

# Plug into Safety with Switch-Rated Connector Systems

Presentation by: Tom Beranek, Global Product Manager – ArcArrest, Molex

## KEY TAKEAWAYS

- Switch-rated connector systems offer flexibility and safety.
- Safety is the primary demand driver for organizations to adopt switch-rated connectors.
- The second major benefit of adopting switch-rated connectors is code compliance.
- Fast and safe equipment changeouts reduce downtime.
- Switch-rated connectors alleviate some of the issues caused by worker shortages.
- Design and testing focus on safety in Molex products.

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## OVERVIEW

Hundreds of incidents of improperly performed work on energized equipment occur every year. On average, one person per day in the United States falls victim to a fatal arc flash incident out of an average of 20 daily arc flash workplace incidents.

Molex ArcArrest switch-rated connector systems protect workers and equipment and maintain productivity. Implementing ArcArrest products helps ensure energized equipment is properly powered down prior to maintenance, resulting in dramatically improved plant safety and efficiency.

Tom Beranek explained what a switch-rated connector is and its main benefits. He then demonstrated the safety advantages and features of Molex ArcArrest switch-rated connectors and other devices.

## KEY TAKEAWAYS

### Switch-rated connector systems offer flexibility and safety.

Switch-rated connector systems are plugs and receptacles listed under UL 2682 that can operate as switches and can be used to disconnect equipment, even while energized. They are a “separable switch” that allows users to quickly and positively remove power from a system.

Standard plugs and receptacles are not designed to be able to break industrial voltages such as 480V 3 Phase—the most commonly used power system in U.S. industrial plants. A regular plug and receptacle should not be used as a switch, as it exposes operators to an arc as the plug and receptacle are pulled apart, and possibly also to touching live electrical components. Standard plugs and receptacles are not designed to withstand repeated usage as a switch, either, and will quickly degrade if used as such.

Switch-rated plug and receptacle connectors offer the flexibility of traditional plug and receptacles, plus the safety and functionality of a switch. The connector is essentially a separable switch that can be pulled apart, offering both visible and invisible safety benefits. Switch-rated connectors are rated only in AC as a switch.

**Figure 1: Combining two benefits in a single connector**



### Safety is the primary demand driver for organizations to adopt switch-rated connectors.

The concept of using a plug and receptacle as a switch was conceived of in the 1950s by a French electrician who witnessed a severe injury due to unplugging a motor. However, it was not until the late 1990s/early 2000s that the industry became more interested in using the configuration for safety reasons. Today, there are only three companies worldwide that offer switch-rated connector systems, including Molex.

To protect workers and adhere to Occupational Safety and Health Administration (OSHA) requirements, switch-rated connectors offer a cost-effective solution that is easy to implement. Switch-rated

connectors help companies satisfy a significant OSHA safety requirement 29 CFR 1910.333(a)(1) “Deenergized parts.” That requirement states:

Live parts to which an employee may be exposed shall be deenergized before the employee works on or near them, unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations.

Meaning, parts must be de-energized and proven to be de-energized before being worked on. The National Fire Protection Association NFPA 70E 120.5 offers guidance for how to prove de-energizing:

Use an adequately rated portable test instrument to test each phase conductor or circuit part to test for the absence of voltage. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on any known voltage source.

Satisfying this OSHA regulation when using traditional switches requires trained technicians and specific personal protective equipment (PPE). Potentially broken parts, faulty design, or degradation over time make it more likely for a switch to fail, which is why these regulations require voltmeter proof of absence of voltage conduct by an electrician or a specially trained technician wearing special PPE.

With a switch-rated connector, the number one benefit is removing the hazard. As a separable switch, the physical and visual separation proves there is no power coming out to the machine, which satisfies the requirements of OSHA and NFPA as proof that power has been removed, for a safer, faster, and easier approach to de-energizing.

Once a machine has been proven to be de-energized, it must be locked out. Lockout tagout is simple and easy when using a switch-rated plug and receptacle.

**Figure 2: Lockout tagout**



This is one of the top citations every year that OSHA issues throughout the United States, and it’s an easy one to overlook because people are in such a hurry. They want production to run as fast, and as high, and as efficiently as they can. They want no downtime. So it’s very easy for workers to skirt this requirement before they start working on something. I can’t think of an easier way to perform lockout tagout than to separate a plug and receptacle, and I know it’s safe to work on [because] you can put the lock through the plug itself; it physically prevents you from connecting.

*Tom Beranek, Molex*

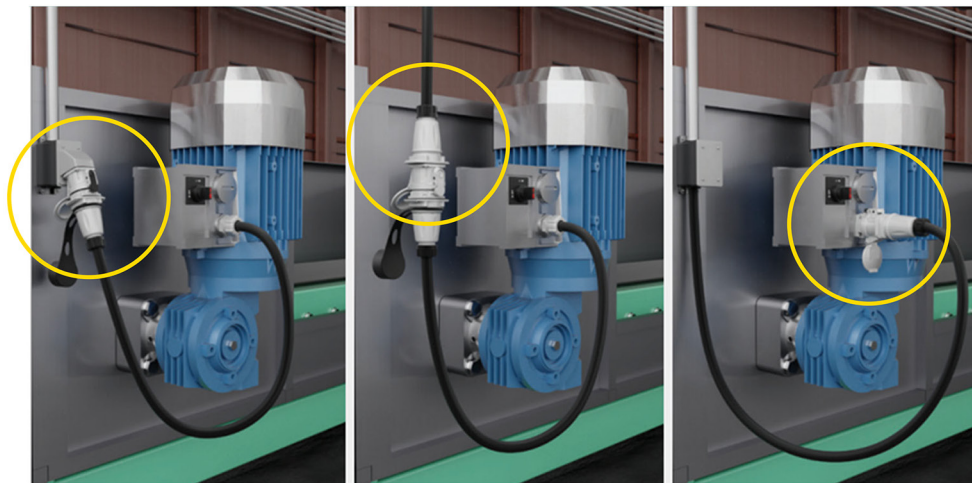
Figure 3: Switch-rated connector versus traditional switch



**The second major benefit of adopting switch-rated connectors is code compliance.**

Code compliance, and especially adherence to the National Electrical Code (NEC), is supported by the use of switch-rated connectors. NEC 430.102(B)(1) requires a disconnecting means for each motor, and it must be located in sight from the motor location and the driven machinery location. “In sight” means the disconnecting means is visible, not more than 50 feet away, and accessible. Switch-rated connectors support compliance with NEC codes because they are compact and flexible in how they can be mounted.

Figure 4: Simplified and flexible NEC compliance



From L to R: a receptacle mounted to a box onto the wall with a short whip/flexible cord from the motor to the receptacle, a core drop coming down from the ceiling, connector mounted flush to the motor.

**Fast and safe equipment changeouts reduce downtime.**

Having motors pre-wired and ready to go reduces downtime and equipment changeouts. Using motors that are pre-wired with a switch-rated connector allows warehouse maintenance workers on the third shift, for example, to easily unplug a downed conveyor motor, move in another pre-wired motor, and plug it in to return operations to normal—without oversight or help from an electrician.

Downtime can be reduced by providing a fast, simple, and safe to de-energize machine, allowing it to be worked on quickly, then plugged back in to get it up and running.

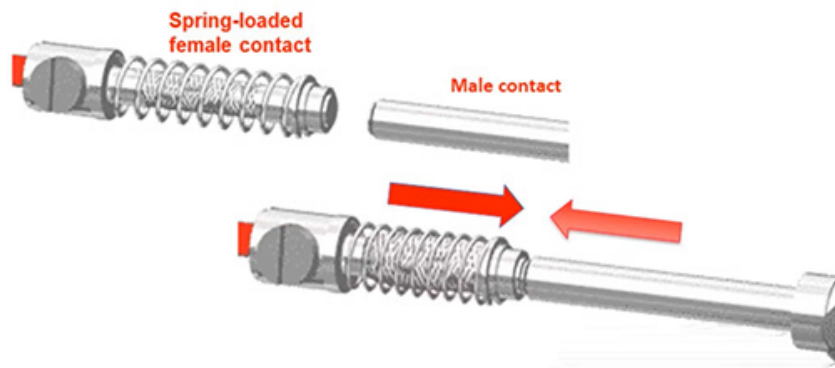
## Switch-rated connectors alleviate some of the issues caused by worker shortages.

The industry-wide worker shortage can make it even more difficult to expand an organization's pool of technicians, such as electricians and mechanics. Using switch-rated connectors that allow workers to de-energize equipment quickly and safely, themselves, can free up precious existing technician resources to focus on other, more important work.

## Design and testing focus on safety in Molex products.

In Molex's ArcArrest switch-rated connectors, the spring-loaded contact in the receptacle is the source of power. This forms a butt contact with the male end coming from the plug. A Silver-Nickel contact tip provides the ability to withstand thousands of arc strikes without deteriorating or welding together. Compressed powdered metals are used for the tips, and because silver and nickel have different melt temperatures, they cannot be melted together.

Figure 5: Spring-loaded butt contact configuration



This contact design has been used in industrial switches, relays, and circuit breakers for decades. It is well-known and commonly used throughout the industry for making or breaking electrical circuits. Motors are a common application for ArcArrest, where the switch-rated connectors are used as a line-of-sight disconnect for motors, for fast and simple lockout/tagout, and for quick equipment change outs. ArcArrest products are also used as an upgrade to traditional plugs and receptacles, in industries such as pharmaceutical or food processing, to give operators a safer means of connecting equipment. They also make great power receptacles for welders and other portable equipment.

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**Think of a shipyard or any other heavy metal fabricator. You've got welders everywhere, and those pieces of equipment draw a lot of current. Welding receptacles are typically 30A, at least. So for providing a nice, safe means of connecting and disconnecting all in one—[ArcArrest] is perfect for that.**

*Tom Beranek, Molex*

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To be classified under UL 2682, the Molex switch-rated connectors must undergo an endurance test, as well as a variety of other mechanical and impact tests. For the short-circuit test for a 30 amp switch-ready device, the connector would have to undergo 6,000 cycles of making and breaking the circuit under load at 30 amps and 600V. This test takes approximately 10 hours to run, after which that device still has to be operable and safe to use.

Molex also provides auxiliary switches as an option for their devices. These are useful when connected to a variable-frequency drive (VFD) or soft starter, to communicate connection status. That is especially important when dealing with VFDs, as a shutdown while the VFD is actively controlling a motor can result in a high amount of energy going back into the drive and damaging it.

## ADDITIONAL INFORMATION

**Molex ArcArrest.** For more information, visit

[www.molex.com/molex/products/family/arcarrest\\_connector\\_system](http://www.molex.com/molex/products/family/arcarrest_connector_system)

## BIOGRAPHY

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Tom Beranek is Molex Global Product Manager/Arc Arrest. He has been in the electrical industry for 15+ years. Tom has a BS in Mechanical Engineering and an MBA from the University of Wisconsin.