ensure the cabinet and its electronic equipment shall perform within normal limits without loss of function or degradation of performance when subjected to radiated electromagnetic fields.

8. If individual defects are discovered in equipment provided by other manufacturers, the purchaser shall be notified immediately.

4.6.2.5 Retesting

If the panel is modified after tests have been performed, tests shall be repeated.

4.6.3 Inspection

The purchaser shall be notified before proceeding beyond the following mandatory hold points:

a. Unless waived by purchaser, witnessing of the following tests:
(1) Wiring tests
(2) Functional tests

b. Packaging and preparation for shipping

4.7 Release for Shipment

4.7.1 Component Identification

All devices and components mounted in the rear or interior of the panels and the back of all front-mounted equipment shall be permanently marked with 6-mm (1/4-inch)-high lettering, as follows:

1. Marking shall be conspicuously placed to minimize the possibility of incorrect identification.
2. Markings shall not be placed on removable covers or on parts that could be interchanged during inspection, testing, or maintenance procedures.
3. Instructions for identifying designations shall be provided by the purchaser.

4.7.2 Preparation for Shipment

4.7.2.1 The finish of panels shall be protected in the best practical manner against abrasion or other damage during preparation for shipment and while in transit. The following requirements shall apply regarding the protection:

a. Sprayed-on coatings shall not be permitted.
b. Sheet plastic may be used for protection of paint against entrance of moisture.
c. Unless internal moisture protection is provided, tight-fitting polyethylene shall not be permitted.

4.7.2.2 Matching ends of shipping splits shall be plainly identified on the equipment and on the drawings. Tubing and electrical connections at shipping splits shall be tagged for field identification.

4.7.2.3 Moving parts shall be firmly blocked on relays and instruments.

4.7.2.4 Glass or plastic doors and faces shall be adequately padded to prevent damage during shipment.

4.7.2.5 If components for an instrument are shipped unassembled, each separate component shall be subject to the tagging requirements stated in Section 4.7.1.

4.7.2.6 Instrument doors and hinged covers shall be secured closed.

4.7.2.7 Tape shall not be applied directly to plastic windows.

4.7.2.8 Doors shall be locked, and arrangements for key shipment shall be confirmed with owner.

4.7.2.9 Documents, tags, or instructions necessary for proper unpacking and protection after unpacking shall be enclosed. The location of these documents shall be marked on outer covering of shipping container.
4.7.2.10 If approved by purchaser, instruments or devices considered incapable of safely withstanding handling and shipment while panel mounted shall be removed and shipped separately in their original shipping containers.

4.8 Documentation

4.8.1 Content

4.8.1.1 Documentation of the type and quantity shown in Table 1 and the purchaser’s PIP PCSCP001-D Data Sheet shall be provided.

4.8.1.2 Installation diagram shall be provided depicting the following:
   a. Panel layout and dimensions
   b. Raceway and piping entries
   c. Panel mounting
   d. Position of electrical supply
   e. Clearances required for maintenance of the panel

4.8.1.3 Interconnection diagram shall be provided for multisection control panels.

4.8.1.4 Schematic wiring drawings shall be provided for all control circuits including alarm, interlock, emergency stop, speed control, and other similar circuits and include the following information as a minimum:
   a. Operation and contact arrangement of control relays, handswitches, alarm switches, and similar devices
   b. Complete schematic diagram with item numbers corresponding to bill of materials
   c. Cross reference to bill of materials and other drawings

4.8.1.5 All engineering data and drawings provided for the equipment shall represent the actual equipment specified and ordered. Generic data and drawings shall not be permitted unless revised to show only the equipment provided.

4.8.2 Submittals

4.8.2.1 Drawings and data shall be provided in accordance with Table 1.

4.8.2.2 Unless otherwise specified on the purchaser’s PIP PCSCP001-D Data Sheet, documentation shall be furnished in purchaser approved editable electronic format.

4.8.2.3 One set of editable electronic native files and the specified number of copies of all documentation and operating manuals as specified on the purchaser’s PIP PCSCP001-D Data Sheet shall be provided.

4.8.2.4 Unless otherwise specified on the purchaser’s PIP PCSCP001-D Data Sheet, format for reproducible drawings shall be CAD convertible .dxf electronic format.
### Table 1 - Documentation Requirements

<table>
<thead>
<tr>
<th>A With Bid</th>
<th>B For Review</th>
<th>C Final Certified</th>
<th>D As Built</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>X</td>
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<td>X</td>
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<td>Detailed bill of material</td>
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<tr>
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<td>General layout of control panel, showing all dimensions, weights, support locations, lifting provisions, outline drawings, conduit entries, plan and elevation views showing the final assembled configuration</td>
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<tr>
<td>X</td>
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<td>Shipping description (number of sections, protection)</td>
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<td>Assembly, inspection, and testing guide</td>
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<td>X</td>
<td>X</td>
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<td>Field and Interconnection wiring diagrams</td>
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<td>Control schematic diagrams</td>
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<td>Lighting, power, and grounding schematic diagrams</td>
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<td>Certified test reports</td>
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<tr>
<td>X (1)</td>
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<td>Installation, operation, and maintenance manual(s)</td>
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<td>X</td>
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<td>Final as-built drawings</td>
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<td>Recommended priced spare parts list</td>
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</table>

A. These documents shall be provided with the proposal.

B. These documents shall be provided for the purchaser’s review and authorization to proceed before fabrication.

C. These documents shall be provided as part of the final certified document submittal.
   (1) Equipment shall be shipped with one set of installation, operation, and maintenance manuals.

D. Final as-built documents shall be provided within 2 weeks following shipment.
**GENERAL (4.1):**
- TYPE: [ ] CONVENTIONAL [ ] OTHER:
- SPACE REQUIRED FOR FUTURE EXPANSION (4.2.2) [ ]
- TO BE SUPPLIED COMPLETELY WIRED (4.3.3) [ ]

**ENVIRONMENTAL:**
- [ ] INDOOR [ ] OUTDOOR [ ] UNDER ROOF [ ] INDOOR CONTROLLED

**DRAWING REFERENCES (4.1.6):**
- FOR FRONT PANEL LAYOUT, SEE: 
- FOR WIRING, SEE: 
- FOR PIPING, SEE: 

**CONSTRUCTION (4.2):**
- DEPTH OF PANEL: [ ] 30 INCHES [ ] OTHER:
- NEMA/IEC CLASSIFICATION: 
- SUN SHIELD [ ] WEATHER HOOD
- PURGED (4.3.14): [ ] TYPE:
- PANEL DOORS: [ ] REAR [ ] FRONT
- MATERIAL: [ ] STEEL [ ] OTHER:
- CABLE ENTRY: [ ] TOP [ ] BOTTOM [ ] SIDE
- CABLE ENTRY SEALING METHOD (4.3.14): 
- DRAWING POCKET: 

**PAINTING (4.2.4):**
- OUTSIDE COLOR: 
- PAINT TYPE: 

**NAMEPLATES (4.5):**
- COLOR:
  - LETTERS: [ ] BLACK [ ] OTHER:
  - BACKGROUND: [ ] WHITE [ ] OTHER:
  - MATERIAL: [ ] PLASTIC [ ] OTHER:
- SIZE:
- FOR ENGRAVING, SEE: 

**DATA SHEET**

<table>
<thead>
<tr>
<th>NO.</th>
<th>DATE</th>
<th>REVISION DESCRIPTION</th>
<th>BY</th>
<th>APVD.</th>
</tr>
</thead>
</table>

**FACILITY NAME/LOCATION**

---

**ITEM NAME:** 

---

**PURCHASER/LOCATION:** 

---

**ITEM TAG NO.:** 

---

**SERVICE:** 

---

**PURCHASE ORDER NO.:** 

---

**UNIT:** 

---

**SUPPLIER/LOCATION:** 

---

**P&ID NO.:** 

---

**SUPPLIER ORDER/SERIAL NOS.:** 

---

**ELECTRICAL (4.3):**
- ELECTRICAL AREA CLASSIFICATION:
  - [ ] NON-CLASSIFIED [ ] CLASSIFIED
  - CLASS: 
  - GROUP: 
  - DIV.: 
- TEMPERATURE RATING: 
- ZONE RATING: 
- POWER SUPPLY: VOLTS: HZ
- PROVIDE PLUG-IN STRIPS FOR SUPPLY CIRCUITS (4.3.11.2)
- RACEWAY TYPE: [ ] EMT [ ] FLEX [ ] RIGID [ ] WIREWAY [ ] OTHER:
- COOLING REQUIRED (4.3.1.5): [ ] TYPE:
- HEATING REQUIRED (4.3.1.5): [ ] TYPE:
- PANEL LIGHTING (4.3.12.1): [ ] INSIDE [ ] OUTSIDE
- CONVENIENCE RECEPTACLES (4.3.13.1)
- INSTRUMENT GROUND SYSTEM BUS BAR (4.3.10.1):
- INSTRUMENT GROUND SYSTEM BUS BAR (4.3.10.2)

**DOCUMENTATION (4.8):**
- COMPLETE SET OF DRAWINGS IN THE DRAWING POCKET OF THE CONTROL PANEL DOOR
- EDITABLE ELECTRONIC DOCUMENT FORMAT
  - [ ] DXF [ ] OTHER:
- MANUFACTURER TO PROVIDE:
  - REPRODUCIBLE PLUS:
  - COPIES OF ALL DOCUMENTATION PLUS:
  - COPIES OF OPERATING MANUALS

---

**NAMEPLATE FASTENING:**
- STAINLESS STEEL SCREWS [ ] SUITABLE PERMANENT ADHESIVE

---

**NO. DATE REVISION DESCRIPTION BY APVD.**

---

**CONTROL PANELS**

---

**MARCH 2020**
## CONTROL PANEL EQUIPMENT LIST

**CONTROL PANEL TAG NUMBER:**

<table>
<thead>
<tr>
<th>REV.</th>
<th>QTY.</th>
<th>DATA SHEET REF.</th>
<th>MFG. &amp; MODEL NO.</th>
<th>P. O. NO.</th>
<th>MOUNTED ON FRONT (F) OR REAR (R) OF PANEL</th>
<th>SUPPLIED BY PANEL SUPPLIER (S) OR BY OTHERS (O)</th>
<th>MOUNTED BY PANEL SUPPLIER (S) OR BY OTHERS (O)</th>
<th>WIRED AND/OR PIPED BY PANEL SUPPLIER (S) OR BY OTHERS (O)</th>
<th>DESCRIPTION AND TAG NUMBERS</th>
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