Expert Q & A:
Combating Environmental Pollutants to Preserve Switch Performance and Reliability

By NKK Switches

Choosing the right electromechanical switch involves many considerations. Panel size, terminal type, actuator style, illumination and contact material are just a few. However these decisions are irrelevant if design engineers do not take switch reliability into account.

While choosing a reputable manufacturer plays a large role in a device's reliability, the environmental conditions and contaminants 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.

Below, Yosuke Nishiyama, engineering manager, NKK Switches, addresses the most common questions associated with combating premature switch failure due to exposure to harsh environmental conditions.

Q: What are the most common contaminants that lead to premature switch failure?

A: The most common issues result from switch exposure to extreme temperatures, water, chemicals, dust, oil and other types of pollutants.

For example, one of our customers manufactures portable audio equipment for the television and motion picture industries. Its devices are designed to operate in the field – whether that be slung over a sound technician's shoulder as he treks through the jungle during the filming of a reality television show, or tossed in and out of a news van as a broadcast team keeps up with daily headlines. In such environments, exposure to any number of contaminants is almost guaranteed.

For this customer and many others, improperly installing a switch that is not designed for such harsh environmental conditions on an interface that will be used in such surroundings can be disastrous.

Q: In which other environments does exposure to these contaminants often occur?

A: The three most common environments where switches are likely to be exposed to harsh conditions and contaminants are automotive, transportation and heavy equipment applications; industrial control panels; and on medical equipment. In each case, unique environmental factors need to be considered.

For example, a key characteristic of automotive, transportation and heavy equipment applications is prolonged or particularly obtrusive exposure to dust, dirt and liquids. Vibration is also a concern. In industrial control environments, switches are often exposed to fluids such as oils, cleaners or materials used in the manufacturing processes. A key concern for switches used on medical equipment is the chemicals used for sterilization, which can impact the performance of the switch. In all of these environments, the consistent performance of a switch can become a safety issue with harmful consequences.

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Q: What is the best way to combat premature switch failure due to exposure to harsh environmental conditions?

A: The most effective means of ensuring proper switch function and life expectancy is to leverage sealed switches. However, there are several options when it comes to sealed switches. These include IP-rated switches, splash proof boots and IP-rated devices with splash proof boots for maximum protection.

Q: What are the key characteristics of IP-rated switches?

A: 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 are the best choice for automotive, transportation and 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.

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Q: When are switches with splash proof boots a good choice?

A: Switches with splash proof boots are ideal for medical and industrial control environments, since constant exposure to contaminants isn't likely, but semi-frequent routine exposure should be expected. As mentioned, the harsh chemicals often used for sterilization in medical environments can impact switch performance. However, the exposure to these chemicals is only during cleaning and typically not when the equipment is in use.

Though switches with splash proof boots do not provide a complete seal, they do 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.

Q: When is the redundancy of an IP-rated switch with a splash proof boot recommended?

A: If an application requiring an IP-rated switch impacts the safety of either the equipment or human life, designing in such redundancy is important to ensure the highest level of protection against contamination and disastrous switch failure can be essential.

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

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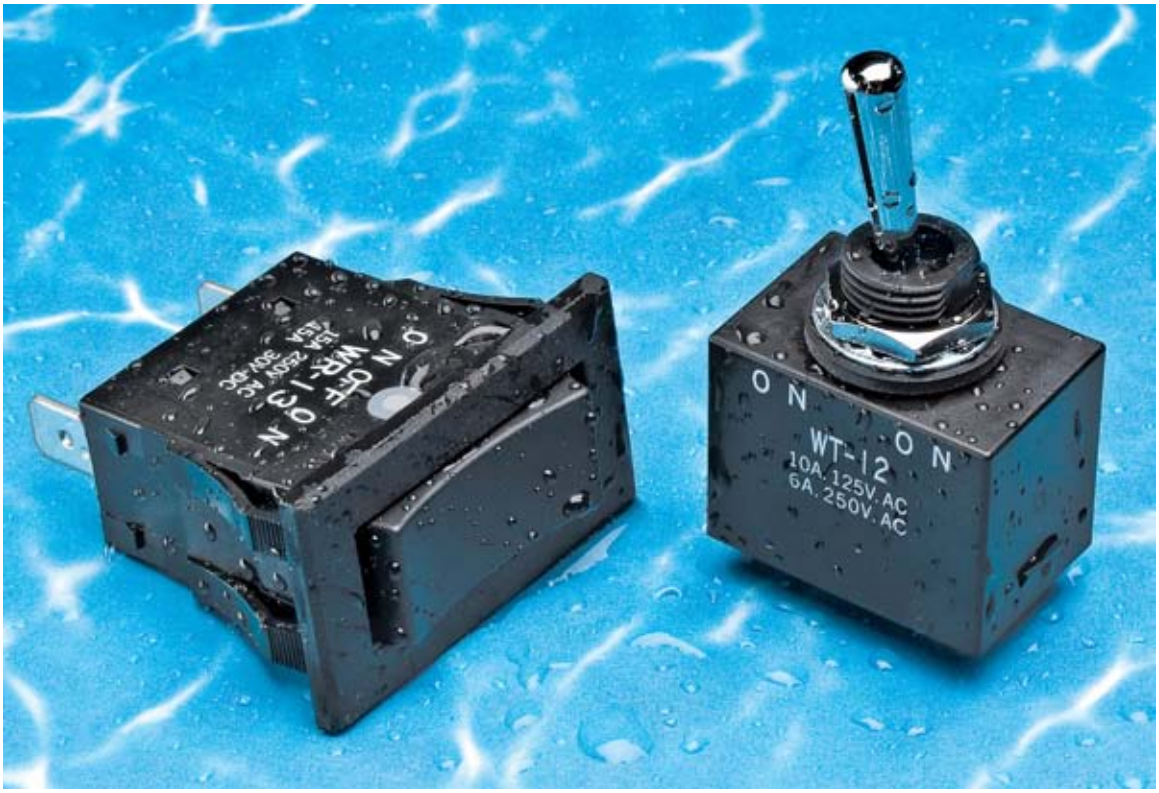
Engineers should answer several questions when selecting a switch for industrial control environments. These include:

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

Q: What is the key takeaway?

A: Because so much relies on switch reliability, choosing and implementing the right sealed switch is critical. And while the ideal sealing method for a specific application is largely dependent on the environment the switch will be used in, the peace of mind that comes from knowing a switch will function as it should every time regardless of harsh conditions is universal.



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