

WHITE PAPER

# Expert Q & A: Combatting Environmental Pollutants

## Environmental Protection for Modern Interfaces



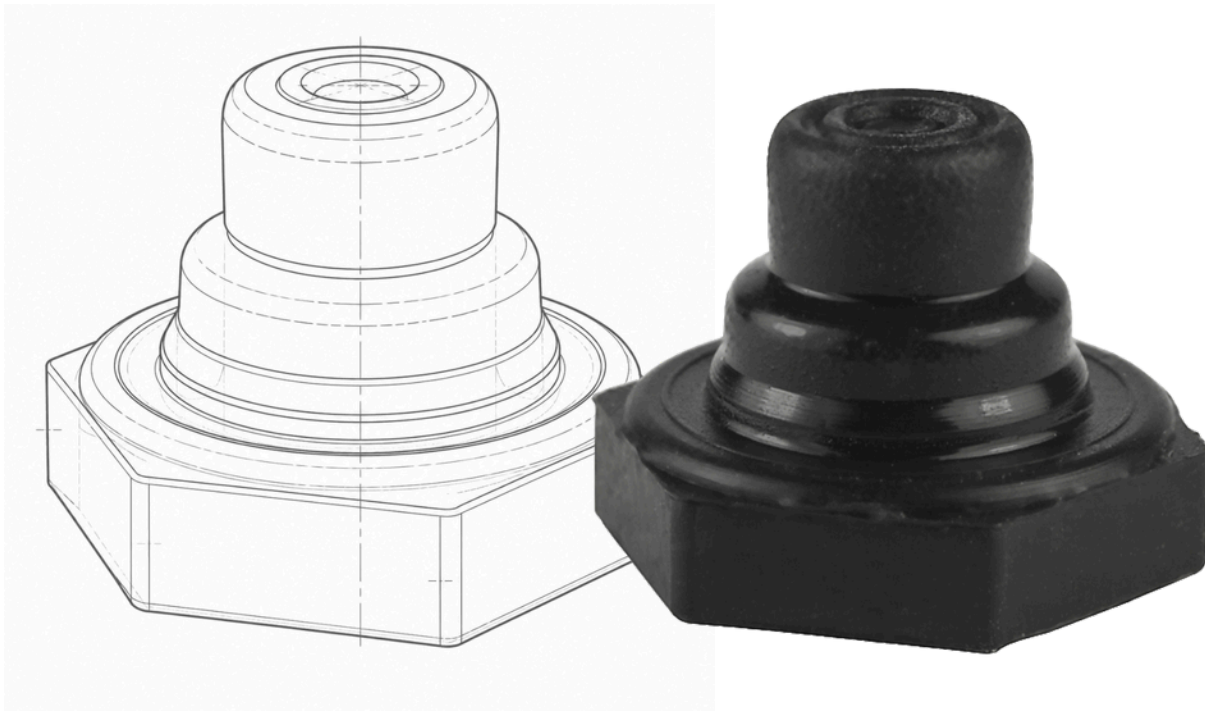
# Introduction

Many interface failures are not caused by electrical overload or mechanical wear. They begin when contaminants enter the switch assembly and compromise performance.



Improper switch selection can lead to reduced operational lifespan, inconsistent performance, costly maintenance, and premature equipment failure. Environmental protection must therefore be considered early in the specification process, particularly in applications involving robotics, industrial automation, transportation systems, outdoor electronics, mobile equipment, and compact operator interfaces.

In this whitepaper, Yosuke Nishiyama, engineer and NKK's product planning manager addresses common questions associated with protecting operator interfaces in harsh environments and improving long-term interface reliability.



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

The most common issues result from switch exposure to extreme temperatures, water, chemicals, dust, oil, sand and other types of pollutants. 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 environments does exposure to these contaminants often occur?

The three most common environments where switches are likely to be exposed to harsh conditions and contaminants are transportation and heavy equipment applications; industrial control panels; and medical equipment.

**For example**, a key characteristic of 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 process. A key concern for switches used in medical equipment is the chemicals used for sterilization, which can impact the performance of the switch. In all these environments, the consistent performance of a switch can become a safety issue with harmful consequences.

### Transportation & Heavy Equipment

Dust, dirt, liquids, and vibration create prolonged mechanical and environmental stress.

### Industrial Control Panels

Oils, cleaners, and manufacturing process materials can affect switching reliability.

### Medical Equipment

Sterilization chemicals may impact switch performance during cleaning routines.

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

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, splashproof boots, and IP rated devices with splashproof boots for maximum protection.

### IP RATED SWITCHES

Process sealed during manufacturing and classified for dust and water protection.

### SPLASHPROOF BOOTS

Add a protective boot for semi-frequent exposure to contaminants.

### IP RATED + BOOT

Use redundant protection for safety-sensitive equipment or high-risk environments.

### Unprotected operator interfaces lead to:



#### Unexpected downtime

Contaminant ingress can cause failures when you need equipment most.



#### Increased maintenance

Contamination leads to more frequent service and higher labor costs.



#### Field replacements

Failed components require repairs or replacements in the field.



#### Reduced equipment availability

More failures mean less uptime and lower productivity.



#### Safety concerns

Interface failures can compromise safety functions and put people at risk.



#### Shortened product life

Exposure accelerates wear and corrosion, reducing overall product life.



Environmental contaminants don't just affect the switch—they impact your entire operation.



Protect your operator interfaces. Protect your performance.

## Q: What are the key characteristics of 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 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:

RATING	DUST PROTECTION	WATER PROTECTION	TYPICAL USE
IP60	Dust tight	Not protected against water	Dry, dusty environments
IP64	Dust tight	Splashing water from any direction	Most transportation/heavy equipment designs
IP65	Dust tight	Low-pressure water jets from any direction	Washdown-adjacent environments
IP67	Dust tight	Temporary immersion up to 1 meter	Higher exposure risk applications

Additionally, NKK Switches has an IP68 rated option for some specific series of products. 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 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.

### Engineering note

NKK Switches also has an IP68 rated option for some specific series. For precision requirements, devices can be rated and tested to the application, including cycle, environmental, shock, and vibration testing.

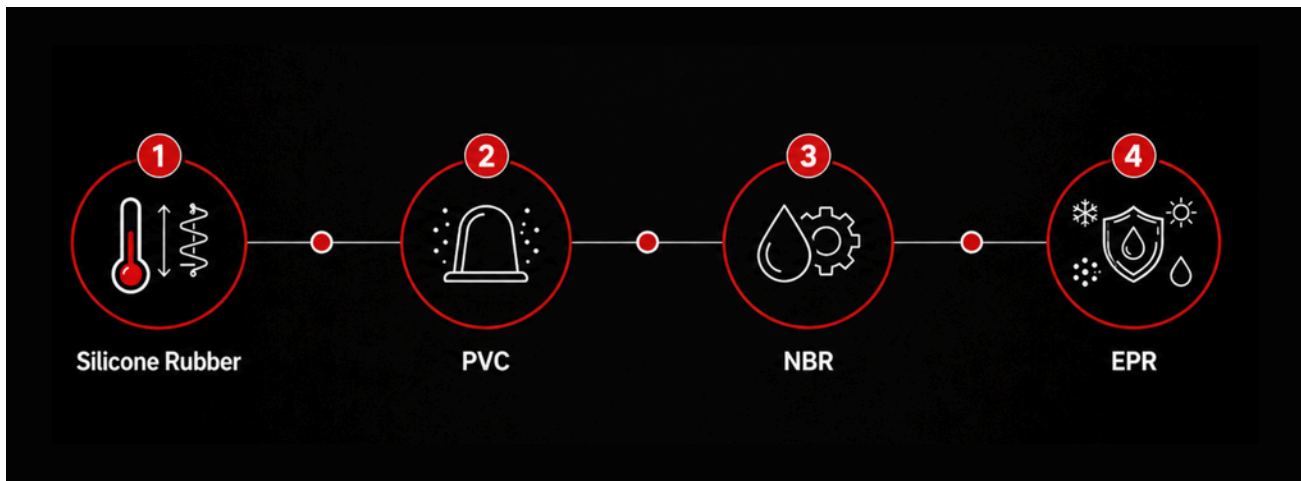


## Q: When are switches with splashproof boots a good choice?

Switches with splashproof 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 splashproof 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. Four 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.
- Polyvinyl chloride (PVC), which is typically only used for dustproof 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, provides relatively less oil resistance.



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

While splashproof 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 splashproof boot recommended?

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

**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 Splashproof 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.



**Simplify assembly with NKK switches available with factory-installed splashproof boots.**

### Questions for industrial control environments

**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?

Because so much relies on switch reliability, environmental protection should be evaluated before a product reaches production. The right combination of switch design, IP rating, and protective accessories can help improve long-term performance in demanding environments.

Many NKK switch series are available with splashproof boot options and other environmental protection solutions designed to simplify specification and assembly.

Explore environmental protection options at [nkkswitches.com](https://nkkswitches.com).



Website: [nkkswitches.com](https://nkkswitches.com)

7850 East Gelding Drive  
Scottsdale, AZ 85260  
480-991-0942

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SWITCHES

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