



Formation of dust explosion hazard

Combustible dust-air mixtures often occur in pneumatic and mechanical transfer systems handling particulate solids, such as dust collection systems. Vessels receiving this material are at risk of dust explosions. Ignition sources generated in other areas of the process are often carried to these collection areas through the transfer duct, chute or conveyor where they can find the right conditions to initiate the explosion.

A dust explosion can cause an over-pressure event up to 10 bar if unmitigated. Such overpressures from dust explosions can rupture filters and dust containers and put employees safety at risk.

All organic dust, i.e. dust containing carbon, may cause an explosion if its particle size is smaller than 0.5 mm.

Elements needed for a dust explosion:

- Combustible dust-air mixture in an enclosed volume
- Oxygen is present in the environment
- An ignition source (e. g. a spark, ember, static electricity)

Characteristics of a dust explosion:

- A flame front which can accelerate up to sonic velocity
- Can cause up to 10 bar pressure wave
- If the pressure wave from the initial explosion is unmitigated it can lift/disturb more dust into the air which if ignited creates a far more devastating secondary explosion.-

Why does dust explode?

Once ignited a combustible dust-air mixture burns very rapidly due to the large surface area of the dust cloud. The energy is released rapidly as a result of combustion. Temperature will rise to $\sim 1800\text{ }^{\circ}\text{C}$ and if in an enclosed volume can cause a high pressure increase according to Charles's thermodynamic law. The pressure increase will discharge from the weakest point of the enclosed volume and often causes even more dangerous secondary explosion.



Chopped wood Fire area
 0.3 m^2 (3.2 ft²)



Chopped wood sawed into cubes of 1 cm
Fire area 5.4 m^2 (58.1 ft²)



Chopped wood ground into dust
Fire area $1,080\text{ m}^2$ (11,625 ft²)

Operating principle of a spark detection and extinguishing system

Atexon® spark detection and extinguishing systems from Helios Fire Systems are designed to protect industrial processes by helping reduce the risk of ignition sources such as burning embers from reaching protected equipment. The system detects sparks and extinguishes them automatically without interrupting process operations. The small amount of water extinguishant used, approximately five litres, will greatly limit any interruption to filters or other production machines. Once the ignition source has been mitigated, the system automatically resets to normal operations and is ready to extinguish new ignition sources.

Operation of Atexon® spark detection system

1. The response time of the spark detectors is only a few milliseconds.
2. The extinguishing unit can extinguish detected ignition sources using only a small amount of water
3. The signal router controls and monitors the extinguishing event.
4. The control panel monitors the status of the system.
5. The signal router gives output alarms using a siren and a strobe light.
6. The fan controller stops the fans in case of overheating or a spark shower.
7. The overheat sensing cable monitors the temperature of the motor cooling fins, the fan bearings and the fan perimeter.
8. The pressure booster controller supervises the water pump and the heat tracing cables.
9. The pressure booster station ensures the correct delivery pressure and prevents pockets of air in the extinguishing water.

Extinguishing units can be mounted outdoors in cold environments using the Atexon® heat tracing system.



Mounting principle of Atexon® spark detection and fire extinguishing system

VR18Z Control unit



Atexon® VR18Z Control panel — Effective protection for large industrial process lines

The VR18Z is one of the most versatile spark detection and extinguishing systems on the market. It is simple and easy to operate, thanks to a user-friendly interface, a large LCD display, and an Ethernet-based remote user interface. The system is equipped with enough memory to log the 10,000 most recent extinguishing events. A unique bus structure developed by Atexon® reduces cabling and installation costs significantly.

Versatile fire protection

The VR18Z control panel has 18 protection zones to ensure that system expansion costs stay low. With up to 18 protection zones, 54 spark detectors, six pressure booster stations and connections for a multitude of different gas, flame and heat sensors help facilitate protection for a wide variety of industrial processes. Optional features include a remote GSM connection for alarm and error state messaging, and a FASU module which can be used to send detailed operational data from the extinguishing system to a factory automation system.



Pressure booster controller

The pressure booster controller is intended to provide extinguishing water at sufficient pressure given the wide range of challenging environments. An integrated heat tracing option provides cost-efficient heating for water pipes in cold conditions without the need for additional thermostats or electrical inputs.

Connections for a wide variety of sensors

- Sensing of both low and high levels of extinguishing water
- Double verification of external temperature for heat tracing operations
- Monitoring of dry running and running time of the water pump
- Water-flow monitoring
- Control of leak prevention valve



Fan controller

When an alarm is triggered, the fan controller can be configured to stop the production process. Alarm threshold values are easy to set from the user interface of the VR18Z control panel. A single fan controller can monitor up to six different fans or other process machinery. Each VR18Z control panel can connect up to three fan controllers.

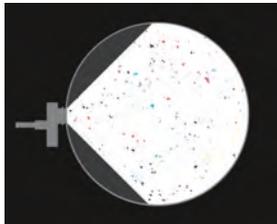
Integrated overheat detection function for additional fire security

The overheat sensor connections which have been integrated into the fan controller can be used to monitor fans and other electrical devices for overheating. The overheating cable is typically 3–4 meters long and senses temperature increases from the fan bearings, from the motor cooling fins and from the fan perimeter. Such broad coverage of the fan allows robust overheat protection and allows prompt shut down. Over 50% of wood industry fires begin from over-heating fans.

V300EX series spark detectors



The FOV of the V300EX does not have blind spots



A typical spark detector

Advanced spark detection technology

The V300EX Spark Detector features a 180-degree field of view (FOV) which ensures reliable detection of ignition sources from high speed material flows, with no blind spots. The V300EX Spark Detector is an excellent choice for industrial facilities such as heat and power plants.

Broadband detection technology

All electromagnetic radiation produced in the target process is relevant when the goal is to detect ignition sources in the most effective manner. Visible light and near-infrared radiation (600–1300 nm) are capable of penetrating through dense material flow and are also reflected effectively from walls and other surfaces. Meanwhile hot (300–550 °C) particles can only be detected at wavelengths longer than 1.5 µm, i.e. via infrared radiation. The Atexon® V300EX features an exceptionally broad sensing spectrum which enables it to monitor both of these wavelength regions at the same time together with a 180-degree field of view. This makes it the ultimate device for detecting both sparks and hot particles.

Features

- 180-degree field of view
- Detects sparks that emit visible light
- Detects hot, >300 °C, particles that emit infrared light
- Quick installation without welding for most applications
- Flat and well-protected lens structure
- High abrasion resistance
- Stainless steel housing (AISI 316L)

Product variations

- V300EX for ATEX zones 20/-
- V300EX PT for ATEX zones 20/21
- V300EX HT for high-temperature locations, such as flues
- VF300EX for locations requiring daylight filtration
- Custom-built models are also available, e.g. 4-20 mA current loop model

Installation equipment

- Quick-mounting adapter (no need for welding)
- Mounting adapter with air purge functionality
- Straight and angled ATEX-compliant sensor cables

Technical specifications

Type	V300EX	VF300EX	V300EX HT	VS300EX
Size (W x H x D)	68 x 68 x 80 mm		68 x 68 x 250 mm	
Weight	450–540 g		800 g	
Detection regions	VIS/NIR/IR*	IR	VIS/NIR/IR	VIS/NIR
Detects	Sparks, flames, embers and hot particles (>300 °C)			Sparks, flames, ... >600 °C
Field of view	180° x 45°			
ATEX Class	20/- (20/21, V300EX PT)		-/-	
Case material	Front AISI 316L, back nickel-plated aluminum			
Lens height	Max. 2.5 mm, lens protected with low RST hood			
Protection class	IP65			
Use temperature range	-40 to +70 °C		-40 to +130 °C	-40 to +200 °C
Humidity (non-condensing)	0–90% RH max.			

*Visible light, Near Infrared Radiation and Infrared Radiation

VMR200EX spark detector



The VMR200EX is the world's smallest spark detector, specifically designed for protection of dust extraction systems.

Dust extraction ducts are often located in tight spaces and/or near walls. The VMR200EX is an extremely small detector that can be installed in a small space, and thanks to its size it is highly resistant to vibration. The detector has an integrated test lamp that is used to test the detector's electrical functions and the cleanliness of the lens of the opposite detector pair. Testing is implemented from the spark detection system control panel. This constitutes a significant improvement in system reliability, since usually the cleanliness of a spark detector lens can only be tested with by manual intervention, often requiring an access platform.

ATEX-approved

The lens-side of the VMR200EX has been approved for ATEX zone 20 and for temperatures down to -40 °C. ATEX certification is included in every standard delivery without additional cost.

VMR200EX spark detector – technical specifications

<i>Size (W x H x D)</i>	<i>48 x 48 x 48 mm</i>
<i>Weight</i>	<i>200 g</i>
<i>Detection regions</i>	<i>VIS–NIR</i>
<i>Detects</i>	<i>Sparks and embers</i>
<i>Field of view (FOV)</i>	<i>>100°</i>
<i>ATEX approved</i>	<i>20/–</i>
<i>Case material</i>	<i>Stainless steel (AISI 316L)</i>
<i>Lens height</i>	<i>Surface-level</i>
<i>Protection class</i>	<i>IP65</i>
<i>Use temperature range</i>	<i>-40 to +55 °C</i>
<i>Humidity (non-condensing)</i>	<i>0–93% RH max</i>

Special applications

Due to its small size, high sensitivity and versatile connections, VMR200EX series Spark Detectors can be used in special applications, e.g. to provide back fire protection in a gas engines' intake manifolds.

Equipment



Electrical connector



Mounting adapter

Flame detectors

The Atexon® high-quality 3IR and UV/IR flame detectors are highly immune to sunlight, arc welding and other types of light, making them suitable for machinery and fuel receiving stations. These flame detectors can be integrated into a battery backed up Atexon® spark detection and extinguishing system.



RFD-3000X 3IR flame detectors – Technical Specifications

Size (W x H x D)	134 x 117 x 110 mm
Weight	3.5 kg
Detection regions	3 IR regions (3IR)
Field of view (FOV)	90°
Detection distance	60 m for an n-heptane flame (0.3 m ²)
Detection sensitivity	Adjustable
Response time from detection	Adjustable: 3–12 seconds
Alarm connections	Relay and Modbus
Certifications	FM 3260, Ex d IIB + H2 T6, IECEx
Case material	Stainless steel (AISI 316L)
Protection class	IP67
Use temperature range	-40 to +75 °C
Humidity (non-condensing)	0–95% RH max
Flame simulator	TL305



RFD-2000X UV/IR flame detectors – Technical Specifications

Size (W x H x D)	134 x 117 x 120 mm
Weight	3.4 kg
Detection regions	UV/IR
Field of view (FOV)	90°
Detection distance	30 m for an n-heptane flame (0.3 m ²)
Detection sensitivity	Adjustable
Response time from detection	Adjustable: 3–12 seconds
Alarm connections	Relay and Modbus
Certifications	FM 3260, Ex d IIB + H2 T6, IECEx
Case material	Stainless steel (AISI 316L)
Protection class	IP67
Use temperature range	-40 to +75 °C
Humidity (non-condensing)	0–95% RH max
Flame simulator	TL205

Equipment



Air purge system



Hinged leg



Sun cover



Flame simulator

Extinguishing units

Atexon® extinguishing units have been purposely designed for pneumatic transport duct systems with air-flow speeds of up to 40 m/s



AS181 Extinguishing unit

Multifunctional sensor technology improves reliability

Atexon® AS181 and AS182 extinguishing units feature a fast acting solenoid valve, a filter, electronic ball valve position monitoring, flow monitoring and real-time extinguishing water temperature monitoring. The integrated water temperature monitoring is especially useful for outdoor installations. This feature verifies the effectiveness of pipe insulation and heat tracing cable through their normal aging process.



AS182 Extinguishing unit

Choosing an extinguishing unit

Channel diameter	Extinguishing unit type
≤500 mm	AS181
501–750 mm	AS182
750–1,000 mm	AS181+AS182
1,000–1,150 mm	2 x AS182
1,200–1,600 mm	4 x AS182

Choosing the water nozzle

For pneumatic transport ducts, Atexon® recommends leak-tight, self-cleaning hollow-cone water nozzles. The feeding and discharge chutes on scraper and belt conveyors should be equipped with full-cone water nozzles that provide deep penetration into dense material flows.

Outdoor installations

When installed outdoors, the extinguishing units are insulated and heated using Atexon® heat tracing system. The extinguishing unit features real-time temperature monitoring that detects inadequate insulation, power outages and loss of power caused by ageing of the heating tracing cables.

The heating tracing functionality is controlled by the pressure booster controller, which monitors outdoor temperatures using two separate temperature sensors. The supply voltage of the heat tracing is monitored, and all power supply failures trigger an output alarm.

NOTE: The insulation jacket of the extinguishing unit is also designed to protect the extinguishing unit from the effects of adverse weather conditions.

Equipment



Insulation jacket of extinguishing unit



Mounting adapter



Specialized water nozzles

Specialised extinguishing units



Alternative extinguishing solutions for processes that are not suited to water extinguishant

Due to its high heat capacity and easy availability water is an excellent extinguishing agent. However, because there are numerous industrial processes that do not tolerate water, alternative extinguishing and protection solutions have also been developed. The Atexon® spark detection and extinguishing system can be used with water mist systems, carbon dioxide and aerosol extinguishing units as well as rapid-response slide gates and diverters used for the redirection of materials.

Water mist extinguishing

- Water mist extinguishing systems use only a small amount of water. This makes them suitable for protecting production machines such as planers, paper machines and wood board presses.

Aerosol extinguishing

- Package material production lines

Carbon dioxide extinguishing

- The Food industry
- Powder coating systems
- Machines

Rapid-response diverters and slide gates

- The material flow is redirected out of the process, and the ignition sources can be extinguished in wastegate; e.g. pellet plants.

Abort Gate

Abort gates are used prior to returning air from the dust collector back into the building. In the event of an explosion, the purpose of the abort gate is to redirect flames and pressure wave to a safe zone, protecting personnel and the building.

Atexon® spark detection and extinguishing system can control abort gates as per NFPA 664 (8–4). The NFPA standards are recognized in North America and other parts of the world.

Alternative solutions and ancillary devices



Carbon dioxide extinguishing



Slide gate



Diverter



Abort gate

Protecting dust collection systems

Explosive dust-air mixtures often form inside dust extraction systems. Such mixtures can be ignited by sparks, embers, hot objects or static electricity. Usually these ignition sources are caused by a damaged blade, a wedged foreign object, resin collected on the fan blades or poor machine grounding. In the mechanical wood working industry, as many as half of all fires are caused by overheated machine due to bearing failures or blocked ducts in the fan.

A dust explosion and burning material can advance into a dust silo, or travel backwards through a return air duct into the production area. All dust collection system fires pose a grave danger to employees and usually cause a lengthy production outage.

Reducing risk factors

A spark detection and extinguishing system is designed to suppress sparks and burning embers traveling through the protected process duct work reducing the risk of them reaching interconnected vessels downstream of the protected area. It is important to protect all ducts, as an ignition source does not always reach the filter through the same duct as the explosive mixture of dust.

The Atexon® spark detection system is available with an integrated overheat function that senses temperature increase of each fan from multiple locations. An increase in the temperature measured from the fan perimeter indicates a blocked duct, the temperature of a bearing can reveal a bearing failure, and an overheated electrical motor usually indicates overload and/or insufficient motor cooling.



-  Spark detection
-  Spark after-detection
-  Spark extinguishing
-  Overheat detection

Protecting planers

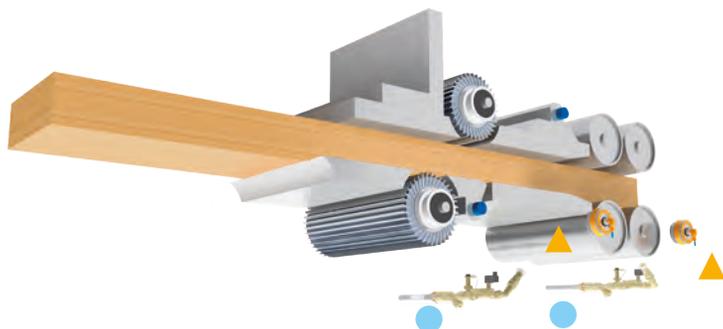
At wood processing plants, few production machines are as valuable as the planer. As many of its numerous components move extremely fast, any waste or other material that has become wedged between its rotating machine components can quickly cause sparks and/or embers. In addition, bearing faults and over-heating electrical motors cause a significant number of fires.

Reducing risk factors

An Atexon® planer protection solution consists of a water-mist extinguishing system which is controlled by flame detectors which monitor the planer from two or three directions. The spark detection and extinguishing system is also designed to mitigate ignition sources detected in the feeding rollers and dust collection ducts.



Ignition sources that may appear in the feeding rollers of the planer are monitored using a spark detection (yellow symbols in the picture) and extinguishing system (blue symbols). The purpose is to extinguish ignition sources locally and reduce any unnecessary use of the system's water mist extinguishing units.



- ▲ Spark detection
- Spark extinguishing
- Water mist extinguishing
- ◆ Flame detection

Protecting pellet plants

Pellet manufacturing processes, such as the drying, grinding and pelletizing of material, can pose a significant fire hazard. In addition, these processes create highly refined highly combustible dust creating the perfect conditions for an explosion.

A hammer mill grinds the raw material down to the required size for pelletizing. Any foreign objects fed into the hammer mill, such as rocks or pieces of metal, can cause sparks, which in turn can cause a fire or a dust explosion downstream inside a conveyor system or silo.

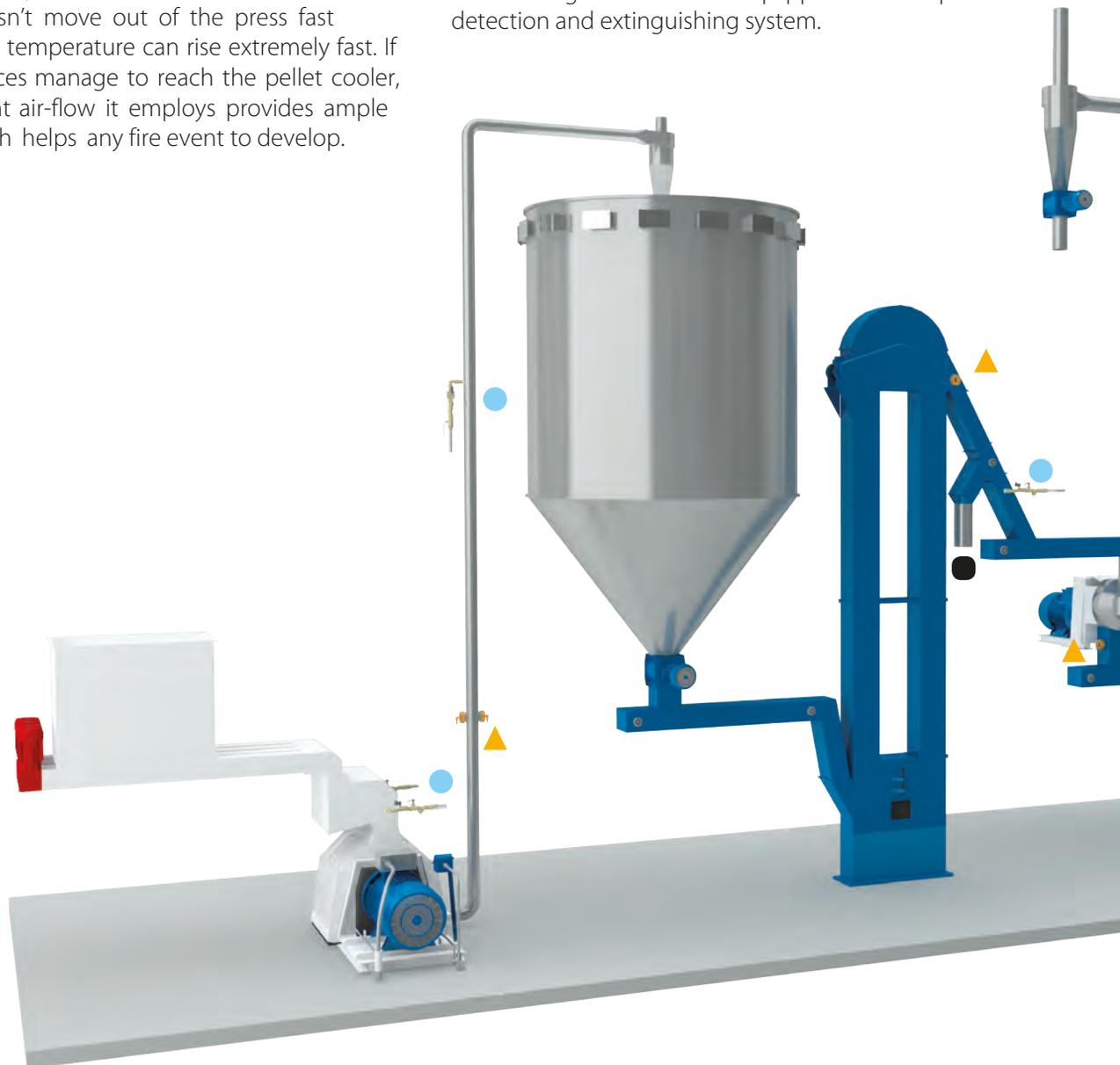
Elevators that transport the combustible material can also be sources of ignition, for example when a drive shaft becomes misaligned or when a bearing fails.

Pellet mills usually operate at a process temperature of approximately 100 °C. However, if the pressed material doesn't move out of the press fast enough, this temperature can rise extremely fast. If ignition sources manage to reach the pellet cooler, the significant air-flow it employs provides ample oxygen which helps any fire event to develop.

Reducing risk factors

The Atexon® spark detection and extinguishing systems are designed to mitigate the risk within a variety of areas within the pelletizing process. Water extinguishers cool ignition sources effectively. If necessary, the extinguishing system can be modified so that all extinguishing actions that take place after the pellet press are implemented to the wastegates. To avoid swelling the pellets, a wastegate's diverter is used to redirect the material out of the process until the ignition sources have been extinguished. The diverter returns back to normal position automatically after a few seconds and the production process can continue as usual. This ensures the quality of production as burnt pellets and extinguishing water are redirected out of the production process.

All pneumatic transport ducts and humidity removal and cooling ducts can be equipped with a spark detection and extinguishing system.

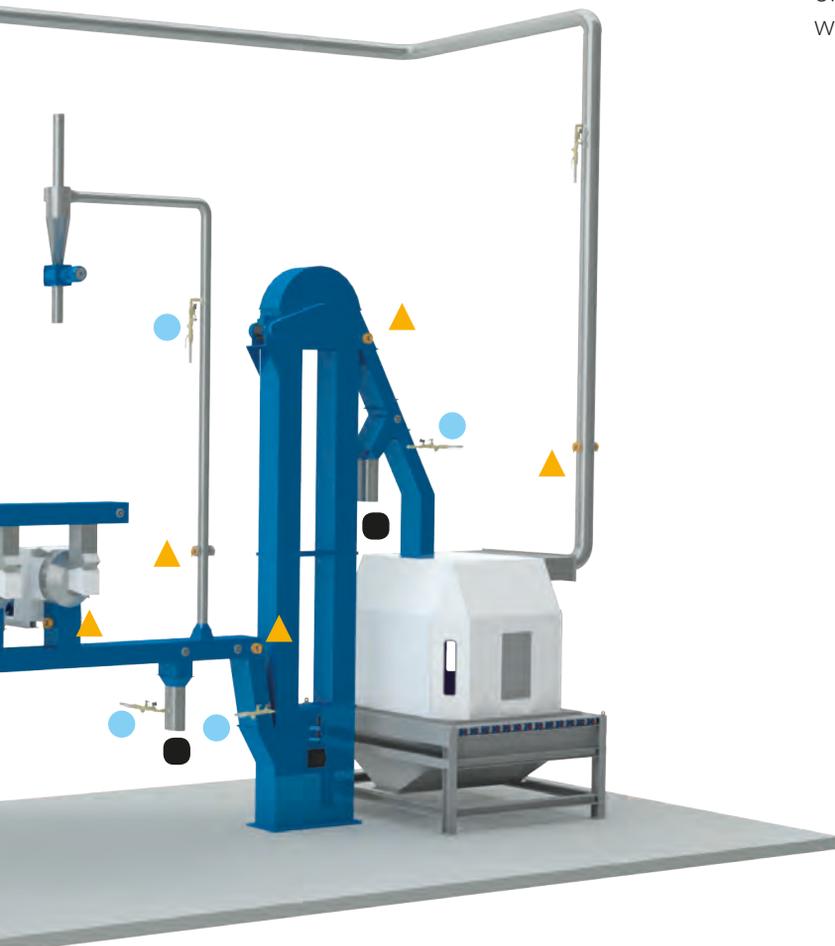


Protecting crushers

Crushers often suffer fire damage. This is mainly due to their extreme power, which makes them unable to sense or react to wedged objects. No less dangerous is the fact that crushers often process materials that are extremely flammable. Crushed material often contains foreign objects that cause sparks. A fire ignited inside the crusher can stay inside or advance into a following conveyor system.

Reducing risk factors

The Atexon® spark detection and extinguishing system is the ideal choice for protecting any crusher system. The spark detection and extinguishing units are designed to mitigate the risk from ignition sources such as sparks that could advance from the crusher to further parts of the process, such as a pneumatic transport system. A local water mist extinguishing system and its triggering flame detector, meanwhile, are designed to extinguish a fire inside the hopper before it can spread into the surrounding environment. An Atexon® water mist extinguishing system uses only a minimal amount of extinguishing water. This ensures that little to no water damage occurs inside the factory environment.



-  Spark detection
-  Spark extinguishing
-  Flame detection
-  Diverter / wastegate

Protecting elevators

Elevators that transport material flows to higher levels pose numerous risks that may cause a dust explosion or fire to occur inside conveyor systems. Typical ignition sources include sparks caused by the displacement of a drive shaft, embers caused by abrasion, bearing failure and hot particles advancing inside the material flow.

Reducing risk factors

Much like with other conveyors, the Atexon® spark detection and extinguishing system is installed in the feeding and discharge chutes where the material is mixed together with surrounding air.

The spark detector is designed to detect sparks in milliseconds and immediately trigger the extinguishing unit. The typical duration of the extinguishing event is five seconds. If multiple, consecutive sparks are detected, the system shuts down the elevator.

If the process does not tolerate water, the material flow can be transported out of the conveyor system for the duration of the extinguishing procedure.



Protecting conveyors

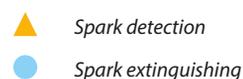
Any mechanical movement (>1 m/s) can cause sparks. A bearing fault or a wedged object inside the conveyor system cause friction and a rise in temperature, which in turn can cause a fire or a dust explosion.

Other risk factors include static electricity, foreign objects inside the conveyor system and the overheating of electrical motors.

Reducing risk factors

When conveyor systems are being protected, a key objective is to implement both detection and extinguishing at the location where the material is dropped down by gravity and simultaneously mixed with air. This is the point at which the material is at its lowest concentration and radiation from possible ignition sources can most easily pass through the material flow and reach the spark detectors.

The Atexon® spark detection and extinguishing system can be used to protect a wide variety of different conveyor structures. Typical target systems include belt and scraper conveyors and screw feeders.



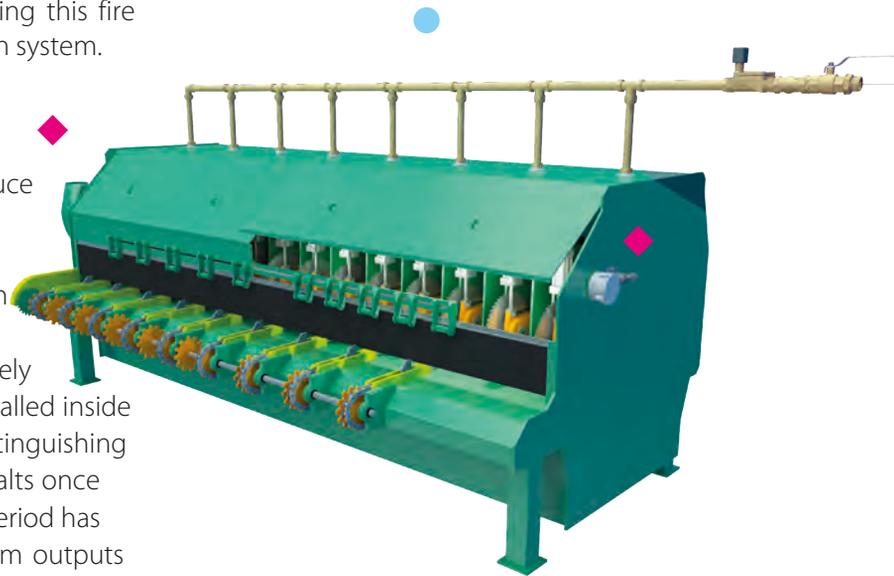
Protecting trimmers

In sawmills, the highest potential for fire hazards can be found in the trimming process. It is one of the final processes implemented at the mill and involves removing low-quality parts and cutting the timber into its final length. The rapid spinning of the circular saws used for trimming often produces sparks. This may occur for example when pushers from the conveyor system reach their blades. In certain conditions, such sparks can cause a local fire inside the blades' housing. From the housing this fire can then advance into the dust extraction system.

Reducing risk factors

The Atexon® spark detection and extinguishing systems are designed to reduce ignition sources created at the trimming station from reaching the dust extraction system. Flame detectors installed at both ends of the blade housing detect fire ignited during the process and immediately trigger the water extinguishing system installed inside the housing, to extinguish the fire. The extinguishing system is fully automatic. Extinguishing halts once the fire has been put out and a set delay period has passed. The system features integrated alarm outputs that communicate faults occurring at the trimming station quickly to the user. This helps reduce more serious breakdowns.

- ◆ Flame detection
- Spark extinguishing



Other applications

Atexon® spark detection and extinguishing systems are an ideal choice for the early detection of ignition sources from a variety of local processes. The primary strengths of Atexon® system are its fast response time and high sensitivity.

Extinguishing can be achieved using water, water mist, carbon dioxide, aerosols and/or various other electronically controlled extinguishing devices. The most commonly used extinguishing agent is water, as it is easily available and does not require the user to implement additional steps between extinguishing events.

Atexon® spark detection and extinguishing systems also support various detection technologies, such as heat and gas sensors.



This belt dryer has been protected using a spark detection system that controls a dry sprinkler system which has been installed above the perforated belt.

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