

## Increasing Reliability with Sealed Switches

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Choosing the right electromechanical switch for any design involves many considerations. Panel size, terminal type, actuator style, illumination and contact material are just a few. However these decisions are all rather irrelevant if design engineers do not take into account what is perhaps the most important consideration of all: reliability.

While switch manufacturers play a large role in a device's reliability, the environmental conditions the switch will be exposed to is another significant factor that should not be overlooked. Switch life expectancy and even critical switch failure issues can arise from improperly installing a device that is not designed for harsh environmental conditions.

Thankfully, combating exposure to harsh conditions – such as extreme temperature, water, chemicals, dust, oil and other types of contaminants – has a simple yet effective solution: sealed switches.

### Sealed Switch Options

Because so much relies on switch reliability and several sealed switch alternatives exist, it is important to understand the primary options. These include IP-rated switches, splash proof boots and IP-rated devices with splash proof boots for maximum protection.

#### *Splash Proof Boots*

Though switches with splash proof boots do not provide a complete seal they do, however, offer adequate protection against a variety of contaminating factors. Boots come in a variety of materials, each best suited to specific applications. Thus, it is also important to choose the right material for every environment. Six of the most common boot materials are:

- Silicone rubber, which provides very good hot, cold, ozone, aging and ultra-violet light resistance. It also offers very good flexibility, resilience and tensile strength over a wide temperature range. However, it is less tear resistant than some other materials, so proper care must be used during installation.
- Natural rubber, which is a great choice for panel seals and gaskets.
- Polyvinyl chloride (PVC), which is typically only used for dust proof covers as other materials provide superior resistance against all other types of contaminants.
- Nitrile butadiene rubber (NBR), which offers an excellent balance between protecting against oil and cold temperatures, good elasticity and prolonged performance. However, it provides inferior ozone resistance.
- Ethylene propylene rubber (EPR), which while offering good hot, cold, dust, ozone and water proofing, it provides mediocre oil resistance.

Switch manufacturers can often retrofit most switch types, including pushbutton, rocker, rotary and toggle switches, with splash proof boots. The only exceptions are typically heavy-duty power rotary and slide switches.

While splash proof boots are an excellent choice for many designs, there are some common pitfalls that often come up during the boot installation process. These include improper panel material or panel thickness, the wrong boot for a specific switch, improper torque sequence or assembly process and insufficient thread engagement.

### ***IP-Rated Switches***

IP-rated switches are process sealed during manufacturing. They are subsequently guaranteed to resist certain environmental factors based on a ratings classification system established by the International Organization for Standardization's (ISO) IEC60529 standard.

This directive specifies the degree of protection of enclosures for low-voltage switches; specifically, protection of operators against contact with live or moving parts and the prevention of contamination by solid foreign material. The IP code is a specification used internationally and is similar to the National Electrical Manufacturers Association (NEMA) standard.

Common IP ratings include IP60, IP64, IP65 and IP67. Here is what each of these ratings means:

- IP60: Dust tight, but not protected against water.
- IP64: Dust tight and protected against splashing water from any direction.
- IP65: Dust tight and protected against low-pressure water jets from any direction.
- IP67: Dust tight and protected against effects of temporary immersion (up to 1 meter).

For designs requiring absolute precision, it is possible to rate to a specific IP rating and test according to a specific application's requirements. A few examples of testing include cycle tests, environmental tests and shock and vibration tests.



### ***IP-Rated Switches with Splash Proof Boots***

As a third sealed switch option, IP-rated devices with splash proof boots combine the sealed characteristics of IP-rated devices with an added splash proof boot. If an application requiring an IP-rated switch impacts the safety of either the equipment or human life, designing in such redundancy to ensure the highest level of protection against contamination and disastrous switch failure can be essential.

### **How to Select the Right Sealed Switch**

The ideal sealing method for a specific application – whether that is a splash proof boot, an IP-rated device or a combination of the two – is largely dependent on the environment the switch will be used in. The most common harsh application environments are automotive/transportation/heavy equipment, industrial control and medical.

#### ***Automotive/Transportation/Heavy Equipment***

A key characteristic of automotive/transportation/heavy equipment environments is assured prolonged or particularly obtrusive exposure to contaminants. These contaminants include dust, dirt and liquids. Such environments can also present temperature and vibration concerns, which could affect the fit and performance of a splash proof boot.

IP-rated switches are the best choice for automotive/transportation/heavy equipment applications. For most designs, an IP64 rated device, which is guaranteed dust tight and protected against splashing water from any direction, is sufficient.

#### ***Industrial Control***

Several questions must be asked when selecting a switch for industrial control environments:

- What types of processes are being used in the facility?
- What is being made in the facility?
- Are there any contaminants in the air that could potentially affect switch performance?

All these factors are critical in the decision. In many cases, switches in industrial control environments will be exposed to fluids such as oils, cleaners or materials used in manufacturing processes. In such environments, where heavy machinery is often present, the consistent performance of a switch can become a safety issue with dire consequences.

Typically, industrial control environments require IP-rated switches. However, when safety is a factor in such environments, an IP-rated device with a splash proof boot is recommended. For example, consider the possibility that in such an environment, the switch housing could become compromised; thus, breaking the housing's seal. The protective boot would thus provide a second, but necessary barrier of defense against contaminants.

## Medical

Key concerns in medical environments are the chemicals used for sterilization, which can impact the performance of the switch. Key specifications that must be considered include the chemicals the switch is exposed to, frequency of actuation and wear and tear. In many cases, IP-rated devices are not required for medical applications. Instead, splash proof boots are ideal for these environments, since constant exposure to contaminants isn't likely, but semi-frequent routine exposure is expected. As mentioned, the harsh chemicals often used for sterilization in medical environments can impact switch performance.

In conclusion, the right sealed switch – whether protected by a splash proof boot, IP-rated or a combination of the two – can create the peace of mind that no matter what the environmental conditions, actuation will occur every time without fail. Many designs do not require sealed switches, but for those that do, not using one can be a costly mistake that can be easily avoided.

