

# The demanding requirements of harsh environment switch designs

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Electromechanical components are not all created equal. A primary concern for design engineers when specifying electromechanical components in industrial applications is ensuring the products are rugged and robust enough to withstand harsh industrial environments. To meet the challenges that the industrial market presents, switch manufacturers have developed advanced designs with new materials to combat the harsh environmental elements. These switch designs optimize accuracy and performance, while increasing functionality and durability.

### Optimized switch designs

As industrial applications have evolved, so have the switch designs. Industrial equipment requires sealed, ruggedized switches that can perform flawlessly despite extreme vibrations and numerous, repeated impacts. Switch configurations reflect the complexity of the equipment design and are created in response to both safety regulations and extended life-cycle needs. Switches combine abuse-proof contacts that reduce maintenance, with haptic technology that provides a consistent tactile efficiency. Precise haptics, the feel of a switch when actuated, are favored among industrial engineers that must be certain of a switch's specific actuation within noisy and sometimes dangerous work areas. Designers must consider the full extent of these environments when specifying switches for specific applications.

New pushbutton designs developed for industrial applications, such as the PWR Series from C&K, provide excellent tactile feel with quiet detent. Designed with a SMD package, the switches allow for single step processing of SMD boards, eliminating the need for secondary processing.

### Extended life cycles

Industrial switches, particularly momentary, single-pole single throw switches,

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require performance life cycles that extend beyond one hundred thousand actuations, despite repetitive actuations necessary for most industrial applications. Power pushbutton switches have actuation life spans exceeding one million, and some feature 'double-break' contacts to provide additional accuracy. Specifying extended life cycle switches that are both durable and dependable will ensure long-term performance in industrial applications, especially when used in conjunction with other rugged components.

### Safety of personnel and equipment

Industrial operators must contend with dangerous, harsh conditions, and the interface with their equipment must be more than simply efficient—they must be reliable and safe. The physical switch must relay some kind of tactual sensation in order for the operator to know if it has been properly deployed. A wide selection of colors for LED backlighting is another safety measure considered by design engineers, enabling the switch to evoke an immediate visual response and introduce switch specificity. In some cases, even more so than a different of color, frequency of blinking is an important differentiator to further mark a switch's function. Operators also benefit from switch combinations that allow for ease of use, where a number of solutions are provided within a bi-directional or multi-channel switch that can be engaged in a variety of different directions. Keylocks are valued by many operators that must change the configuration of many switches at one station before moving onto another; and self-cleaning contacts are desirable for reliable operation. Beyond the safety of operators, there are also increasing concerns for switches to adhere to environmental standards as well. Halogen-free and RoHS-compliant options are usually preferred as industrial equipment designers are increasingly asked for more advanced "green" solutions.

### Sealed for integrity

IP67-rated sealing has become the defacto standard for all industrial switches. Design engineers continually work on new components that combine the same functionality of IP67 designs with increased sealing ratings, such as IP68 or IP69K, which protect important equipment from dust and total water immersion, respectively. Outer caps made of silicon protect switch mechanisms from debris and other harsh environment concerns and allow for repeated successful performances, while internally, the switch is sealed to protect from liquids that can also cause in-filed failures.

### Rugged switch materials

Versatile industrial switches must allow for surface mounting and the ability to withstand higher temperatures. Maximum exposure temperature requirements can be as high as 260°C in some cases. Process sealing is also an extremely important design consideration for engineers. Dependable, durable equipment requires switches that are able to thwart chemical contamination, hydraulic fluid and oil leaks, and additional hazards. Teflon films and adhesives are often used to seal switches that cannot be plated, as many component designs have space constraints even if the switch has the capacity to be mounted in a different manner.

### Accurate switching technology

Accommodating wide voltage ranges benefit integration options of switches. The

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most commonly used switches in harsh environments operate within a voltage range of 20VAC to 250VAC, have a current range of 10mA to 2A, and a maximum contact resistance of 100mΩ. Being able to withstand inrush loads of up to 7A while maintaining accuracy is essential for industrial equipment. Design engineers intentionally create switch components that can be easily customized based on the application-specific needs of operators and consumers. Flexibility in tailoring force values is important, and offering custom solutions by refining or expanding actuation travel options, or providing double-pole single-throw capacity, are hallmarks of a successful design.

### **Conclusion**

The challenges of industrial equipment manufacturers increase with each passing year, requiring design engineers to create components that reflect the environmental standards, safety regulations, and efficiency expectations for harsh environment systems. Design engineers must not only adhere to standards and guidelines already in place, but seek to exceed the requirements of existing applications when creating new designs.

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