# Part 1. GENERAL

## General

### The objective of this section is to provide guidance to the contractor for custom-built panels for new facilities, upgrades and expansion of existing water and wastewater infrastructure.

### Control panels (CP) house the Programmable Automation Controller (PAC) field controller for remote facilities or process area control. Requirements apply to field panels, area control panels, PAC panels and all other panels used to house control and monitoring equipment.

### This section is a specification for custom-built panels. Vendor supplied panels provided as part of a packaged system are also to conform to the requirements identified within this specification.

### Contractor shall provide all control panels, complete and operable, in accordance with the contract documents.

### Use enclosures which conform to the requirements of the NEMA/EEMAC type specified or shown on panel drawings and requirements in the enclosures section of this document.

### Ensure that the panels selected are large enough to contain all required equipment, with 25% of the space for expansion of the PAC I/O including terminals and power wiring.

### Follow ISA-RP60.6-1984, Recommended Practice for Nameplates, Labels and Tags for Control Centres where specifications do not identify requirements.

### No process related instruments are to be mounted in control panels. Instruments to be wall mounted.

### All panels to have minimum depth of 300mm (12”).

### No components are to be mounted on the sides of the panel.

### Once panel FAT has been completed, control panels are not to be modified unless modifications are approved by the Region.

### Outdoor panels are to be double door factory insulated by the enclosure manufacturer with 300mm (12”) high mounting feet, mounted on a concrete pad. PAC control panel to be mounted in a panel installed within the double door enclosure.

### Where conduit runs will pass through a concrete pad, the Consultant is to review all conduit runs before the concrete is poured. The contractor will adjust all conduit runs as required by the Consultant at no additional cost to the project.

### All conduit entries are to be at the bottom of the panel.

### Panel shop must be CSA C22.2 No.14 (Industrial Control equipment) certified.

### Panel shop is responsible for complete panel factory acceptance testing including all necessary software and documentation required for the successful completion of the test.

## Panel Shops

### Recommended Panel Shop Subcontractors:

#### 1149855 Ontario Inc., o/a Procon Niagara.

#### ACP Solutions Inc.

#### Real Time Systems Inc.

#### Selectra Inc.

#### Summa Engineering Limited

#### Or Equivalent.

## Coordination

### Coordinate with Division 16.

## Shop Drawings

### Comply with the requirements of Division 1.

### Provide internal and external layout scale drawings as part of shop drawings showing exact dimensions of the equipment provided.

#### Panel drawings included in the contract documents are based on the Region of York standard panel drawings. CAD files of these drawings will be provided to the panel shop.

#### Panel shop drawings are to utilize the Region of York standard panel drawings CAD files. The actual I/O points are to be modified but the drawing layouts, PAC card quantity and type, bill of materials and sheet numbering are not to be modified unless approved by the Region.

#### The internal and external layout drawings included in the Contract Drawings are based on typical equipment and are not to be used for fabrication.

#### The Consultant may increase panel size during shop drawing review.

### Provide calculations for sizing the UPS cooling fans, air conditioners, heaters and heat exchangers.

### Provide colour chart for selection of the exterior colour where other than the standard colour is specified.

### Provide one additional set of panel "As-Built" drawings and all PAC documents to place in the door pocket. Provide electronic copies (CAD and PDF format) of “As-Built” drawings on a CD in the door pocket.

### Provide a schedule of all nameplates, labels and tags.

### Specify precision of any resistors on shop drawings.

### Submit catalog cut sheets/datasheets of all control equipment including enclosures, over current devices, relays, pilot devices, terminations, and wire troughs.

## Quality Assurance

### Comply with the requirements of Division 13 and Division 16.

### Test individual components, individual control panels and control panel assembly at manufacturer’s plant.

### The Consultant and Region’s Representative will witness Panel Factory Acceptance Tests and inspect completed assembly. Advise the Consultant in writing ten (10) working days minimum prior to carrying out tests.

### Control Panel(s) shall be factory assembled and tested for sequence of operation prior to jobsite delivery and shall have passed the Panel Factory Acceptance Test (FAT).

### Submit for approval and follow the Region’s Panel Factory Acceptance Test Document as outlined in Section 13311.

### Shop tests to include, but not limited to:

#### Standard production tests.

#### Interchangeability of similar items of equal rating.

#### Mechanical and electrical operation of switches, contactors, interlocks, draw-out mechanism, auxiliary devices and manual devices.

#### Functional tests on components and circuits. Where necessary, suitably simulate external devices.

#### Testing and calibration of metering and protection devices.

#### Test control panels as complete assembly. Separate testing of individual components only is not acceptable.

#### Prior to shipment, submit to the Consultant six (6) copies of certified final test results.

# products

## Construction

### Panels must carry CSA/UL label and be tested in accordance with CSA requirements.

### Approved manufacturers: Refer to the Bill of Materials on the panel drawings.

### Panel backplate must be unistrut mounted such that the backplate depth can be adjusted in the field. There must be enough slack in any cabling going to the panel door to allow for the backplate to be adjusted.

### Provide 304 SS screws, bolts, fasteners and wall spacers.

### Cut, punch, or drill cut-outs for face-of-panel mounted instruments and smoothly finish with rounded edges, maintaining the NEMA/EEMAC rating.

### Use panel fabrication techniques that allow for removal and maintenance of all equipment after installation.

### Install door mounted equipment flush mounted and properly sealed, maintaining NEMA/EEMAC rating. Internal mounted panels to be at least 1.6 mm sheet steel, uniform size, with spare removable panels for future use.

### Fabricate panels, install instruments, plumb and wire in the factory. Arrange wiring and ducts in the control panel to match floor and/or ceiling conduits. Test wiring and plumbing prior to shipment.

### Locate all face-of-panel mounted devices higher than 0.8 m and lower than 2.0 m from the floor.

#### Arrange status lights above corresponding pushbuttons or selector switches.

#### Arrange digital and analog indicators above corresponding controls.

#### Centreline of OITs are to be mounted 1.7m off the floor.

### Arrange backplate mounted devices in a neat and orderly fashion. Allow 25% space for future additions. Use mounting plate for mounting all components.

### Environmental Protection:

#### Provide internal condensation protection on all panels.

#### Provide freezing protection with thermostat control on outdoor panels.

#### Provide louvers, forced ventilation, or air conditioners as required to prevent temperature build-up and protect equipment, with ambient temperatures of up to 50oC. Provide louvers, forced ventilation, or air conditioners as required to limit temperature build-up to a maximum of 40oC to protect equipment.

#### Provide HEPA air filter to reduce dust on electrical equipment.

#### Provide clean instrument air purging arrangement with filter regulator and shut-off valve, as indicated in schedule or panel drawing.

### No screws or bolt holes through the panel are permitted, only stud welding is permitted.

### Indoor floor mount panels to be installed on a 100mm plinth.

### All instruments/equipment mounted outdoors shall be installed in enclosures rated for NEMA 4X service, with heaters, and be suitable for operating in temperatures from -30 to +50oC.

## All Enclosures

### Provide enclosures which conform to the requirements of the NEMA type specified in the schedule or panel drawing.

#### No panels to be placed in Class 1/ Division 1 hazardous locations.

#### Panels to be NEMA 12 type for electrical rooms, NEMA 4/4X for damp areas or process areas.

#### Outdoor panels to be stainless steel NEMA 4X.

### Paint steel enclosures. Prime with one coat and finish with two coats of factory finished, epoxy-based paint. Paint the exterior colour ANSI/ASA61 – standard gray, if not otherwise specified. Panel backplate to be painted white. Stainless steel panels are not to be painted.

### Provide each enclosure with full height, fully gasketed access doors where shown.

#### Construction: 3.43mm (10 gauge) thickness, single piece with edges turned back and rounded for rigidity

#### Latches: Three-point latching mechanism only. Screw clamps are not acceptable.

#### Hinge: Continuous piano hinge with removable stainless steel pin

#### Gasket: Secured resistant neoprene gasket.

#### Door handle: Automotive type handle with latch padlock hasp. Keyed handles are not acceptable.

### Provide a minimum 250 mm wide print pocket within each enclosure.

### Fold down laptop tray to be provided mounted on outside of control panel door at height 1.0m off the finished floor. Laptop tray to be stud welded to the door, maintaining NEMA/EEMAC rating. Laptop tray and combination 120VAC/RJ45 receptacle to be located on same door.

### Use 304SS screws, bolts, fasteners and wall spacers.

### Control Panel(s) voltage to be 120VAC maximum.

### All internal wiring shall be factory-installed and shall be contained in PVC raceways having removable covers. Wiring to door-mounted devices shall be extra flexible, wrapped in plastic spiral wrap, and be anchored to doors using wire anchors epoxyed in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals. Follow manufacturer installation recommendations.

## PAC Panel Enclosures

### Refer to the Bill of Materials on the panel drawings for specific applicable panel type.

## Free-Standing Enclosures - Steel

### Fabricate enclosures from sheet steel.

#### Provide single door enclosures with 2.67mm (12 gauge) sides top, and back.

#### Provide double door enclosure with a 3.43mm (10 gauge) back with 2.67mm (12-gauge) top and sides.

#### Provide multi-door enclosures with 3.43 mm (10 gauge) sides, top, and back.

### Grind and sand exterior welds to a smooth finish free of burrs, mill scale, rust, grease, and oil. Make surfaces free of ridges, nuts, bolt heads, and similar protrusions. Fill all imperfections and sand smooth.

### Internally, supply the enclosures with a structural steel framework or bracing for equipment support and enclosure bracing. Permit lifting without racking or distortion. Provide removable lifting rings designed to facilitate rigging and lifting of the enclosure during installation. Provide steel plugs to fill the lifting ring holes after installation is complete.

### Provide enclosures with louvers as required. Except for enclosures mounted with their backs directly adjacent to a wall, place louvers in the rear of the enclosure, top and bottom. For enclosures mounted with their backs directly adjacent to a wall, place louvers on the sides.

### Construct a 100 mm high concrete housekeeping pad, with dimensions as specified or noted in the schedule or panel drawing on which to install floor mounted control panels.

### Manufacturer: Hammond Manufacturing Co. Ltd., Hoffman Enclosures Inc., EXM (Eurobex), or Equivalent.

## Free-Standing Outdoor Enclosures – Stainless Steel

### Adhere to requirements of steel panels except that exterior painting is not required. Finish exterior in brushed or matte.

### Internally, supply the enclosures with a structural steel framework or bracing for equipment support and enclosure bracing. Permit lifting without racking or distortion. Provide removable lifting rings designed to facilitate rigging and lifting of the enclosure during installation. Provide steel plugs to fill the lifting ring holes after installation is complete.

### Construct a pad, with dimensions as specified or noted in the schedule or panel drawing.

### Outdoor panels are to be mounted on 304mm high mounting feet.

### Panels are to be constructed with drip shield, and factory insulated. Drip shields not factory installed are unacceptable.

### Outdoor panels are to be fabricated and shipped from the factory with insulation installed.

### Conduit entries are to be from the bottom of the panel only. Side, back, and top entries are not allowed.

### Manufacturer: Hammond Manufacturing Co. Ltd., Hoffman Enclosures Inc., EXM (Eurobex), or Equivalent.

## Wall-Mount Enclosures - Steel

### In addition to the NEMA standard, meet the following requirements:

#### 1.91mm (14-gauge) minimum metal thickness.

#### Doors shall be 2.67mm (12-gauge) minimum thickness, rubber-gasketed with continuous hinge.

### Manufacturer: Hammond Manufacturing Co. Ltd., Hoffman Enclosures Inc., EXM (Eurobex), or Equivalent.

## Wall-Mount Enclosures - Fiberglass

### In addition to the NEMA standards, meet the following requirements:

#### Hinge doors on the left side and equip with quick release latches.

#### Provide fibreglass reinforced polyester latches and hinges.

### Manufacturer: Hammond Manufacturing Co. Ltd., Hoffman Enclosures Inc., EXM (Eurobex), or Equivalent.

## Enclosures – Stainless Steel

### Adhere to requirements of steel panels except that exterior painting is not required. Finish exterior in brushed or matte.

### Manufacturer: Hammond Manufacturing Co. Ltd., Hoffman Enclosures Inc., EXM (Eurobex), or Equivalent.

## Enclosure Accessories

### Louvers

#### Include washable aluminum air filters with louvers used for ventilation where required by the contract drawings.

### Fans

#### Provide forced ventilation fans, where used, with washable, aluminum air filters and finger guards, where required by the Contract Drawings.

#### Operate fan motors on 115VAC, 60 Hz power. Include thermal protection. Use motors rated for 20,000 hours of continuous operations without lubrication or service.

#### Provide exhaust grilles with filters where required by the Contract Drawings.

#### Provide one (1) can of filter spray adhesive for every enclosure.

### Panel Heaters

#### Provide thermostatically controlled fan heaters for freeze protection down to –30oC for all outdoor panels or as specified in the schedule or panel drawing. Size heaters to maintain the inside temperature above 4oC

#### Meet the following requirements:

##### Power: 115VAC, 60 Hz.

##### Minimum Rating:

###### 100 Watts for panels smaller than 25 cm by 41 cm

###### 150 Watts for panels smaller than 31 cm by 62 cm

###### 250 watts for panels smaller than 46 cm by 76 cm

###### 500 Watts for panels smaller than 61 cm by 122 cm

## Panel Service Power

### Provide for feeder circuit conduit entry and provide a terminal board for termination of the wires.

### Place no more than five (5) devices on any single circuit, as required. Avoid common mode power loss. Subject to project review.

### Where multiple units perform parallel operations, do not group all devices on the same branch circuit. This will prevent failure of any single branch circuit from shutting down the entire operation.

### Do not exceed 15A continuous on the branch circuit.

### Protect power supply from damage due to external failure.

### Manufacturer: Refer to the Bill of Materials on panel drawings.

## Electrical

### Provide two 120 VAC/24 VDC (5A min.) power supplies, complete with fault contacts. Size so that one power supply can handle the total 24 VDC load. Provide one protection diode redundancy module. Provide fused terminal blocks to distribute the 24 VDC power. Connect DC power supply fault contacts in series and wire to PAC as a digital input.

### Main electrical feed circuit breaker, and all breakers 10A or greater to be primary breakers, not supplemental breakers.

### Identification: Identify switches, circuit breakers, components, terminal blocks, power supplies, relays, wiring and similar devices. Comply with Division 13 & Division 16.

### Warning signs: Identify sources of supply. Comply with Division 16.

## Grounding

### Comply with Division 16.

### Provide two (2) separate ground bars, one for instrument grounding (ie 4-20 mA cable shields etc.) and one for control circuit grounding (ie. case grounds, control circuits, etc.). Install grounding so as to keep two grounds isolated (separate). The instrument ground bar is to be isolated from the panel backplate. Ground conductors are to be number 6 AWG, coloured green, with white stripes used for instrument grounds and dark green for control circuit grounds.

### Ground: Full length tin plated copper ground bus or ground stud with tin plated copper lugs at ends, suitable for minimum number 6 AWG ground wire.

### Provide grounding lugs for connection to the external grounding system.

### Provide CSA 13.3 mm2 (AWG 16) size stranded copper grounding for DC signals.

### Connect the ground buses with a removable cross connector located near the panel ground.

## Wiring

### Size and install all wire and cable in accordance with CSA, Ontario Electrical Safety Code, IEEE and other applicable electrical safety codes (latest versions). Comply with Division 16.

### Terminate all internal panel wiring to external devices at the terminal strips. Connect all field wiring to one side of the terminal strip. All panel wiring to be connected to the opposite side. Arrange terminal strip for field wire connects in consecutive order.

### Provide continuous wire between the power supply point and the load point without splices.

### Use flexible, stranded, copper TEW wiring. Run wires in continuous lengths from terminal to terminal. Splices and marettes are not allowed.

### For analog signal wiring - Internal Panel Wiring:

#### Use uniformly twisted shielded pairs not smaller than CSA 0.823 mm2 (18 AWG) with a minimum of six twists per 300mm (one foot). Separate analog signal wiring at least 150mm (six inches) from power wiring. Provide continuous foil or metalized plastic shields with 100 percent coverage. Include a drain wire in continuous contact with the shield. Multiple cables must have an overall shield and individual shields for each signal cable.

#### Single Pair Cable: Beldon #8760.

### Use CSA= 1.3 mm2 (16 AWG) stranded copper with TEW insulation if approved under the local electrical authority or larger for internal control signal wiring. Run wires in continuous lengths from terminal to terminal; do not splice wires.

### DC Digital Signals – Internal Panel Wiring:

#### #16 AWG, 26 X .010 stranded copper conductors CSA labeled tray cable at 600 volts with TEW insulation with PVC jacket, 105°C.

### AC Digital Signals – Internal Panel Wiring:

#### #16 AWG, twisted, 26 X .010 stranded copper conductors CSA labeled tray cable at 600 volts with TEW insulation with PVC jacket, 105°C.

### Use power wiring with insulation rated at 600 V. Use CSA= 3.31mm2 (12 AWG) stranded copper with TEW insulation or larger for power wiring. Run wires in continuous lengths from terminal to terminal; do not splice wires.

### The conductor designation is that green conductors are always at ground.

### Supply shielded cables as follows:

#### Single Pair Cable: For individual instrument circuits use single-pair, two inch lay, twisted, foil 100% shielded with bare #18 AWG copper drain wire, #18 AWG, 19 X 30 stranded copper conductors CSA labeled tray cable at 600 volts.

#### Multi-Pair cables: For multiple instrument circuits, use multi-pair cables made up of individual single pair, two inch lay, twisted, foil 100% shielded with suitable drain wire, #18 AWG, 19 X 30 stranded copper conductors CSA labeled tray cable at 600 volts copper conductors CSA labeled tray cable at 600 volts.

#### Shields: Signal shields should have one ground point located in the panel. Shields should be continuous through cabinets, panels, and junction boxes.

#### RS232 and RS422 cables: 4 pair, 22 AWG stranded copper, separately twisted pairs, overall 100% aluminum-polyester shield, tinned copper stranded drain wire, type #9305 by Belden Wire and Cable.

#### Termination fittings: Type, configuration and gender required to connect cable directly to equipment without additional adapters or fittings.

### Segregate signal wiring from control power wiring: group functionally, and arrange neatly to facilitate tracing of circuits.

### Provide panel wiring neatly dressed and run in plastic duct with AC, DC, analog, and communications conductors in separate ducts as much as possible. Maximum 25% fill, with snap-on cover. No loops or tie-wraps permitted.

### Do not intermix signals within the same bundle or duct.

### Install low level analogue signals, 50 VDC maximum or 4-20 mA, and digital signal operating at 50 VAC or DC maximum, in a raceway electromagnetically isolated from high power or signal wiring. Comply with wiring separation and isolation guidelines recommended by instrument and PAC equipment manufacturers.

### Ferrules are to be installed on the wiring smaller than 18AWG in the PAC panel.

### Provide adequate slack on cable harnesses to permit easy removal of I/O and other printed circuit cards and/or modules and instruments during service or repair.

### Insulating barriers: Covering exposed terminals and terminal blocks against inadvertent contact. Warning labels: Lamacoid with 3mm white letters on red background, on front of compartments where multiple power sources are present.

### All wiring to instruments mounted on doors shall be twisted into one bundle and shall cross from the cabinet to the door at a shallow angle using expandable sleeving.

### Colour code for internal panel wiring as follows:

#### Line and load circuits AC:

##### Hot: Black

##### Neutral: White

#### 24VDC Distribution:

##### Blue (+)

##### Blue/White Stripe (COM)

#### Analog signal grounding conductors:

##### Green/Yellow Stripes

#### Equipment grounding conductors:

##### Green

#### Analog Signals

##### Black (-)

##### White (+)

#### AC Control Circuits

##### Red

#### DC Control Circuits

##### Blue

#### Interlock control circuits on the panel energized from external source:

##### Yellow

#### Current carrying grounded conductor (neutral):

##### White

### All communication connections to be terminated inside panel (none outside). Ensure proper strain relief.

### Velcro cable ties (Hubbell or Panduit) are to be used for bundling and securing all wiring not enclosed in duct.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

### Refer to Section 13305 - Field Wiring for field wiring colour coding and requirements.

## Terminal Blocks

### Provide DIN style high density, rail mount type terminal blocks.

#### Control relays c/w L.E.D. Provide control relays, as required. Relays shall be 10 A, 120 VAC, Single Pole Double Throw (SPDT) or Double Pole Double Throw (DPDT), pin-base, plug-in style with neon indicator.

### Fused Terminal Blocks with Fuse Blown Indicator:

#### Manufacturer: Refer to the Bill of Materials on the panel drawings.

### Non-Fused Terminal Blocks:

#### Manufacturer: Refer to the Bill of Materials on the panel drawings.

### All terminals should be easily accessible with ample room for termination of field and panel wiring. Supply terminal block partitions for separating instrument loop (4-20 mA, etc.) from 120VAC terminals as necessary. Arrange terminal strips so that power, control wiring, instrument wiring and ground points are partitioned by terminal block barriers. In panels with large numbers of terminals provide separate rails for 120VAC blocks.

### Provide mounting rails as required with one end stop at each end of rail.

### Space terminal block strips no closer than 150mm centre to centre.

### Minimum spacing between two (2) rows of terminal blocks shall be 80mm (3” inches).

### Minimum space from edge of terminal strip to edge of wire duct: 50mm

### Provide a continuous marking strip with the terminals.

### Provide terminal block barriers to separate 24 VDC instrument loops, 120 VAC power, 120 VAC control wiring, 24 VDC control wiring and grounding.

### Reserve one side of each terminal strip for field incoming conductors. Do not make common connections and jumpers required for internal wiring on the field side of the terminal. Terminate no more than one wire at any one terminal except where jumper wires are needed for internal wiring in which case two wires may be connected.

### Provide a minimum of 25% spare terminals on each rail, minimum four (4) spares per rail.

### Provide insulated centre jumper bars for 120 VAC terminal blocks. Refer to Bill of Materials.

### Provide centre jumper bars to connect common wires and terminals. All common terminals to have the same number.

### For each instrument or piece of equipment, group all field wiring together at the terminal strip. Provide a common group marker for each set.

### Provide individual terminal block type circuit breakers to isolate 120 VAC power feed to field instruments.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

### Supply twenty (20) spare fuses of each fuse type rating in a DIN rail mountable storage box with each Control Panel.

## Signals and Interfaces

### Analog signals are 4-20 mA DC and conform to the compatibility requirements of ISA Standard 50.1. Provide the signal conversion necessary for compatibility with instruments and the interface to the digital controllers.

### Current/Current converters are to be utilized where more than two (2) loads are present in the current loop or if otherwise recommend by the manufacturer.

### Provide interposing relays with switch, if required, for retransmission of isolated discrete (digital) signals to digital controllers. Relays shall be rated for switching 6 Amps, 250 VAC, SPDT, pin-base, plug-in style with neon indicator.

### Supply and install timers as shown on drawings. Timers to be DPDT with 5 A and 120 VAC unless otherwise noted

### If a network access closet is at the facility, all network cables are to be home run to the access closet. One (1) spare network cable to be run between network access closet and control panel.

### If a network access closet is not present at the facility and the network switch is located in the control panel, provide factory made network patch cables as required.

### Furnish, mount, and wire control components such as relays, timers, and other equipment to provide the interfacing and interlocking between the motor starter and associated protective circuits, or other type of control circuit function applicable to a particular final control element. Use sealed and plug-in type components.

### The Drawings show the interface for equipment. The Drawings are typical for the equipment expected to be furnished and are provided to show the intended control functions and interfaces. Provide intended panel functional interfaces.

### Refer to the Bill of Materials on the panel drawings.

## UPS

### UPS shall be on-line, no-break, batteries continuously in circuit with static bypass loads. The UPS shall be 1500VA, 120Vac, 60Hz and minimum 60 minutes run time, unless otherwise specified. Extended battery modules are to be installed as required.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Local Operator Interface

### Local Operator Interface Terminal (OIT) to be mounted on the control panel.

### Manufacturer: Refer to the Bill of Materials on the panel drawings for model number and options.

## Nameplates, Labels and Tags

### Furnish face-of-panel mounted nameplates to identify systems and equipment.

#### Use engraved Gravoply laminate nameplates having white letters on black background.

#### Include device identification number as well as a descriptive name.

#### Center lettering on each line.

#### Use minimum 6 mm high characters.

#### Mount nameplates with 2 stainless steel machine screws.

#### Name plate mounted at top of panel, 12mm high characters describing equipment code, equipment description, process name, contract number and date.

### In the panel interior, furnish surface mounted nameplates to identify each device mounted on the panel exterior and interior.

#### Use engraved Gravoply laminated nameplates with white letters on a black background.

#### Place the tags above, but not on the device.

#### Do not obstruct visibility of nameplates with wire bundles or other equipment.

#### Include device identification number as well as a descriptive name to match identification shown on drawings.

#### Mount nameplates with 2 stainless steel machine screws.

### All wiring to be identified with heat shrinkable slip-on markers c/w type written thermal transfer tag numbers as manufactured by Brady or similar. Slip-on markers must be sized to suit wire size and type. Tagging to be completed as per the drawings.

### Terminal blocks are to be identified self adhering type written tag numbers as manufactured by Raychem or similar. Tagging to be completed as per the drawings.

## AC Control Relays

### Universal pole type: electrically held 3PDT, push to test, convertible from NO to NC by changing wiring connections.

### Provide with position indication (open/close).

### Manufacturer: Refer to the Bill of Materials on the panel drawings

## Solid State Timing Relays

### Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.

### Operation: as indicated on drawings.

### Potentiometer: self contained to provide time interval adjustment.

### Timing ranges: as required by the process.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Intrinsic Safety Barriers

### Monitor discrete signals that originate in hazardous area and are used in a safe area.

### Interface analog signals as they pass from hazardous area to safe area.

### Intrinsic safety barriers to be mounted outside of PAC control panel in separate NEMA rated panel.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Pushbuttons

### NEMA oil tight. Operator extend type 30mm diameter. Black with NO and NC heavy-duty type contact blocks, labels as indicated. Stop pushbuttons colored Green. Start pushbuttons colored Red. Reset buttons colored black.

### Number and arrangement of contacts: In accordance with the schematic control diagrams and specified functional requirements; minimum 1 NO and 1 NC contact.

### Electrical rating: Equal class, division and group rating of the area.

### E-stop pushbuttons to be mushroom head on yellow background with twist to release function.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Selector Switches

### Maintained unless otherwise indicated, labeled as indicated, heavy duty, 30mm diameter oil-tight standard operators, contact arrangement as indicated.

### Provide number of positions and contact arrangement as shown on the drawings.

### Contact blocks: Heavy duty silver to silver butting type contacts, and on low voltage (24 VDC or less) circuits: gold plated contacts rated 0.5 A at 115 VAC. Make before break where required.

### LOCAL-REMOTE switches to be make-before-break.

### Electrical rating: Equal class, division and group rating of the area.

### Where the contact blocks switch analog (4-20 mA) and 24 VDC or less, provide contact material of gold or gold flashing over silver.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Indicating Lights

### NEMA oil-tight, LED lamp which allows bulb removal and replacement through the front of the unit, transformer type, 30mm diameter, lens colour: as indicated, labels as indicated.

### All pilot lights to be push to test (P.T.T.) type.

### Electrical rating: Equal class, division and group rating of the area.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Circuit Breaker

### Main feed to panel to be connected directly to a primary breaker, not a supplemental breaker.

### DIN rail mounted, rating as indicated on the drawings and specifications, Contractor to provide load calculations and submit with panel shop drawings. Fuse and circuit breaker chart laminated and mounted on interior door of panel.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Receptacle

### Non-UPS fed receptacles are to be 15 A, ivory in color. .

### Provide GFCI type receptacles for outdoor panels.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Over-Voltage and Over-Current Protection Devices

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Key Switches

### Provide key switches where identified on the contract drawings.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## LED Digital Display

### Provide LED digital displays where identified on the contract drawings.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## LCD Digital Display

### Provide LCD digital dsiplays where identified on the contract drawings.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

## Signal Conditioning – Current to Current Converter

### Provide signal conditioning where identified on the contract drawings and/or as specified in Division 13.

### Manufacturer: Refer to the Bill of Materials on the panel drawings.

# execution

## Installation

### Section 13311 Panel Factory Acceptance Test (FAT) Document must be prepared by the contractor, submitted no later than four (4) weeks and accepted by the Consultant prior to Panel FAT being held. Photos of the completed panel must be submitted to the Consultant/Region and accepted no later than two (2) weeks prior to the Panel FAT.

### The panel must pass the Panel FAT and must be and accepted by the Consultant and/or Region prior to Panel being shipped to site. PAC to be removed prior to shipping and shipped separately. PAC to be re-installed after panel is installed and field wiring is completed.

### Wrap panels in heavy duty plastic prior to shipping. Protect against damage and moisture.

### Construct a 100 mm high concrete housekeeping pad, with dimensions as specified or noted in the schedule or panel drawing on which to install floor mounted control panels.

### Provide wall mounted panels with 6 mm nylon spacers.

### Where two or more enclosures are shown mounted immediately adjacent to one another, install both of them securely together with their front faces parallel. Panels typically will not be placed back-to-back, use one large panel if space is available.

### After setting panel in place, remove the lifting rings and fill the lifting ring holes with the manufacturer supplied plugs.

### Mount power supplies such that dissipated heat does not adversely affect other components.

### Mount fuses to be easily seen and replaced.

### Provide 120VAC plug mold for panel components with line cords.

### Lamacoid labels to be installed on contact block terminals for identification purposes. Labels are to match panel drawings. Handwritten labels are not permitted. Preference is for labels to be installed on devices.

### Install lightning and surge protection on all analog signal cabling entering or exiting buildings. Provide two (2) spare units of each type used.

### Maximum voltage in PAC panels is to be 120VAC. PACs are not to be installed in enclosures housing 600V or grater equipment/devices.

### For new installations, all field wiring is to enter the PAC panel from the bottom.

### For retrofit installations, filed wiring is permitted to enter the PAC panel form the top, run behind the panel back plane and come up into the wire ways from the bottom.

## Site Inspection, Commissioning and Test

### Provide services of panel manufacturer’s representative to inspect, test and commission control panel installation.

### Carry out functional tests with Region’s Representative and Region PCS group to confirm field wiring, interlocks, and PAC functionality.

### Submit certified inspection and test reports.

#### Section 13311 Panel Factory Acceptance Test Document.

#### Panel FAT must be completed and accepted by the Consultant and Region prior to Panel being shipped to site.

### Field Verification

#### Field verification of panel functionality must be completed prior to final acceptance by the Consultant and Region. Refer to Section 13930 – Instrument and Equipment Testing.

**END OF SECTION**