Russelectric Inc
800 225-5250
russelectric.com

Fail-Safe vs. Maintenance Bypass Switches: A Comparison

Introduction

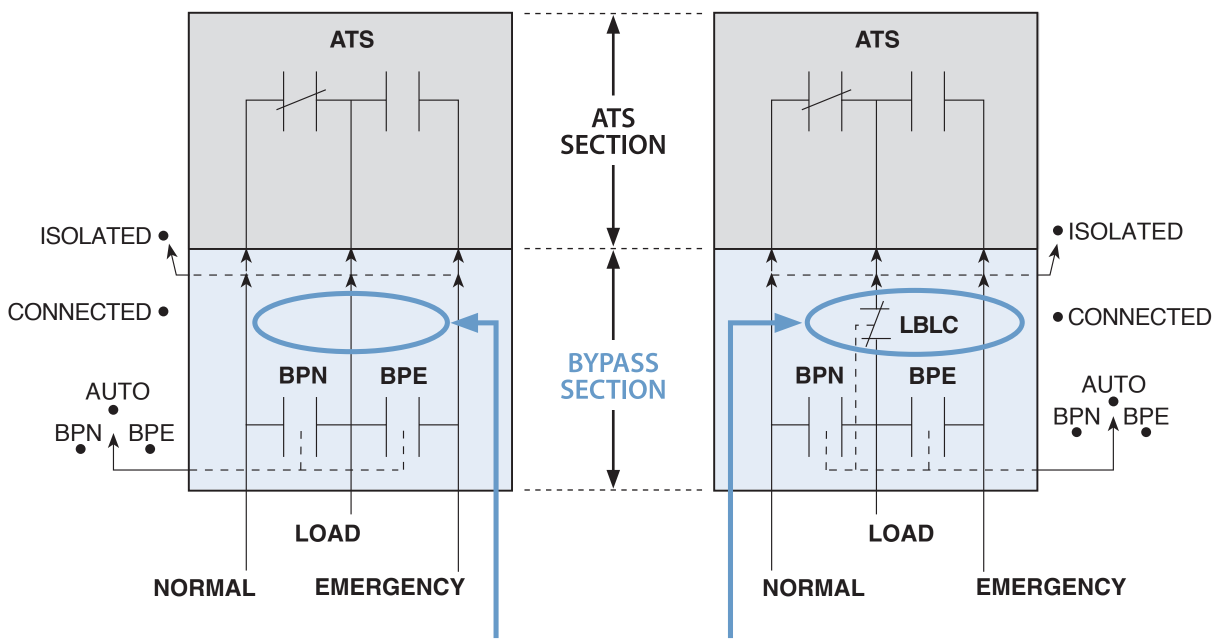
This tech brief is intended to explain the differences between **Fail-safe** and **maintenance** bypass/isolation switches.

Please note that this brief deals only with the bypass function, and this discussion should not be confused with open- or closed-transition automatic or manual transfer switching.

Bypass-Isolation Switch Comparison

Figure 1: Maintenance Bypass Design

Figure 2: Fail-safe Bypass Design



As shown above, competitors' designs do not have any load contacts. Russelectric's design has overlapping load contacts (not shown), however, both designs add steps and time, and limit the operator's options in an emergency situation.

NOTE: The make-before-break contacts in Russelectric's Maintenance Bypass design eliminate any momentary outage on bypass, but the switch has the same operational limitations as competitors' switches.

Additional load contacts in the Fail-safe Bypass design reduce the number of steps and time required to bypass the ATS by allowing the bypass switch to be thrown at any time to either source — *regardless of the position or condition of the ATS.*

NOTE: Russelectric is the ***only manufacturer*** to offer this bypass design.

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Fail-safe Bypass Design

Fail-safe bypass/isolation switches provide an absolutely foolproof method of bypassing either the normal or the emergency power source around the ATS part of the unit to the load.

To achieve maximum operational flexibility, the **Fail-safe** bypass design utilizes an additional set of load contacts between the manual bypass switch section and the automatic transfer switch section *(see Figure 2)*, which allow the bypass switch to be thrown at any time — *regardless of the position or condition of the transfer switch*. These extra load contacts in the bypass switch section isolate the load side of the ATS and allow an operator to actuate the source bypass contacts with no thought whatsoever to the ATS. This is a tremendous benefit in an emergency situation where normal power has been lost and the ATS has failed to transfer. After quickly checking to see that emergency power is available (automatic engine start would have been initiated upon failure of the normal source), the operator can simply throw the bypass handle to emergency — in one simple motion.

Conversely, **Maintenance** bypass switches do not offer the flexibility of the **Fail-safe** bypass switch design. With **Maintenance** bypass designs, the automatic transfer switch must be in the same position (i.e., normal or emergency) as the source to which the load is being bypassed (i.e., normal to load or emergency to load). Otherwise, a direct short would occur (e.g., if the ATS were in the normal position when the bypass switch was actuated emergency to load). In many of these designs, the only thing preventing this type of catastrophic event is an elaborate system of electrical solenoids or electrical and mechanical interlocks — weak links in a product whose sole purpose is to enhance the safety and reliability of the electrical system.

Advantages

- Designed for rapid response in emergencies, the **Fail-safe** bypass switch offers a fast, easy, totally mechanical, and absolutely foolproof method of bypassing the ATS — *regardless of its condition or position* — and allowing an operator to restore power quickly to vital circuits in an emergency.

- This design is extremely simple and reliable. With its additional load contacts and foolproof mechanical interlocks, the **Fail-safe** bypass switch design precludes the possibility of a direct short circuit that could bring down the entire power system.

- The **Fail-safe** bypass switch's foolproof mechanical interlock system is not dependent upon additional electrical interlocks, such as those required with **maintenance bypass** designs. Mechanical interlocks are engineered and purpose-built for extreme reliability. Their cam design, precision machining, and welding ensure long-term alignment and flawless operation without need for adjustment. Aircraft ball joints prevent interlock rods from binding.

- **Fail-safe** bypass switch contact mechanisms are identical to those used in the switch's ATS section, simplifying maintenance and the stocking of spare parts.

Disadvantage

- When a **Fail-safe** bypass switch is bypassed, its **load** contacts will cause the same type of momentary load interruption that occurs when transferring a comparably sized transfer switch.

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Maintenance Bypass Switch Design

With a **maintenance** bypass switch, in order to bypass to either the normal or emergency source, *the ATS must be in the source position to which the operator wishes to bypass*. If it is not, then it must be electrically or manually transferred to that source before it can be safely bypassed. In some designs, feeder breakers must be opened first to accomplish this. Or, the manual bypass switch must be bypassed to whatever source position the ATS is in, the ATS must be isolated, then the manual bypass switch must be bypassed a second time to the desired alternate source. In an emergency situation, these additional steps can significantly increase the time required to bypass the ATS and restore power to the load. And, if the ATS portion of the unit has been damaged or intentionally locked in the opposite position, a manual transfer could be at best extremely hazardous or at worst impossible. In this type of situation, operating the bypass switch could trigger an extended electrical outage (ironically, a situation it was designed to prevent) and/or present a serious safety hazard to personnel.

Advantage

- Allows bypass of the ATS section from either normal source to load or emergency source to load without load interruption, *only if the ATS is connected to the source to which the operator wishes to bypass*; otherwise, the operator must first manually transfer the ATS to this source and experience a load interruption.

Disadvantages

- Designed primarily to allow maintenance without an interruption of load, **maintenance** bypass switches do not meet the specification requirement: "Bypass of load to either the normal or emergency power source with complete isolation of the automatic transfer switch shall be possible regardless of the position or condition of the automatic transfer switch".

  If for some reason, the automatic transfer switch portion of the unit has been rendered mechanically or electrically inoperable while in the opposite position, bypass becomes impossible and the bypass/isolation switch is left useless. In accordance with UL l008, Paragraph 19.12, manual operation of the automatic transfer switch is hazardous unless the manual operating handle of the transfer switch is external to the enclosure (a modification not typically specified).

- To prevent the possibility of a direct short circuit, the operation of most **maintenance** bypass switches is inhibited by an elaborate arrangement of electrical and mechanical interlocks that prevents the operator from bypassing the normal source to load while the transfer switch is in the emergency position or vice versa. The more elaborate these safeguards, the greater the possibility of their malfunctioning or of operator error.

Conclusion

With its additional (break-before-make) load contacts, the **Fail-safe** bypass switch design reduces the number of steps and, therefore, the time required to bypass the ATS. This design allows the bypass switch to be thrown at any time — *regardless of the position or condition of the ATS* — dramatically simplifying the switch's operation in emergencies and virtually eliminating the chance of operator error.

So, unless an application involves an installation where a momentary (approximately 3-5 cycles) load break would be unacceptable (such as a facility without a UPS system), load-break bypass switches offers key operational advantages over no-load-break bypass switches.