



# Trapped Key Interlocks for Aggregates and Mining





**Applications Guide**



The Future of Safety is Here



-  Castell Offices
-  Castell Installations

**We Keep You Safe at Work  
Worldwide**

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# Why Choose Castell?



**Founder:**  
James Harry Castell  
1880 - 1953

## Castells Expertise in Industrial Safety

For over 90 years Castell has recognised the importance of robust products in harsh environments. That makes Castell trapped key interlocks be the perfect choice for protecting personnel in areas such as mines, quarries, cement works and brick making facilities. Our experience of solutions to these industries ensure we provide safety solutions that last for decades.

### Castell Offers:

- Expertise in providing the best possible trapped key solution whatever the industry
- 90 years of experience protecting people and assets in industry
- High quality innovative products
- ISO 9001: 2008 accreditation
- Global team dedicated to providing technical support and assistance in selecting the correct solution
- The widest range of rugged and reliable trapped key interlock products globally
- The ability to produce customised solutions to meet the demands of your specific application

## How to design an interlock system?

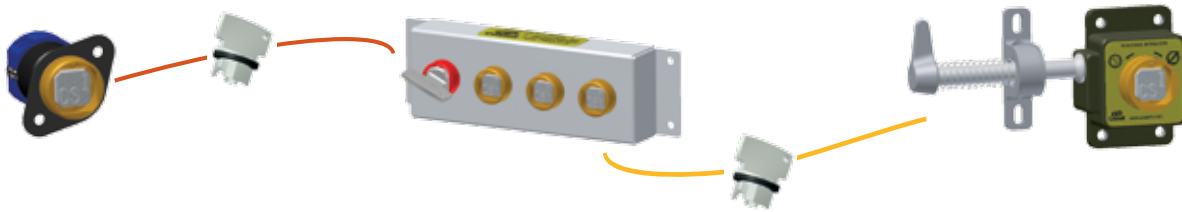
Through development and experience Castell have a number of methods to isolate machinery. This can be done mechanically, through control circuitry, through power circuitry or valve control. In complex operations a number of isolations may need to occur to ensure the plant is safe to work on. The isolation key(s) are then used to either gain direct access, are transferred to a time delay unit or for multiple entry points access through an exchange box.

## The three points of trapped key interlocking

### 1 Isolation

### 2 Key Exchange

### 3 Access Control



## Access and Personal Protection

Access to the hazardous area needs to be assessed as either part body, arm only, or full body access. Once this is determined an access lock(s) can be selected.

### Part Body Access

A part body access lock has only one lock and the isolation key is used to open this. Whilst the access lock is open the key can not be removed and therefore the process can not be started. Only once the lock is closed can the isolation key be removed and the process restarted.

### Full Body Access

Full body access locks have two locking mechanisms; the first step in the process is to insert the isolation key. This will allow the personnel key to be removed and then access can be granted by opening the bolt. The isolation key can only be removed once the personnel key has been inserted. Therefore whilst the personnel key is removed and the lock is open the process can not be started. Only once the lock is closed and the personnel key returned can the isolation key be removed and the process restarted.

## Coding a System

The coding of the system is an important aspect of the design as this ensures the integrity and safety of the interlocking system. Castell's Trapped Key Interlocks allow for in excess of 50,000 combinations. With this level of available codes entire factories and plants can have trapped key systems with out codes being repeated. It is highly recommended that each site keeps a record of the key codes to ensure that codes are not reused in areas of the site. The isolation, access and personnel keys all need to be coded differently so the process of safe access is ensured. For example in a simple system code 'A' is used for isolation key, this is then transferred to the exchange box where the code 'B' keys are released for access, 'C' keys are then released from the Access Locks for personnel keys. Coding in this way ensures the access process can not be short cut and the system has integrity.

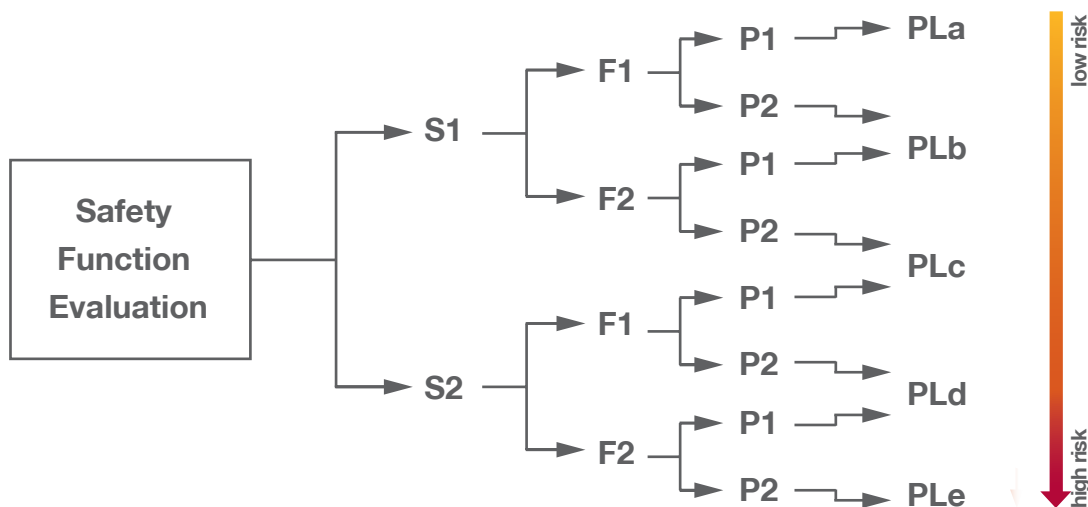
## ISO EN 13849-1

The integrity of a safety system is paramount to the safe function of machinery and process. The elimination of risk and the safe operation of a process is ensured by using the appropriate level of functional safety. **ISO EN 13849-1 EN** is the latest standard used to identify risk and determine the minimum performance standards of a safety system. The performance levels (PL) range from a to e dependant on the severity, frequency and possibility of avoidance of an injury whilst operating a process. These performance levels have superseded the CAT ratings as described in EN 954-1.

Each Performance Level is defined not only by the level of safety but also by the probability of failure by the safety system. Therefore the safety system has to be assessed not only for protection but also for reliability. The performance safety system as a whole is determined by the performance and interaction of each component For each component the following data must be used in the calculation of the performance:-

- 1) The MTTFd mean time to dangerous failure,
- 2) The DC Diagnostic Coverage
- 3) The CCF Common Cause Failure management.

The actual performance level can then be compared to the required performance level. If the actual PL is higher then the system is deemed to provide suitable level of protection. The required PL can be achieved using the chart set out in the standards, this is shown below:



Severity of injury (S)	Frequency/Exposure (F)	Possibility of avoidance (P)
S1 - Slight injury	F1 - Seldom to less often or short exposure	P1 - Possible under specific conditions
S2 - Serious injury, death (irreversible)	F2 - Frequent to continuous or long exposure	P2 - Scarcely possible

Castell provided the required information on each of its products on the website under Quality section.

# Aggregates and Mining - Applications

**Application** Tunnel Boring Machinery

**Safety Issue** Danger from rotating tunnelling head and head cutter platform collapse

**Solution** Interlock the power supply isolator with access guards, via key exchange (for multiple access points). There is a common key for the isolator and control lock in the key exchange box. The key remains locked in isolator whilst machine is running. Access keys are only released when the power is isolated and the isolation key is placed in the control lock in the exchange box.



## Products To Provide Solution

### 1 Isolation



**KSD**  
Switch  
Dosconnector



**KS**  
Powersafe Electrical  
Switch



**K**  
Bolt Interlock

### 2 Key Exchange



**X**  
Key Exchange  
Box

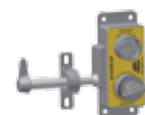
### 3 Access Control



**Salus**  
Automatic Access  
Interlock (Part Body)



**AI**  
Single Key Access  
Interlock (Part Body)



**AIE**  
Dual Key Access In-  
terlock (Full Body)



FLIP CAP - a protective cap is recommended to be used to protect locks from dust and dirt ingress.

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# Aggregates and Mining - Applications

**Application** Coal Conveyors

**Safety Issue** Danger from moving parts on chain drive at the directional change point

**Solution** Interlock power supply isolator with the access guard at the directional change point. The isolation key is common to both is either locked in isolator whilst machine is running or in access guard when machine stopped.



## Products To Provide Solution

### 1 Isolation



**KSD**  
Switch  
Dosconnector



**KS**  
Powersafe Electrical  
Switch



**K**  
Bolt Interlock

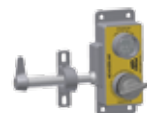
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# Aggregates and Mining - Applications

**Application** Dragline Crane

**Safety Issue** Danger from live slip rings

**Solution** Interlock power supply isolator with manhole. Key common to both is either locked in isolator whilst machine is running or in manhole when machine stopped.



## Products To Provide Solution

### 1 Isolation



**KSD**  
Switch  
Dosconnector



**KS**  
Powersafe Electrical  
Switch



**K**  
Bolt Interlock

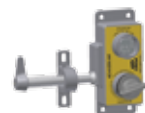
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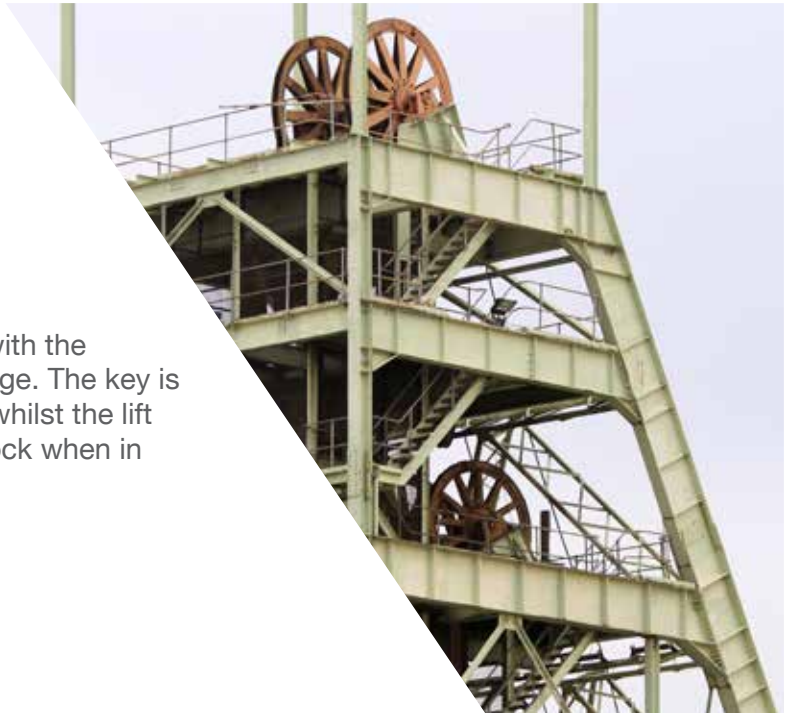
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# Aggregates and Mining - Applications

**Application** Lifting

**Safety Issue** Danger from hand winding

**Solution** Interlock the power supply with the access lock on the safety cage. The key is either locked in the isolator whilst the lift is running or in the access lock when in manual mode.



## Products To Provide Solution

### 1 Isolation



**KSD**  
Switch  
Dosconnector

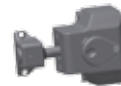


**KS**  
Powersafe Electrical  
Switch



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Bolt Interlock

### 2 Access Control



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# Aggregates and Mining - Applications

**Application** Twin Boom Cutter

**Safety Issue** Access danger to the rotating heads

**Solution** Interlock the power supply isolator with the access for changing the cutting heads. The key common to both is either locked in the isolator whilst machine is running or in access lock when machine stopped.



## Products To Provide Solution

### 1 Isolation



**KSD**  
Switch  
Dosconnector



**KS**  
Powersafe Electrical  
Switch



**K**  
Bolt Interlock

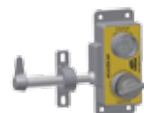
### 2 Access Control



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# Aggregates and Mining - Applications

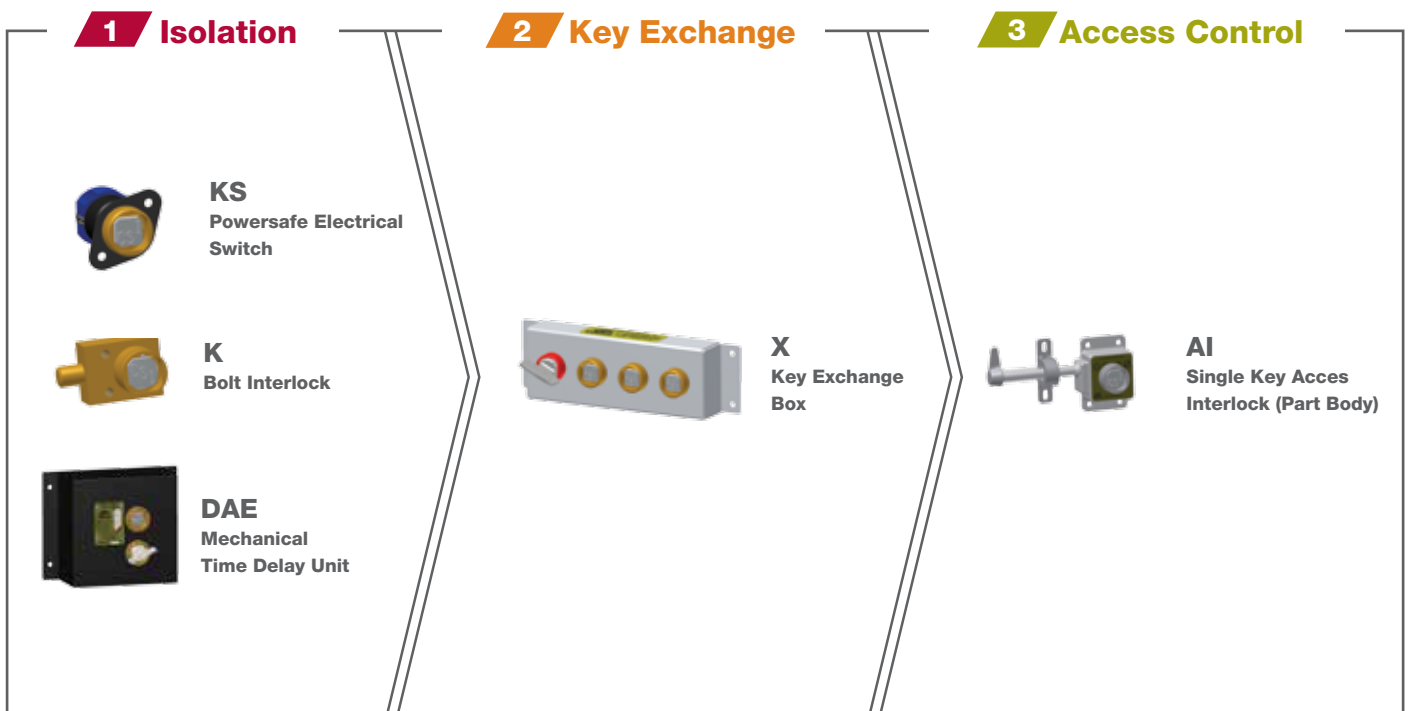
**Application** Cement Mixer  
(Power Isolation)

**Safety Issue** Danger from an operational mixer

**Solution** Isolate the mixer by removing the key from the KS switch or K Bolt. Insert into the DAE time delay unit if there is a run-down time. If there isn't a run-down time, or regardless, insert the released key into the exchange box for multiple key release. Insert the released key(s) from the exchange box into the AI or Salus access locks to gain access.



## Products To Provide Solution



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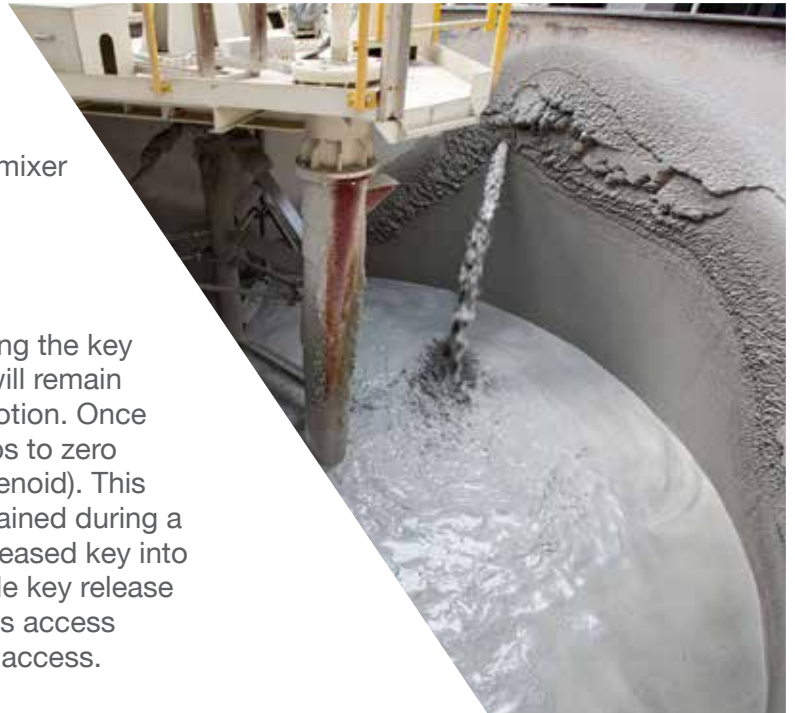
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# Aggregates and Mining - Applications

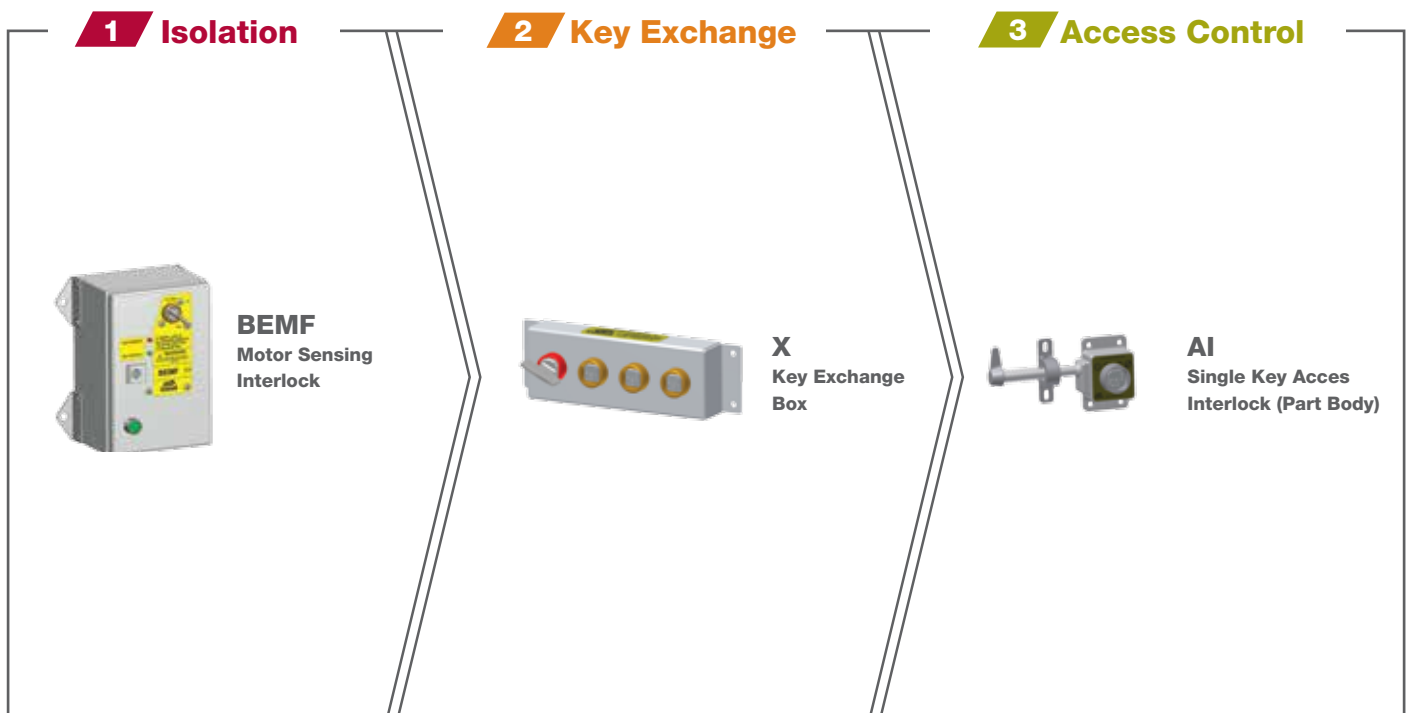
**Application** Cement Mixer (BEMF)

**Safety Issue** Danger from an operational mixer

**Solution** Switch off the mixer by turning the key on the BEMF unit. The key will remain trapped whilst motor is in motion. Once the BEMF on the motor drops to zero the key is released (via a solenoid). This ensures no access can be gained during a run-down time. Insert the released key into the exchange box for multiple key release or directly into the AI or Salus access control units for single point access.



## Products To Provide Solution



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# Aggregates and Mining - Applications

**Application** Cement Mixer  
(Time Delay)

**Safety Issue** Danger from an operational mixer

**Solution** Isolate the mixer by turning the switch to the off position on the TDI time delay isolator, which changes the contacts to the switch and initiates the timer. The time set would be greater than the duration the mixer takes to stop. When the time has elapsed the solenoid is energised, which releases the keys preventing the mixer from restarting. Insert the released key(s) into the AI or Salus access interlocks to gain access.



## Products To Provide Solution

### 1 Isolation



**TDI**  
Electronic Time Delay  
Isolator

### 2 Access Control



**AI**  
Single Key Acces  
Interlock (Part Body)



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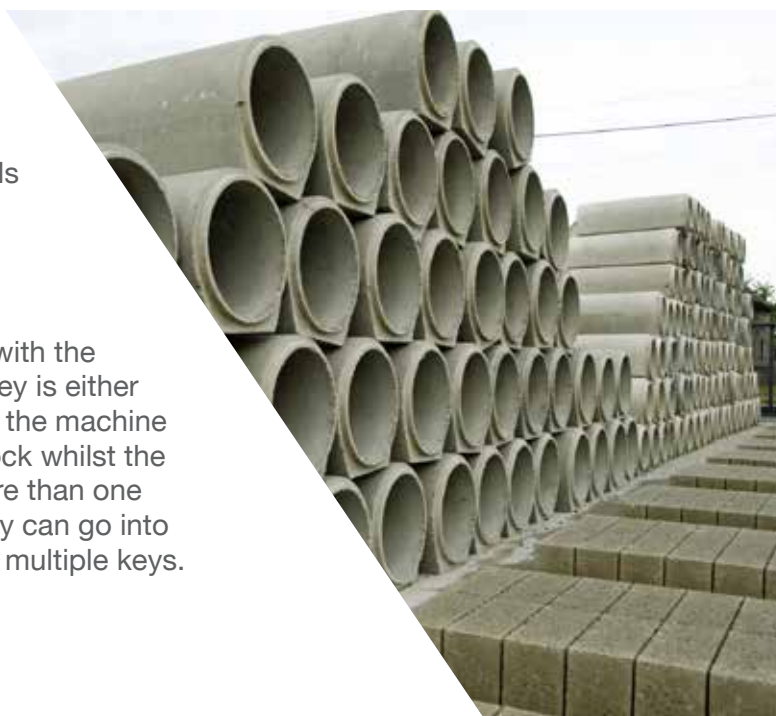
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# Aggregates and Mining - Applications

**Application** Extruders

**Safety Issue** Danger from large gearwheels

**Solution** Interlock the power isolator with the access gate. The common key is either trapped in the isolator whilst the machine is running or in the access lock whilst the machine is stopped. For more than one access point the isolation key can go into the exchange box to release multiple keys.



## Products To Provide Solution

### 1 Isolation



**KS**  
Powersafe Electrical  
Switch



**K**  
Bolt Interlock

### 2 Key Exchange



**X**  
Key Exchange  
Box

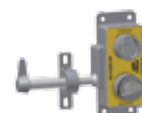
### 3 Access Control



**Salus**  
Automatic Access  
Interlock (Part Body)



**AI**  
Single Key Access  
Interlock (Part Body)



**AIE**  
Dual Key Access In-  
terlock (Full Body)



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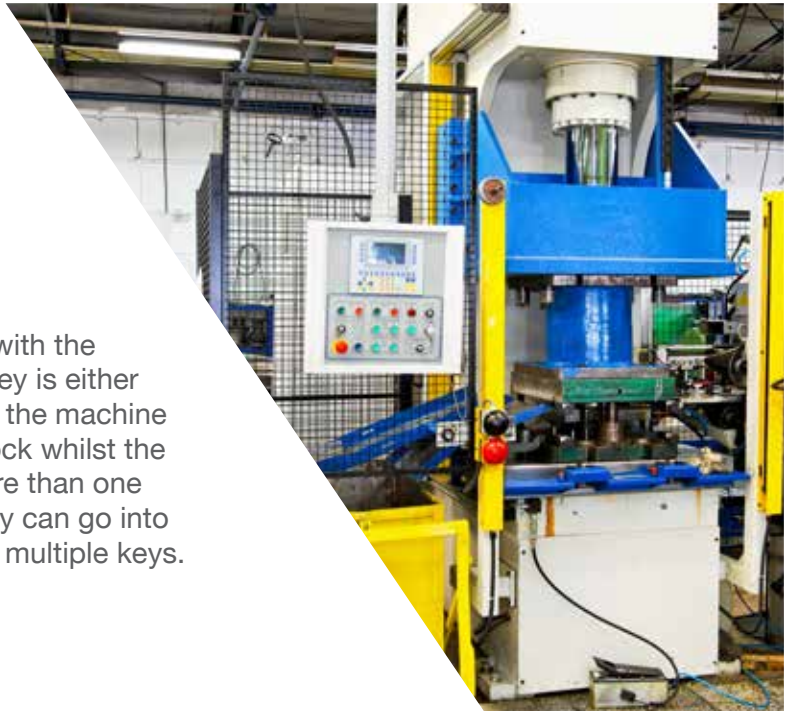
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# Aggregates and Mining - Applications

**Application** Hydraulic Paving Press

**Safety Issue** Danger from rollers

**Solution** Interlock the power isolator with the access gate. The common key is either trapped in the isolator whilst the machine is running or in the access lock whilst the machine is stopped. For more than one access point the isolation key can go into the exchange box to release multiple keys.



## Products To Provide Solution

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Switch



**K**  
Bolt Interlock

### 2 Key Exchange



**X**  
Key Exchange  
Box

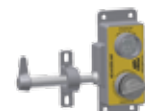
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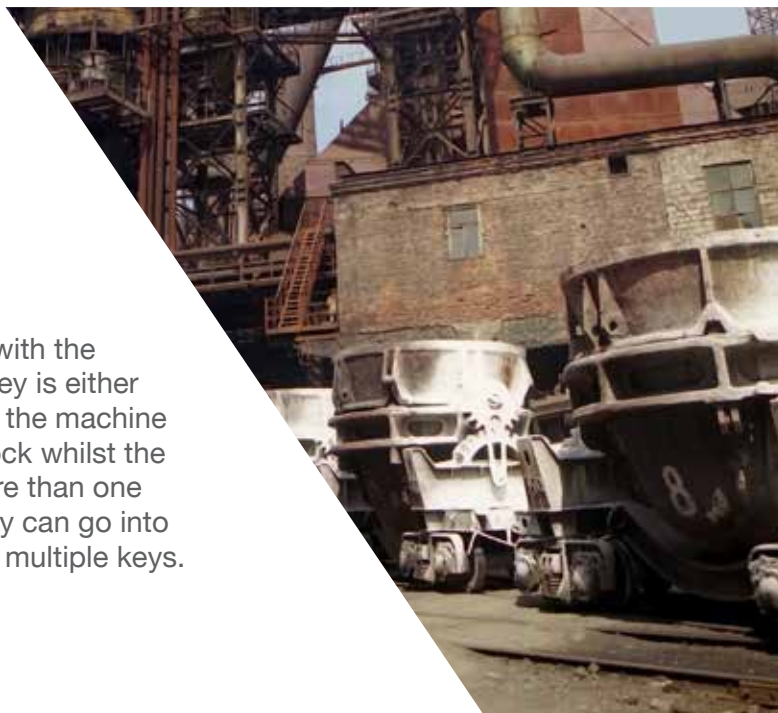
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# Aggregates and Mining - Applications

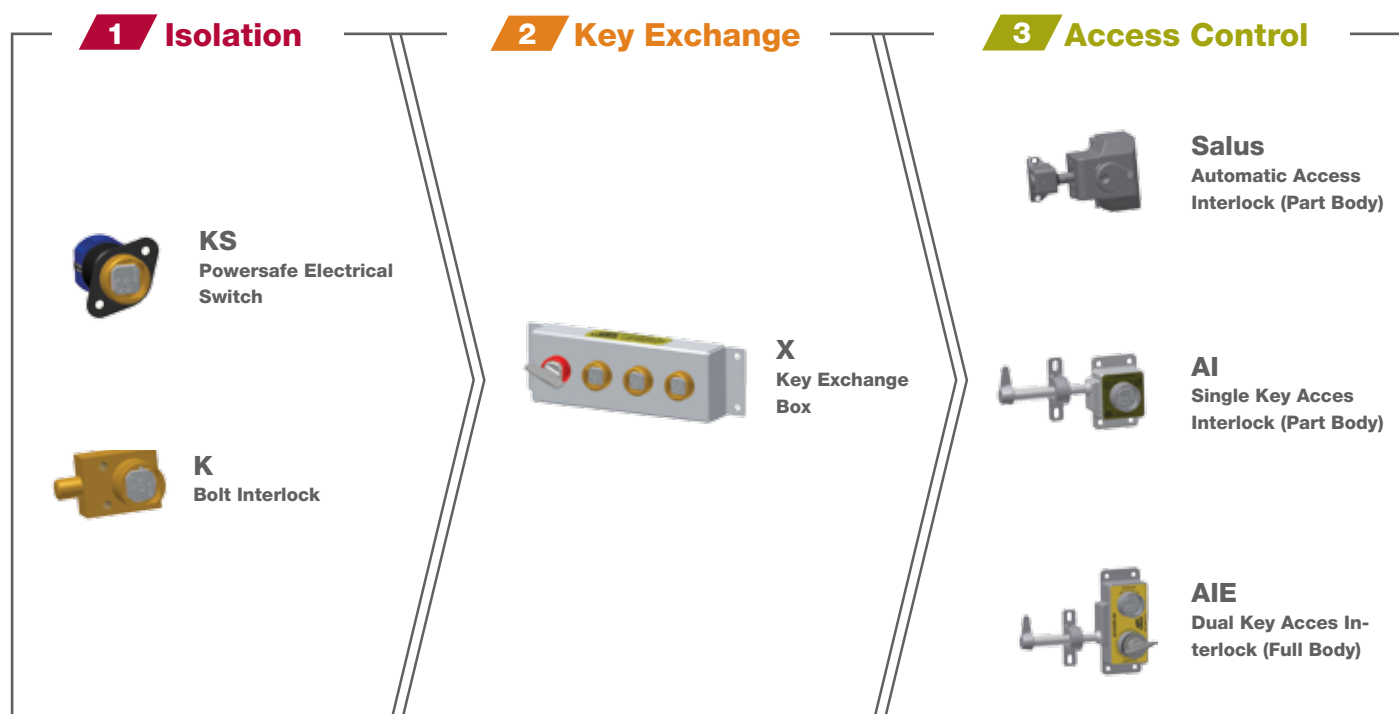
**Application** Rolling Mill

**Safety Issue** Danger from rollers

**Solution** Interlock the power isolator with the access gate. The common key is either trapped in the isolator whilst the machine is running or in the access lock whilst the machine is stopped. For more than one access point the isolation key can go into the exchange box to release multiple keys.



## Products To Provide Solution



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# Aggregates and Mining - Applications

**Application** Steam Autoclave

**Safety Issue** Danger from steam and risk of explosion through build-up of pressure

**Solution** Interlock the power isolator with the perimeter guard. The common key is either trapped in the isolator whilst the machine is running or in the access lock whilst the machine is stopped. For more than one access point the isolation key can go into the exchange box to release multiple keys.



## Products To Provide Solution

### 1 Isolation



**KS**  
Powersafe Electrical  
Switch



**K**  
Bolt Interlock

### 2 Key Exchange



**X**  
Key Exchange  
Box

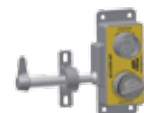
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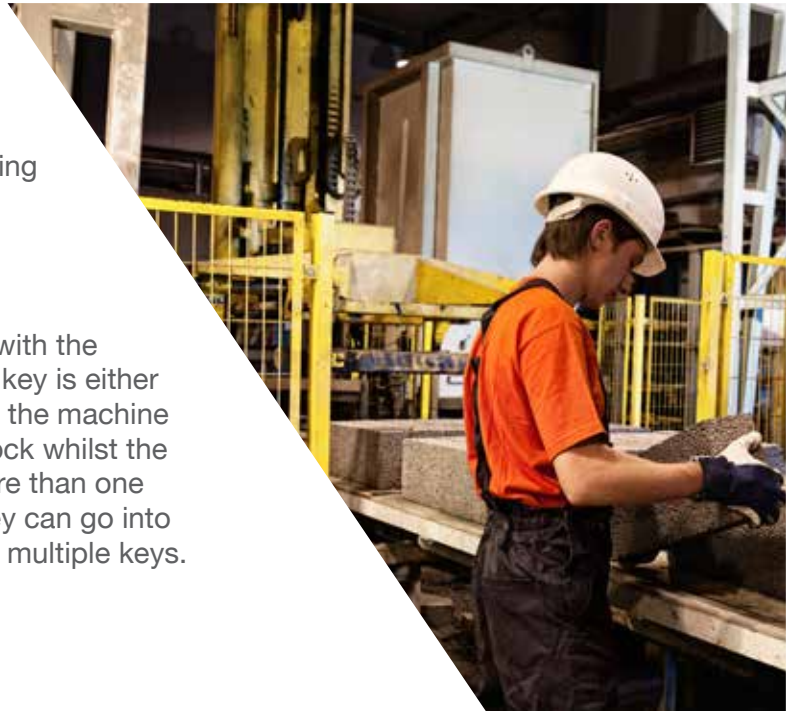
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# Aggregates and Mining - Applications

**Application** Brick Making Machine

**Safety Issue** Danger from die table in mixing process

**Solution** Interlock the power isolator with the access guard. The common key is either trapped in the isolator whilst the machine is running or in the access lock whilst the machine is stopped. For more than one access point the isolation key can go into the exchange box to release multiple keys.



## Products To Provide Solution

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Powersafe Electrical  
Switch



**K**  
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### 2 Key Exchange



**X**  
Key Exchange  
Box

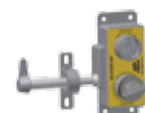
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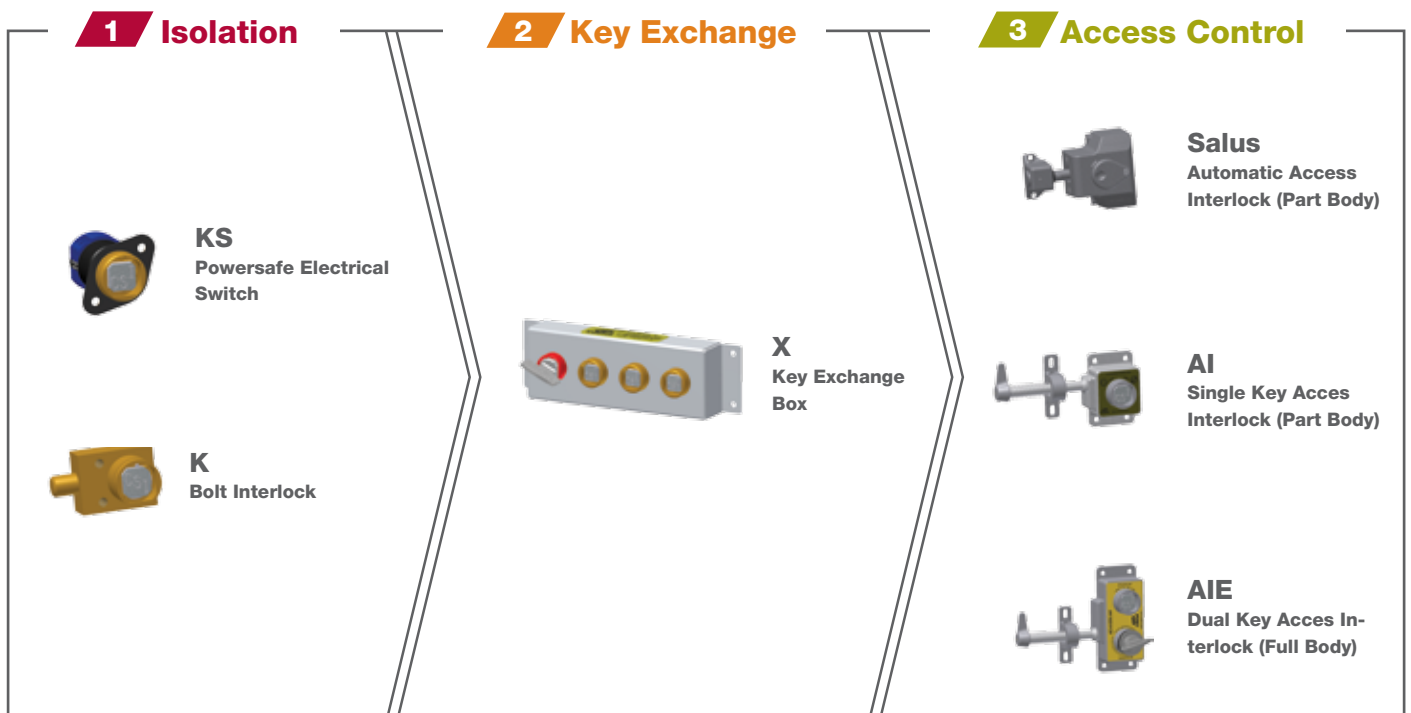
**Application** Block Cutting Machines

**Safety Issue** Danger from cutting blades and driving gears

**Solution** Interlock the power isolator with the access guard. The common key is either trapped in the isolator whilst the machine is running or in the access lock whilst the machine is stopped. For more than one access point the isolation key can go into the exchange box to release multiple keys.



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