Control Panel Layout And Wiring Best Practices

Large Control Panel Wiring Example.
What are some good practices? What could be improved?
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The quality of the wiring methods used in an industrial control panel can vary quite widely. This article summarizes what this author believes are some best practice when it comes to control panel layout and wiring.

The goal is to produce a panel that is logically arranged and easy to maintain for the life of control panel.

I leave it to the reader to use these suggested "best practices" outlined below to evaluate and improve upon the control panel designs that they encounter or are part of producing.

BASIC WIRING PRACTICES.

1. * **Wire:** Use all 600V 90 Deg C rated wire. Use stranded wire. Use MTW type wire. Note any exceptions so these can be added to the drawings or design notes.

2.  * **Wiring across a hinged door or panel.** U loop, as long as possible, facing down anchored on each side of the hinge with screws or bolts (no adhesive). Place sleeve or spiral wrap over the wires running over the hinge between the anchor points.
3. * **Spacing between wired devices and wireway or other obstructions:** 2" minimum; 2 1/2 – 3" preferred for 120VAC and less. 4" for 480 volt (enough to insert a closed fist between the device and the wireway or obstruction.
4. * **Minimize the use of cable/wire ties if wire duct is used.** They get cut off when troubleshooting and are rarely replaced. A good wire management system should not require any wire ties. Make it a goal to use no wire ties except temporarily while wiring.
5. **Leaving Slack:** Generally, leave only "hidden" slack. Leave service loops as the wires leave or enter the device or terminal. Run wires in the wireway so they enter and run to the middle or far side of the wireway or duct. Take all corners in a wiring duct as wide as possible. Run wires in horizontal and vertical lines. This also adds further "slack" and improves the appearance. Avoid looping wires in the wireway unless the wireway is designed for this.
6. * **General Wire Routing**: Run wires in horizontal and vertical lines, no diagonal runs. "Train" the wire by bending it to make neat vertical and horizontal lines. Delicate wire will require "training" by bending and forming the bend gradually. Wire in wire duct should be run so they do not cross each other excessively. Wire entering or leaving a wire duct should be brought to the front of the duct before entering/exiting where possible. Leave service loops and run wires in the wireway so they enter and run to the middle or far side of the wireway or duct and take all corners as wide as possible. Do not run wire over other devices, including the wireway. Elevate the duct and go under the duct with wires if needed. Review needed exceptions.
7. * **Wiring Power And Motor Wiring:** Place Pig tail loops between devices that are spaced such that it makes it easier to remove wiring if the pig tail is added. Consider using High Flex power wires such as "Railroad Wire" or high strand count wire. Train the wire by bending it in the direction you want it to go or lay

in the duct, rather than just trying to lay it in a wire duct and hope it "stays down" in the duct. See also "General Wire Routing".

8. * **Wiring Signal and Shielded Cables:** Use 18 AWG shielded, twisted pair (or Triad) type cables rated at 600V as the default signal wire type. Unless specifically required strip off a generous amount of the jacket so that each conductor can be easily accessed for removal, testing, and replacement. Also remove the jacket as it exits a wire duct, keeping the twists where the cable otherwise creates unwanted wire congestion. Examples: going to Analog I/O modules, or routing to elevated side terminals. Terminate all shields. Terminate all shields close to the signal wires. Consider using 2, 3, or even 4 high terminal blocks with jumper slots for signal wiring depending on the wiring needed. This allows busing the power supply voltages for a cleaner installation. Option: Place heat shrink tubing 1/2 over the cut end of the cable jacket and 1/2 over the exposed wires.
9. * **Wiring Control Wires:** Use 14 AWG 600V MTW (stranded) wire for 120VAC wire. Use 16 or 18 AWG 600V MTW (stranded) wire for 24VDC wire for up to 10 and 5 amps respectively. Use "General Wire Routing" recommendations found elsewhere in this document.
10. * **Terminations:** leave some bare wire showing to allow visual inspection and to avoid screwing down on the insulation. Wires should exit the terminal straight. Do not bend the wire at the point of termination. Instead loop or bend wires on the insulation that do not go straight to the wireway.
11. * **Terminals:** Screw Terminals: Use tubular, pressure plate type screw terminals that minimize wire distortions or damage when terminating. Position Terminals to allow visual inspection of the recessed connections. Elevate Control Terminals to allow wiring under the terminals if needed. Keep it stiff using a heavy-duty DIN rail or Hoffman Terminal Straps or equivalent. Angle and elevate terminals mounted on the side panel for wiring ease and to allow visual inspection of wiring in the terminals.
12. * **Grounding Principle:** Wire all grounds to the incoming ground lug either directly or with a wire to the other ground bus bars. Add a main ground lug and/or a ground bus bar for each grounded power supply. A number of busbars can be utilized but should all be wired together and then to the incoming ground lug to at least 1 point if not two (2). This is in addition to the ground established through the panel. Use 2 ground wires from opposite ends of the bus or chain of ground bars if the ground is isolated. Wire the ground on all doors and subpanels and the cabinet itself to a ground bar terminated at the main ground lug. Wire all equipment and chassis grounds to the ground bar(s) which

is terminated at the main ground lug. For additional details on grounding and bonding see the Grounding And Bonding post dedicated to just this subject.

PANEL LAYOUT CONSIDERATIONS:

Example of good spacing between the terminals and the wireway.

1. * **Optimize the Space**. Place PLC I/O racks in the "bay" created by the wiring duct to allow room for the high density of wires going to them from the duct. Don't leave space where there is no wiring, typically the top of the I/O rack. Place similar sized devices in their own "bay" where possible. Consider the routing of all of the wires and how the various voltages will be kept separated.
2. * **Spacing between wired devices and wireway or other obstructions:** 2" minimum; 2 1/2 – 3" preferred for 120VAC and less. 4" for 480 volt (enough to insert a closed fist between the device and the wireway, another device, or obstruction.

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