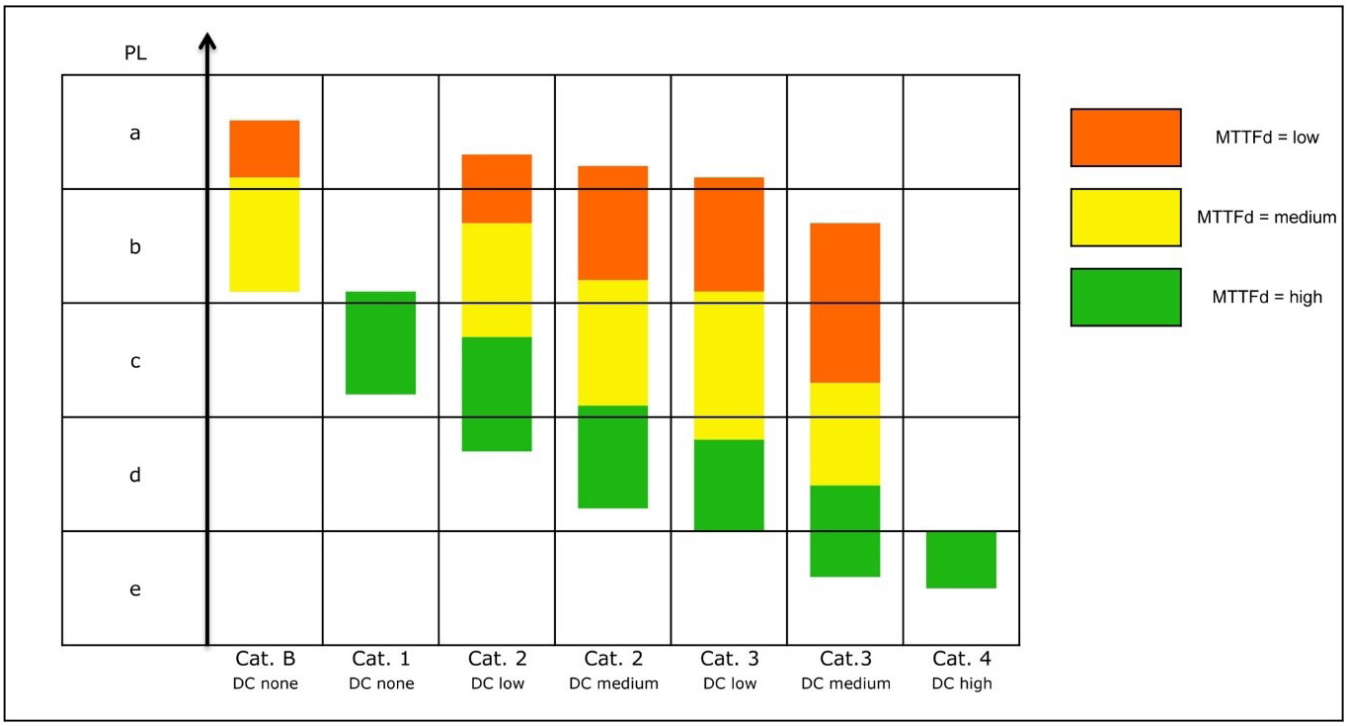
How Mechanical Trapped Key Interlock Systems Can Meet PLe

There are several benefits of using a mechanical trapped key interlocks over electronic or electromechanical door interlock systems, namely the vast reduction in installation and commissioning costs (no wiring to the gate and no programming of a safety plc required) and the ability to operate in harsh conditions where electronic components can become unreliable.

Generally, for Performance Level d and always for performance level e you will require a dual channel system (e.g. Category 3 or 4) with monitoring between the channels. However, despite not meeting the typical architecture of a high PL electromechanical or electronic safety related part of a control system, it is very possible and often easier to reach a Performance Level d or e using purely mechanical trapped key systems. This is done by meeting Category 3 or 4 behaviour rather than the circuit diagrams designed for electrical components.



A representation of Figure 5 in ISO 13849-1 2015 showing the relationship between Category Architectures (Cat B-4), Diagnostic Coverage (DC none – high), Mean time to Dangerous Failure (MTTFd Low – High) and the Performance Level (PL)

Category 3 behaviour means that there are no faults that can occur which can lead to loss of the safety function. This is achieved by ensuring all faults to danger can be excluded (generally by over dimensioning and ensuring the device is much stronger than required – the guarding will break first). The device will be designed to fail to safe in any other fault modes.

Category 4 behaviour means that an accumulation of faults does not lead to the loss of the safety function, only a combination of two faults needs to be considered (unless three or more faults are foreseeable). This is generally achieved by ensuring if a fault occurs, the device is rendered inoperable preventing access or machine restart until the device is replaced. In Fortress' trapped key interlocks this can be seen in the shear point on a key. The key will break, causing a fail to safe condition, before the lock can be forced or overridden.

In either Category 3 or 4, if all the faults that can lead to a dangerous failure have been excluded, either single faults of an accumulation depending on the Category, there is no longer a need for Diagnostic Coverage (DC). This allows the fully mechanical system to meet either PLd or PLe without monitoring and therefore without any wiring or programming. Careful consideration of all possible faults is needed and for peace of mind Fortress has obtained 3rd party certification on our mGard range of Mechanical Trapped Key products as suitable to be used in a PLe system for reassurance that all possible failure modes have been well considered.

For more information on Trapped Key Interlocks see ISO TS19837 or contact your local Fortress representative who will be more than happy to discuss any questions or applications you may have.