Standard System Panel Specification

This document contains the specifications and requirements for CCC's standard system panels:

General Requirements

1. Engineering Units
    a) All dimensions and measurements will be in English units, and may be followed by the equivalent value in the "International System of Units" (SI) between brackets. When not critical, the equivalent dimensions may be rounded off to their nearest practical value.
2. Environmental Conditions
    a) The control cabinet equipment and wiring will be typically designed for continuous operation between +5 and at 50 °C, altitudes up to 1000m above mean sea level and relative humidity 95% maximum (non-condensing). The temperature of 50 °C allows for a 35 °C room ambient plus a 15 °C rise within the cabinet. This is subject to the published hardware limit.
    b) A temperature gauge (RTD / Temp. switch) to monitor the operating temperature of the equipment will be available inside the cabinet (temperature switch is used for Series 3^{++} panels).
    c) Two (2) fans for cooling, redundant system where one (1) fan can fulfill the required cooling if necessary. Additional measures will be taken to prevent harmful effects of occasional condensation (environmental conditions dependent).
    d) Precautions will be taken to protect the control cabinet equipment against the effects of transportation and storage temperatures within a range of –25 °C to +55 °C. Suitable means will be provided to prevent damage from humidity, vibration, electrostatic high differential potential, and shock.
3. Area Classifications
    a) Indoor cabinets will be installed in rooms within a general purpose, non-classified area per ANSI/NFPA 70 National Electrical Code (NEC), Article 500, Non-classified area per ATEX directives (EU).
4. Layout
    a) Each component is located to facilitate its operation and maintenance and to maintain the temperature within the permitted limit (air flow circulations path are accurately evaluated).

b) AC and DC wiring are kept separate using cable trays. Wire trays are also used for incoming field wiring.

c) Components are individually fused (on individual circuits).

d) Four (4) lifting eyes are provided at the top-corners of the cabinet.

Panel Design

1. Style: The cabinets will be rigid, self-supporting, and floor-mounted. Instruments and electronic accessories will be wired in accordance with this specification. Indoor cabinets will be made of metal. Rittal TS panel type is the standard.
2. Construction
   a) Steel construction:
      - Frame: 16 gauge (1.5 mm)
      - Door: 14 gauge (2.0 mm)
      - Internal: 14 gauge (2.0 mm)

   b) Dimensions:
      - Height: 83.0 inches (2100 mm) (includes 4" plinth)
      - Width: 31.5 inches (800 mm)
      - Depth: 31.5 inches (800 mm)

   c) Access:
      - Series 3++: Controller access is from the front of the panel. Rear door entry is only for wiring access.
      - Prodigy®: front door entry
3. Cabinet Finish: Dip bath, prime and powder coated exterior. Standard paint is Rittal Light Gray (RAL 7035).
4. Nameplates: Internal and external nameplates are used to label devices. The nameplates are in English and are made with a white background and black lettering. Nameplates used for "caution messages" can be with red background and white lettering.

Cabinet and Panel Spare Requirements

Unless otherwise specified in the Purchase Order, each cabinet will be provided with the following wired spare capacity to allow for future system modifications:

1. 20% installed spare terminal blocks of each terminal block type used. Spare terminal blocks are to be distributed to match the layout of required spare I/O modules, field termination assemblies, relays, etc.

NOTE: Space is allocated for 20% of conditioning modules; conditioning modules not included.

2. When possible, sufficient spare panel space will be provided for at least 20% additional future instruments.
3. No spare cutouts will be provided unless specified.
    a) A minimum of two (2) spare fuses or 10% (whichever is greater) for each type of general power and termination strip fuses used within each cabinet will be provided. This requirement includes supplying spares for fuses integral to installed electronics (i.e., field termination assemblies, etc.).

Electrical Requirements

1. Instrumentation
    a) Instruments, protective devices, control wire and cable systems shall be designed and installed in accordance with ANSI/NFPA 70 National Electrical Code (NEC) unless otherwise indicated, in accordance to EN-60439-1, EN-60204-1 (EU).
2. Cable Entry: Field wiring and system power are brought into the cabinet through cabinet bottom entry gland plates. Top entry cabinet is available upon request.
3. Protection Against Electrical Shock
    a) Ingress protection:
        - Series 3++: NEMA1 (IP20)
        - All other control platforms: NEMA12 (IP54)
4. Power Supply Outputs and Voltages
    a) Power supply outputs will be individually fused or protected by a circuit breaker.
    b) Any of the of the following supply voltages can be used as required by customer:
        - 120 VAC
        - 240 VAC
        - 24 VDC

5. Wire Specifications

   Control wire and cable systems are designed to ensure a voltage drop from the point of supply to the load less than 5% of the nominal voltage under normal operating conditions. Typical cross- sectional areas / current-carrying capacities for cables inside enclosure are:

   a) All Instrument signals (AI, AO, DI, DO) 18 AWG, 300V, MTW, 90°C -- 0.75 mm^2, PVC fire retardant, U_o/U 450/750V, maximum rated normal temperature 70°C, unless otherwise indicated (EU).

   b) DC power (24 VDC)

      a) 30 amps and above: 10 AWG, 600V, MTW, 90°C
      b) 20 to 30 amps: 12 AWG, 600V, MTW, 90°C
      c) 10 to 20 amps: 14 AWG, 300V, MTW, 90°C
      d) 5 to 10 amps: 16 AWG, 300V, MTW, 90°C
      e) 0 to 5 amps: 18 AWG, 300V, MTW, 90°C

      EU - PVC fire retardant, U_o/U 450/750V, maximum rated normal temperature 70°C, unless otherwise indicated:

      a) 0 to 5 amps: 1 mm^2
      b) 5 to 10 amps: 1.5 mm^2
      c) 10 to 15 amps: 2.5 mm^2
      d) 15 to 20 amps: 4 mm^2
      e) 20 to 30 amps: 6 mm^2
      f) 30 amps and above: 10 mm^2

   c) All AC power

      - 30 amps and above: 10 AWG, 600V, MTW, 90°C
      - 20 to 30 amps: 12 AWG, 600V, MTW, 90°C
      - 10 to 20 amps: 14 AWG, 600V, MTW, 90°C

      EU - PVC fire retardant, U_o/U 450/750V, maximum rated normal temperature 70°C, unless otherwise indicated:

      a) up to 10 amps: 1.5 mm^2
      b) 10 to 15 amps: 2.5 mm^2
      c) 15 to 20 amps: 4 mm^2
      d) 20 to 30 amps: 6 mm^2
      e) 30 amps and above: 10 mm^2

6. Terminal Strips

   a) The termination method will be channel (rail)-mounted terminal blocks.

   b) Terminal strip spacing will allow ample room for plastic wire trays and permit training and lacing of cables, and fanning of individual wires to termination points. Each terminal strip will be labeled, as shown on wiring diagrams. Terminals for similar (AC or DC) current service will be grouped together and physically separated from terminals for different service by means of dividers, separate mounting rails or separate wire trays.

   c) Signal wiring is organized according to the customer cable schedule, if supplied.

      - For Series 3^{++}: If one is not supplied then CCC organizes as follows: 1) Train#1 – analog inputs, analog outputs, discrete inputs and discrete outputs then frequency inputs. Train #2 –analog inputs and so on.
      - For all other platforms: per FTA

7. Terminal Blocks
    a. Screw-type terminal modules for internal wiring.
    b. No more than two wires shall be connected to each side of a single terminal block. Manufacturer jumper bars and jumper combs will be used when possible.
8. Wire Trays and Looms
    a) The wiring is organized in PVC wiring trays with AC power in separate trays from DC power and instrument wiring.
9. Wire Color Coding
    a) All internal wiring is color-coded and labeled with heat shrink markers for easy identification.

Table 1 – I/O Wire Colors

I/O Wire Colors		
AI	(+)	White (W)
	(-)	Black (BK)
AO	(+)	White (W)
	(-)	Black (BK)
FI (passive)	sig (+)	White (W)
	sig (-)	Black (BK)
FI (active)	pwr (+)	Red (R)
	sig (+)	White (W)
	com.	Black (BK)
3 wire RTD	sig (+)	White (W)
	sig (-)	Black (BK)
	comp.	Black (BK)
Thermocouple	(+)	White (W)
	(-)	Black (BK)
DI	(+)	Red (R)
	(-)	Black (BK)
DO	(+) or com.	Red (R)
	(-), (NO) or (NC)	Black (BK)
3 wire LVTD	exc (+)	Red (R)
	sig.	White (W)
	exc (-)	Black (BK)
5 wire LVTD	sig (+)	White (W)
	sig (-)	Black (BK)
	com.	Black (BK)
	exc (+)	Red (R)
	exc (-)	Black (BK)
Intrinsic Safety	(hazardous side)	LT Blue (LT BU) or Blue (BU)

Table 2 – Power Wire Colors

Power Wire Colors		
24VDC	(+) (-)	Red (R) Black (BK)
AC (110)	(Line) (Neutral)	Black (BK) White (W)
Safety Gnd (AC 110)	Gnd	Green (GN)
Instrument Gnd (AC 110)	Gnd	Green/Yellow (GN/Y)
AC (220)	(Line) (Neutral)	Brown (BN) Blue (BU)
Safety Gnd (AC 220)	Gnd	Green/Yellow (GN/Y)
Instrument Gnd (AC 220)	Gnd	Green (GN)

Table 3 – Series 3^{++} Communication Wire Colors

Series 3^{++} Communication Wire Colors		
Serial Port 1 (2 wire)	(+) (-)	White (W) Black (BK)
Belden Cable 8723	Tx (+)	White (W)
(2 pair, 4 wire)	Tx (-) Rx (+) Rx (-)	Green (GN) Red (R) Black (BK)

Table 4 – Series 5 / Prodigy® Communication Wire Colors

Series 5 / Prodigy® Communication Wire color		
Belden #9842 for 2 pair		
Pin 1 Pin 2 Pin 4 Pin 5	TX (+): TX (-): RX (-): RX (+):	White/Blue stripe (W/BU) Blue/White stripe (BU/W) Orange/White stripe (O/W) White/Orange stripe (W/O)
Belden #9841 for single pair		
Pin 1 Pin 2	TX/RX (+): TX/RX (-):	White/Blue stripe (W/BU) Blue/White stripe (BU/W)

10. Wire Tagging
    a) Ferrule tag indicating destination or wiring diagram page /progressive number. The marker material is heat shrinkable polyester sleeve, up to 20 characters or plastic sleeves that are specifically designed to fit on a specific wire gage or come with pre-printed alpha-numeric inserts (such as Grafoplast Trasp System).
    b) Wire tags shall be installed and oriented such that the tags are easily read.
11. Terminal Coding
    a) Each row or column of terminals will be clearly identified with an alphanumeric label.
    b) Numerical terminal identification and coding will be assigned sequentially (in ascending order, from top to bottom or left to right).
12. Push Buttons and Lights
    a) Push buttons and lights will be industrial quality. Push buttons can have protective mechanisms to prevent accidental activation as required by the detailed design specification. Long-life type de-rated lamps or LED cluster lamps will be used. Only screw terminals will be provided on push buttons.
13. Circuit Breakers and Fuses
    a) For each incoming source of supply a switch disconnector, with or without fuses, or a circuit-breaker suitable for isolation will be provided with a means permitting it to be locked in the OFF (isolated) position.
    b) Individual circuit breakers (for AC) and fuses (for DC) will be provided for each power supply unit.
14. Cable Shields: will have a single, continuous path to ground. Shields will be consolidated and connected to the Shield Connection Ground Bar (instrument bonding IE).
15. Grounding: Two Main Bonding Types Provided
    a) Safety (protecting bonding, PE) – it consist of a 1.375 x 0.25 inch tinned copper bus bar connected to the control panel frame, PE terminals and protective conductors; All exposed conductive parts will be connected to the protective bonding. Each protective conductor connecting point will be marked using letters PE or the properly symbol. For each incoming supply, a terminal is provided in the vicinity of the associated phase conductor terminals for connection of the external protective earth system or to the external protective conductor, depending upon the supply distribution system.
    b) Instrumentation (instrument bonding, IE) – consists of 1.375 x 0.25 inch electrically isolated tinned copper bus bar, conductors and terminals or additional 0.375 x 0.20 tinned copper bus bar to connect cable shield and functional bounding of equipment.

    An additional bonding (intrinsically safe bonding, ISE) is provided if intrinsically safe barriers are mounted inside the cabinet. – It consist of 1.375 x 0.25 inch electrically isolated tinned copper bus bar, conductors and terminals (the color of the bonding wires is green).

16. Protective conductors

    a) Copper is used for all protective conductors. Each conductor will be capable of withstanding the highest thermal and mechanical stresses that can be caused by earth-fault currents that could flow in that part of the protective bonding circuit.

    b) Conductors are terminated to prevent accidental loosening (ring terminals are used for connecting equipment chassis and conductive structural parts).

    c) The cross-sectional area of protective conductors is determined in accordance with the requirements of section 543 of IEC 60364-5-54; or 7.4.3.1.7 of IEC 60439-1, depending on the type of cable insulation and on rating of the protection devices. The cross-sectional area of the protective conductor (S_{PE}) generally is equal to the one of phase conductors (S) associated with that part of the equipment (S_{PE} = S, S<16 mm^2; S_{PE} = 16 mm^2, 16 mm^2<S<35 mm^2).

17. Electromagnetic compatibility (EMC)

    The control cabinet will be suitable for the physical environment and will not generate electromagnetic disturbances above levels that are appropriate for its intended operating environment. At the same time, it will have a level of immunity to electromagnetic disturbances so that it can function in its intended environment. Measures to limit the generation of electromagnetic disturbances include:

    a. Power supply line filters are installed for each incoming line

    b. Chassis are connected to earth (PE) using a conductor with low RF impedance, as short as possible

    c. Cable shields

    d. Sensitive circuits are separated from disturbance sources

    e. Doors and movable mechanical parts of the enclosure are connected to earth (PE) using a conductor with low RF impedance and bolts.

    f. Equipotential bonding of the conductive parts inside the cabinet, and

    g. Panel enclosures are designed to minimize radiation; Rittal TS panel EMC type is available upon request.

18. Lighting, Convenience and Power Distribution Receptacle Outlets

    a) 1 light single entry; 2 lights double entry

    b) 1 outlet per cabinet, for service computer only

Testing and Inspection

Control Panel Factory Testing – A control panel test will be conducted for all projects on which CCC furnishes the panels. This test will include:

1. Visual inspection to verify compliance with requirements of this specification
2. Voltage and ground circuit tests
3. Complete wiring check with verification that terminal and wiring code conforms to cabinet design drawings
4. A function test of all electronic instruments and electric control circuits and relays

Panel Documentation

Documentation will be provided in electronic format. This will formally document the design and specifications. Documentation will include:

1. Drawing list
2. Panel structural and layout drawings
3. A bill of materials of CCC-supplied equipment
4. Cabinet wiring diagrams
5. Standard Operation and maintenance instructions

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