

Panel Essentials Series 3: UL508A Control Panel Design Considerations

Introduction

[Industrial control systems](#) are regularly under attack, yet they play a very crucial role in any manufacturing business. Unfortunately, many industrial operational technology departments have lagged in managing new threats. Starting with a robust control panel design, you can begin to better manage your business. The goal of this paper is to introduce you to these design considerations and the UL 508A Standard. Before we delve into the control panel design considerations, let's look at some of the basics.

What are Industrial Control Panels?

An industrial control panel is an assembly of standard and systematic arrangement of various components. It comprises overload relays, motor controllers, circuit breakers, and fused disconnect switches. Other related control devices include pushbutton stations, timers, switches, terminal blocks, and pilot lights, among others. According to the official definition by Underwriters Laboratories (UL), an industrial control panel is an assembly of two or more pieces of industrial control equipment. It also comes with related control circuit devices, provided with interconnecting wiring and terminals.

What is the UL508A Standard for Control Panels?

UL 508A certification is a directive for the industrial control panel covering components, SCCR, wiring, and more. This mark is important to electrical and municipal inspectors along with the panel purchaser. Therefore, engineers certified for the UL 508A standard advise their clients on how to design products with [UL compliance](#). They also work with them to achieve a global design, hence eliminating the need for multiple variants.

IMPORTANT: A panel that carries a UL508A certified mark does not mean that the completed control panel has been tested to UL 508A standards. It means that the panel, its electrical contents and construction each meet the UL 508A standard. UL also has general requirements for all enclosures covering:

- Markings
- Enclosure Openings
- Disconnect Switches
- Internal Wiring
- Ventilation Openings
- Bonding
- Field Wiring
- Enclosure Environmental Control Devices

What are the Benefits of UL508A Control Panels?

Benefits of choosing enclosures that carry the UL 508A certification include, but are not limited to the following:

1. **Third-Party Certification** provides evidence that the enclosure meets nationally recognized safety standards.
2. **UL Certified Components** certify that UL508A enclosures include only quality, tested controls.
3. **Periodic Audits** ensure that manufacturers employ consistent techniques in order to meet UL508A requirements.
4. **Proper Labeling and Technical Ratings** limit risks and verify that standards are met.

Electrical Control Panel Design Basics

Industrial control panel design basics are easy to grasp. Although cost is an essential consideration, so are an attractive appearance, reliable operation, and operator controls. With simple designs, panel control and maintenance are easy, and so production is less costly. Understanding control panel design is a crucial process that helps ensure what you want is what you get. When you first put your requirements on paper, they seem unorganized, which is acceptable. Here's a guide to help you in making an informed decision.

1. *Outlining Physical Characteristics*

A reliable control panel design includes both electrical and physical requirements. When drawing up the schematic outlook, alternately evaluate the physical and electrical problems. This should be done until all potential issues have been eliminated.

In doing so, you minimize delivery delays and unresolved physical issues discovered during testing or production. After these considerations, drawings are created which outline the specific circuits, wiring, controls, and other aspects of the configurations. The drawings should clearly outline:

- The bill of materials
- Control cabinet and back panel layouts
- Power distribution network

- Input/output layout
- Functional diagram

It's also recommended to have a clear table of contents since a proper schematic entails many different elements and lays the foundation for the process of developing the actual control panel.

Remember that the process isn't as simple as selecting the appropriate enclosure and back panel to house the electrical hardware. [Proper wiring is required](#), and the equipment must adequately be integrated into the machine. Improper configuration won't only result in machinery malfunction but will also pose an unnecessary risk to the operators.

2. Meeting the Regulatory Standards of Control Panel Design

The planning and construction of an industrial control panel isn't complete without meeting various regulations:

UL

The UL 508A control panels are designed to meet the Underwriters Laboratories (UL) standards. It gives clearance for devices that produce heat, including Variable Frequency Drives and Programmable Logic Controllers among others. The main aim is to ensure there's enough room for ventilation.

UL 508A

The [UL 508A](#) certification serves to protect quality and integrity while keeping up with the standards of public safety. What happens if an inspector rejects a user's control panel? The first thing is to understand the reason for the rejection. It could be a safety issue, or just that the equipment lacks documented adherence to the safety standards.

Your options as the client are:

- Contact UL's Field Evaluation Services and tell them of the situation. Ask them to schedule a field visit for evaluation. You'll have to meet the cost of this arrangement.
- Contact a UL 508A shop near you and have them evaluate the control panel. They'll let you know the work required to make the panel meet the standards. This should cost you less than the first option.
- Select the best UL 508A panel shop for you from the list of Electrical Control Panel Builders. Let the service you're satisfied with start producing control panels that meet the UL 508A standards for you. Costs will vary.

NEC

The National Electric Code is a widely used regulation that ensures the safe installation of electrical equipment and wiring. Required for power wiring clearance, the NEC requires a specific radius to be provided for incoming and outgoing power connections.

According to Article 409, all industrial control panels must be examined and given a rating for their [Short Circuit Current Rating \(SCCR\)](#). This is established by reviewing each feeder separately then all the branch circuits. The kA value used for the whole system is the smallest one but must be higher than the kA value of the incoming source.

NFPA 79

The National Fire Protection Association 79 also provides regulations for wiring standards. It's a section of NEC that pertains to the electrical and electronic industrial machinery components. It specifically targets those operating at or below 600V.

Some types of machines under this regulation are assembly, machine tools, injection molding, and material handling machinery. Others are inspection and testing machinery. The [NFPA 79 regulation](#) safeguards machinery operators and facilities from electrical hazards and fires. It also takes care of equipment and work-in-progress.

3. Considering Enclosure and Space Requirements

The environment you intend to use the control panels in largely determines the type of enclosure. You need a large enough space to install the components and do the wiring. It's also a good idea to plan for several receptacles to reduce the need for extension cords when it becomes necessary to test appliances for power.

Besides thinking about [the enclosure](#), placement is another important consideration for control panel design. Make the necessary plans for swing requirements like cabinet doors if a cabinet will be used for enclosure. Factor in air conditioning and ventilation if the panel will be placed in an area with high temperature. Where temperature control applies, plan in a way that allows for easy access to exhaust vents and air intakes. NEC requires clearance around heat producing devices to allow adequate ventilation.

One of the most common NEC violations involves control panels that are too confined or too small. Their small size doesn't allow for wire bending and wiring. Space requirements are essential not just for the current configuration but for future adjustments.

4. Using the Best Control Type

It's always advisable to start with the simple control components. These include timers and relays. If these don't get the job done, go for something with more functionality such as a Programmable Logic Controller or Smart Relay. These devices require a computer and programming software to achieve the desired functionality. Some manufacturers prefer to use PLCs, but you should always go for the simplest control type for your application.

5. Using the Best Operator Type

Just like with the control types, it's advisable to start with simple operator devices. These include Pilot Lights, Pushbuttons, and Digital Panel Meters. To enhance the appearance, Color Graphic door laminate can be added.

For a more enhanced look and if the simple choices aren't the best, Human Machine Interface comes in handy. It's a color touch screen that provides more functionality but requires programming software and a computer.

6. Supplying Conductors and Handling Overcurrent Protection

Supply conductors are the elements that carry the power load. They should be able to allow for the highest possible load. This can be determined by calculating the sum of all connected apparatus and motors. Add this figure to the full load current for all resistive load plus 125% of the highest rated motor on full load current.

Overcurrent protection is another crucial consideration in the control panel design phase. There are two options to hack this successfully. The first option is to place the overcurrent protection ahead of the panel. Alternatively, a primary protective device can be incorporated in the panel itself, yet this is not recommended in order to minimize the need to open the panel's enclosure.

7. Ensuring Worker Safety

The safety of the workers is of paramount importance. Manufacturers should ensure plenty of illumination and space within the panel's enclosure. The components used should also be safe to touch, which is one of the best ways to keep workers safe.

It's recommended to use the lowest practical voltages, usually 120Vac and 24Vdc, for automation circuits. However, some panels must have components that supply higher voltages like 480Vac power to heaters and motors. For safety concerns, it's highly recommended to keep voltages above 120V in separate panels and enclosures.

8. Protecting Equipment

Excellent control panel design should make it easy for workers and operators to use an interlock. This reduces the chances that field equipment will suffer damage. It's necessary to design fail-safe circuits so that the equipment transitions to safety when there's power loss or disconnection.

9. Organizing Front Panels and Faceplates

These two components usually seem like an afterthought, but they're equally essential to the operation of machinery. The front panels need to be durable to endure extreme weather conditions, cleaning products, and temperatures.

Faceplates and front panels may include plastic or metal substrates, depending on the specifications of the application. They can be mounted with adhesives, studs, or fasteners. Moreover, they need to have the necessary durability to remain legible throughout the life of the asset.

10. Labeling

The importance of labeling all wires and terminals can't be overemphasized. Despite being a time-saving strategy, it also reduces the likelihood of errors in testing, maintenance, and repairs. Labels should be able to withstand environmental conditions and must remain legible.

Standards within the Standard

The UL 508A Standard refers to other UL Standards. Here are some of the most common:

[UL 218: Standard for Fire Pump Controllers](#)

[UL 294: Standard for Access Control System Units](#)

[UL 698A: Standard for Industrial Control Panels Relating to Hazardous \(Classified\) Locations](#)

[UL 845: Standard for Motor Control Centers](#)

[UL 864: Standard for Control Units and Accessories for Fire Alarm Systems](#)

[UL 891: Standard for Switchboards](#)

[UL 916: Standard for Energy Management Equipment](#)

[UL 924: Standard for Emergency Lighting and Power Equipment](#)

[UL 1037: Standard for Antitheft Alarms and Devices](#)

[UL 1203: Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous \(Classified\) Locations](#)

[UL 1640: Standard for Portable Power-Distribution Equipment](#)

[UL 1563: Standard for Electric Spas, Equipment Assemblies, and Associated Equipment](#)

[UL 1741: Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources](#)

[UL 1773: Standard for Termination Boxes](#)

[UL 2017: Standard for General-Purpose Signaling Devices and Systems](#)

[UL 2075: Standard for Gas and Vapor Detectors and Sensors](#)

[UL 60950-1: Standard for Information Technology Equipment – Safety – Part 1: General Requirements](#)

Control Panel Design – Final Thoughts

UL 508A is a control panel standard that must be met by industrial equipment. The control panel design goes a long way in determining the safety and functionality of the machinery. In the construction of control panels, there are many factors to consider. Firstly, the panels must meet safety standards and regulations stipulated by the UL and National Electrical Code. Other provisions are NFPA and CSA. Apart from meeting the regulation standards, the panels must also be well constructed for the safety of workers.

Wiring, space, controller and operator types, and enclosure must all be considered. If one of these factors doesn't meet the standards, it's highly likely that a client will need a replacement. Since control panels are a long-term investment, their design is of utmost importance.

There are many [design tips and tricks](#) that experts have developed. Do some additional research before you embark on your control panel design. The key to a successful control panel design and passing UL inspections is to know what you are going to do before you drill that first hole!

And, if you're looking for quality electrical control components for your panel, be sure to [browse our huge collection!](#)

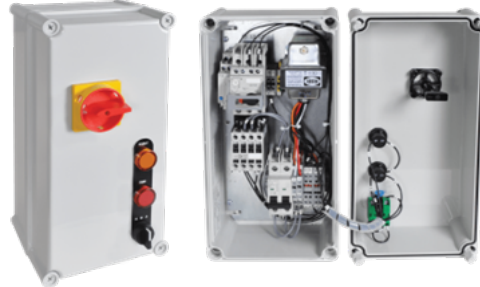
c3controls UL508A Control Panel Offerings

Located in Beaver, PA, c3controls operates a UL508A certified panel shop serving a wide range of industries. c3controls' panel shop acts as a resource for the OEM and for other panel shops by offering everything from simple value-added projects to complete finished solutions such as:

- [UL508A Combination Motor Starters for Air Handling](#)
- [Enclosed Motor Starters for General Industry](#)
- [Control Stations](#)
- [Alarm Panels](#)
- Custom DIN Rail Assemblies, Control Panels, & Control Stations (*consult c3controls panel shop for details*)
- [Enclosed Disconnects](#)
- [Enclosed Motor Protection Circuit Breakers](#)

Having trouble finding qualified employees and/or quality components? c3controls can supplement your inhouse manufacturing for custom or specialty control panels.

For your complete panel needs, check out our [enclosed panel solutions!](#)



c3controls Panel Essentials Papers

- **Series 1:** [DIN Rail](#)
- **Series 2:** [Wire Duct and Terminal Blocks](#) (for wire and cable management)
- **Series 3:** [UL508A Control Panel Design Considerations](#)
- **Series 4:** [Electrical Control Components](#)
- **Series 5:** [Control Panel Industry Trends](#)

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