



Elements of a “Fail-to Safe”, Control Reliable Inspection System (CRIS) Methodology as per the patented CRIS2020 Barcode Verifier

US Patent #s 8,077,051 and 7,983,779

The Key element in the “Fail to Safe” CRIS methodology is that the inspection system to assumes the “Mismatch or Wrong Code” condition is present at the start of each machine cycle. This will initiate the Fail-to Safe shutdown process, unless an overriding positive match confirmation signal comes from the inspection device .

Only an authorized and identified operator may teach-in, or select from a recipe screen, a new barcode to load into the inspection system for a product change. The newly taught or selected code is set into the “Positive Match Code” register in the inspection system.

An inspection device communications heart beat is required to confirm an active communication loop between the inspection device and PLC.

Dual trigger eyes with complimentary outputs should be used. The output from the first eye directly triggers the scanner, and the other runs to the PLC. The second eye runs a complimentary signal back to the PLC to back-check the function of the trigger system. This allows for immediate trigger eye failure detection.

The machine cycle process is as follows:

- Carton triggers photo eyes, one signal goes high and one goes low to the PLC to monitor trigger eye health. The second signal from the first eye goes directly to trigger the scanner.
- The inspection system triggers and inspects the product. If a barcode is read, it compares it to the match code register “Positive Match Code”.
- Trigger eye signal goes low signaling “End of Barcode Cycle” to scanner AND to the PLC.
- If the PLC sees the data from the inspection device and it matches the data in the “Positive Match Code” register, the barcode is confirmed to be a good match and the machine is allowed to continue running its process.
- If the PLC sees “No Read” data from the inspection device, the barcode is either unreadable or not present and the carton reject signal from the CRIS system is fired. The reject of the carton off the production line MUST be confirmed by a reject confirmation eye tied back into the Control Reliable Inspection System, or the production line will immediately be shut down to prevent the unidentified product from exiting the inspection zone. If this “No Read” sequence happens three consecutive times, the machine is shut down.
- If the PLC sees both Trigger Eye Inputs only and no data from the inspection device, the barcode is a “Mismatch or Wrong Code” and the machine is immediately shut down. This immediate shutdown would also occur if the scanner itself failed or the wiring from the scanner to the PLC became compromised.



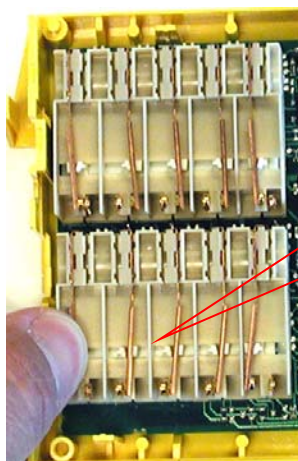
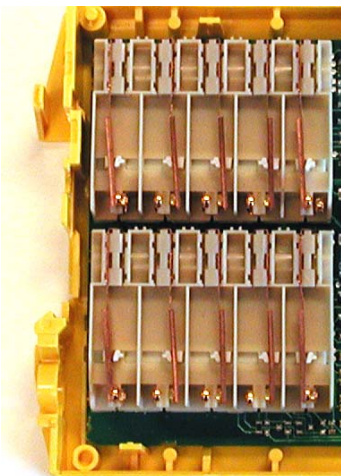
For a “Fail to Safe” system, the controlled shutdown command for the machine is run to the PLC to perform a normal controlled stop. As with most safety systems, an E-Stop circuit is run parallel to the controlled shutdown signal. The E-stop relay is fired after a predetermined time period expires, this time period allows the machine to perform a normal shutdown before opening up the E-Stop contacts. This E-Stop circuit runs through a safety relay that allows redundant positively driven contacts to perform the guaranteed machine shutdown function (Barcode Mismatch positive allergen) in the event that the controlled shutdown relay contacts weld or any number of other machine stop errors occur. The use of a Certified Safety Relay allows back checking of the safety shutdown circuit back to the PLC. This will detect any single component failure in the shutdown circuit, while still providing a guaranteed safe stop of the machine.

Using the patented Fail-to-Safe setup, we have verify:

- Secure product teach-in, or product recipe selection, by authorized identified personnel only.
- All events, including product changeovers and any component failures, are Time and Date stamped and are available for real time updating via the onboard Ethernet connection.
- Confirmed a correct matching Barcode for each product allowed to pass the inspection point.
- Incorrect carton (Good read but mismatch code) with immediate shutdown
- No Read / Unreadable code product has been confirmed rejected from the production line

A “Fail to Safe” Control Reliable Inspection System (CRIS) system MUST detect within one cycle:

- Failed, unplugged, or covered trigger eye within a single product inspection cycle
- Failed scanner or ANY compromised scanner output wiring with immediate shutdown after one inspection cycle
- Failure to reject bad product from the line
- Failure of one of the two sets of contacts on the Safety Shutdown Relay while still guaranteeing a safe machine shutdown AND the prevention of further machine running until the safety relay is replaced.



Safety Shutdown Relay; Notice the contacts are all linked with a plastic connection bar to be



Testing procedures to determine if an inspection system meets “Fail-To-Safe” criteria for a Control Reliable Inspection System (CRIS)

- 1) With the system powered, **disconnect the inspection device, (scanner or camera)** from the system. Within a short time the lack of Heartbeat signal must be detected and the system must shut down and not allow a restart until communications with the inspection device can be confirmed. The Human Machine Interface (HMI) display screen must display the detected failure and advise corrective action.
- 2) **Disconnect one of the trigger eyes.** The trigger fault must be detected within two product inspection cycles. This fault must shut the system down. The HMI must display the detected failure and advise corrective action.
- 3) **Misalign one of the trigger eyes** so that it cannot see the reflector (or cover the eye). The trigger fault must be detected within two product inspection cycles. This fault must shut the system down. The HMI must display the detected failure and advise corrective action.
- 4) **Run a product with no Barcode** past the scanner with the reject mechanism disabled. The CRIS must detect that the product had not been rejected from the line and must shut the production line down to prevent the product from escaping down stream. The HMI must display the detected failure and advise corrective action.
- 5) **Run a product with the incorrect barcode** past the scanner. The CRIS must immediately shut down as the product exits the scanning area. The system must not allow restart until the critical fault of the incorrect carton has been acknowledged and logged.
- 6) With the CRIS in an stopped condition, jumper the back-checking contact of the safety relay closed (or if no safety relay is used jumper the run contact closed) and test if the system can detect the failure of the contact opening on the next request for machine startup. The machine **MUST** still perform a stop and not allow the machine to be restarted until a new safety relay is in place. The HMI must display the detected failure and advise corrective action.