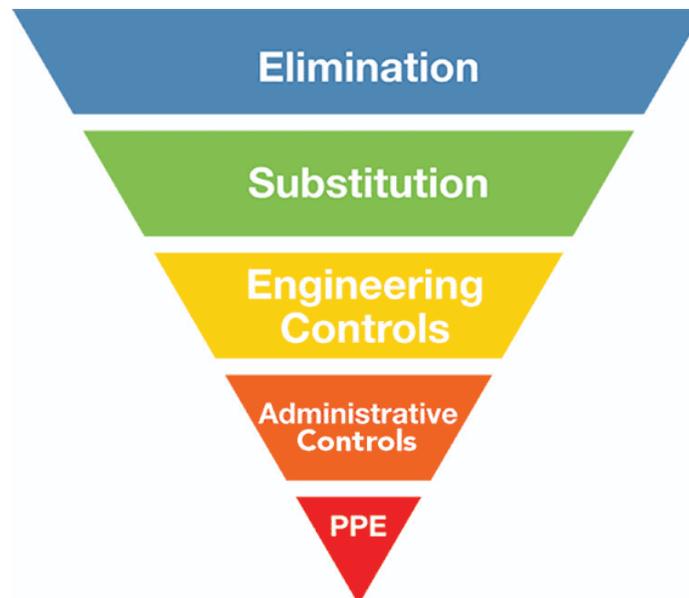


## Example of a Trapped Key Interlock System in the Control of Multiple Energy Sources

Controlling hazardous energy to allow safe work with machinery, during all types of interactions and operations, can be complex and difficult to enforce, particularly when there are multiple energy sources involved.

Hazards associated with electrical energy sources are often quickly identified, but what about hydraulic and pneumatic sources? Does the removal of energy sources create a hazard and how is stored energy managed?

Lockout/Tagout programs are designed and implemented to mitigate risk, but there is no guarantee that employees de-energize and lock energy sources off. Lockout/Tagout is an administrative control, so there is a reliance on human behaviour, and whilst, if managed effectively, it can be functional, it may fall down where multiple energy sources exist.

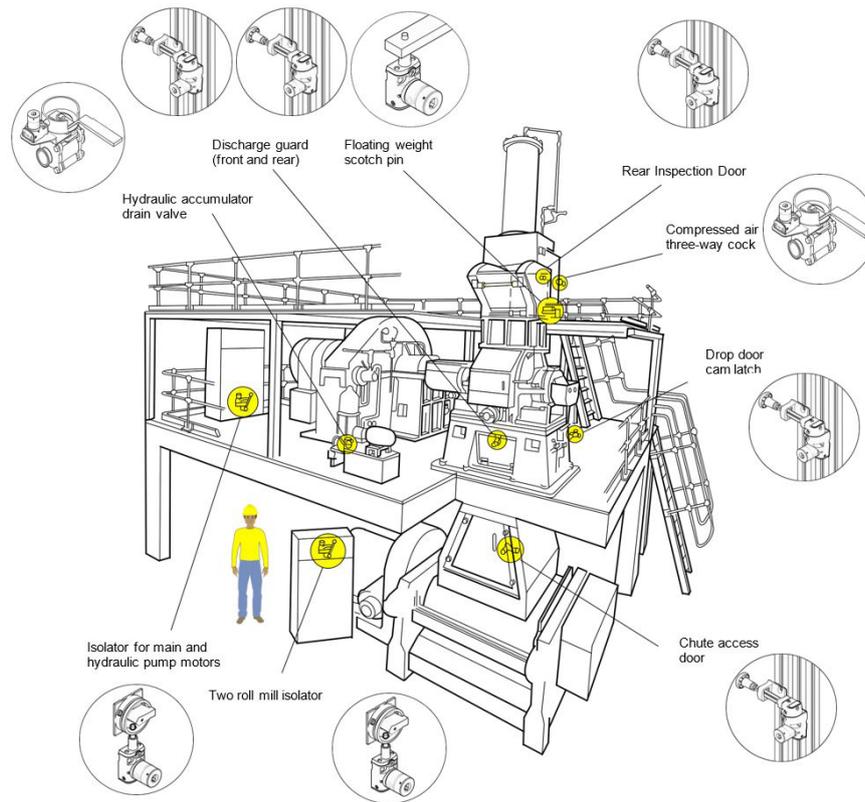


Hierarchy of Controls

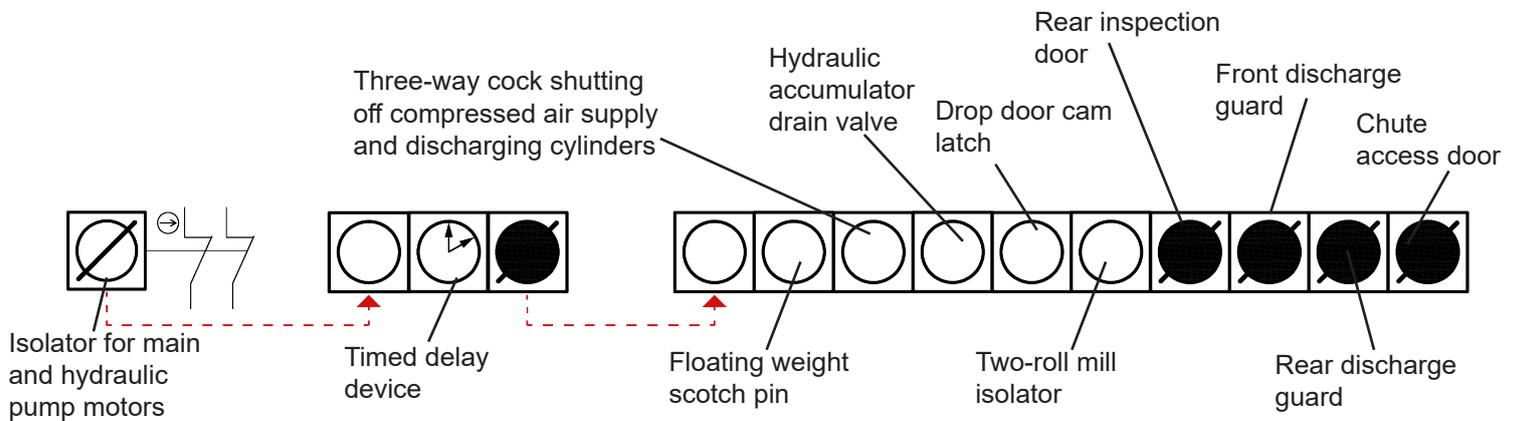
Almost 50 years ago work began on a British Standard, BS5304, Safeguarding of Machinery, which was to lead the way in machinery safety standards, and one of the examples featured was the internal rubber mixer.

In the vast majority of applications there are typically more access doors than energy sources, but in the case of the internal rubber mixer example this was reversed.

It is an excellent example for the control of hazardous energy because with two electrical, a hydraulic, pneumatic, and stored energy sources, it demonstrates the complexity of ensuring energy sources are locked off and ensures safe access for all tasks. Almost 50 years later the same example is being used in the revision of ISO14119 – Safety of Machinery – Safety Interlocking devices associated with guards. Principles for design and selection.



Internal Rubber Mixer showing energy sources and access points.



Schematic showing a trapped key interlocking system in an internal rubber mixer application.

Keys are released from trapped key interlocking devices: when each energy/power source is reduced to zero. A hazard is created by removing the hydraulic energy source to the ram and it must be held and locked in position before entry to the machine.

Where stored energy is present a time delay ensures the release of a key only after the energy has dissipated.

All of the keys associated with energy sources must be inserted into the key exchange device before the four keys are released to allow entry to the safeguarded area.

A trapped key interlock system enforces the isolation sequence and guarantees energy sources are locked off before access to the safeguarded space is granted. This is an Engineering Control and does not rely on users remembering to carry out lockout procedures.