PANEL & ENGINEERED LUMBER INTERNATIONAL CONFERENCE & EXPO ™

APRIL 13-14, 2018 / ATLANTA, GEORGIA, USA

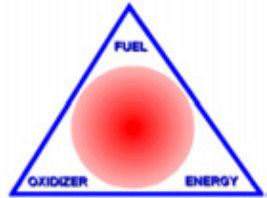# Spark Detection Prevents Fires and Saves Your ASSets!

Presented by: Jeffrey C. Nichols
Industrial Fire Prevention, LLC

Bio

Jeffrey C. Nichols, Managing Partner, Industrial Fire Prevention, LLC, providing special hazards protection for combustible dust processes since 1979.

Spark Detection Subject Matter Expert. Expertise protecting process equipment, conveying, fume and dust collection systems from fires and explosions in many diverse industries. Started out protecting process and dust collection systems when spark detection & extinguishing systems were first introduced into the United States in the 1970's.
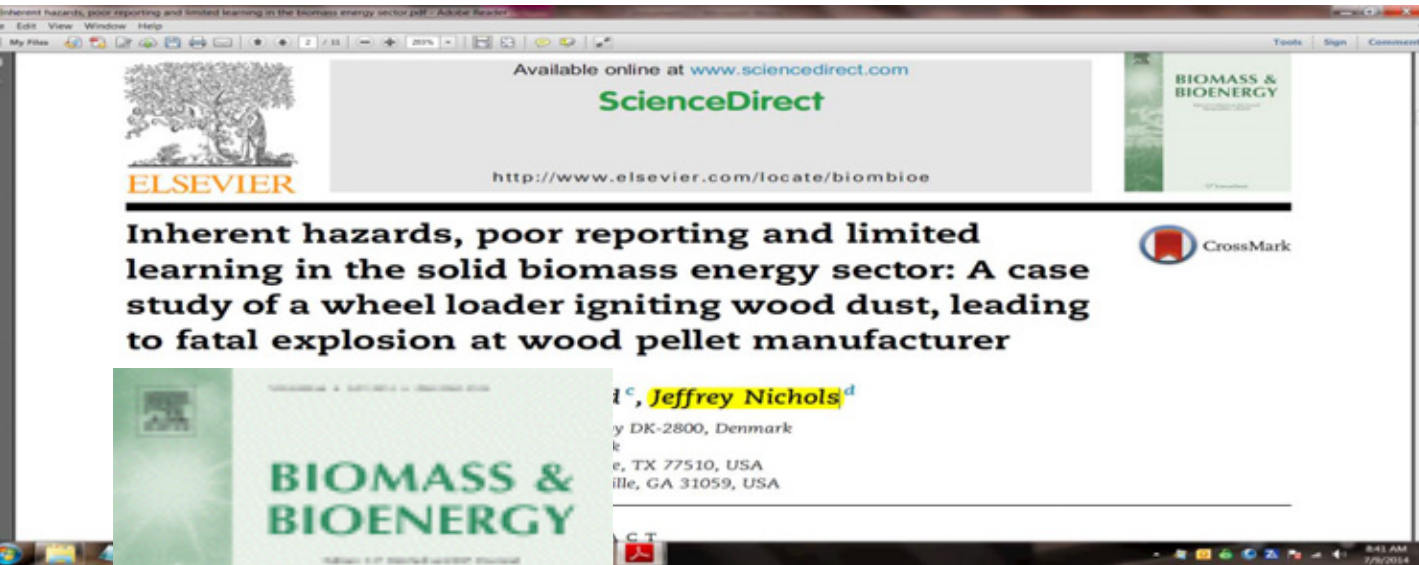

NFPA 664 Wood and Cellulosic Materials Processing Technical Committee

Related Education & Training

- **GreCon University** – Process Safety, Fire Prevention, Spark Detection Systems
- **StuvEx** – Process Safety, Explosion Protection
- **ATEX** – Explosion Protection
- **Fike** – Explosion Protection Fundamentals
- **AF&PA American Forest & Paper Association** – Understanding and Practical Application of Combustible Dust Hazards in the Wood Products and Paper Industries
- **The NFPA Fire Protection Research Foundation-** Dust Explosion Hazard Recognition and Control
- **Georgia Tech Research Institute** – Process Safety Management
- **Georgia Tech Research Institute** – Combustible Dust Safety Training
- **Georgia Tech Research Institute** – Preventing and Mitigating Combustible Dust Fires and Explosions
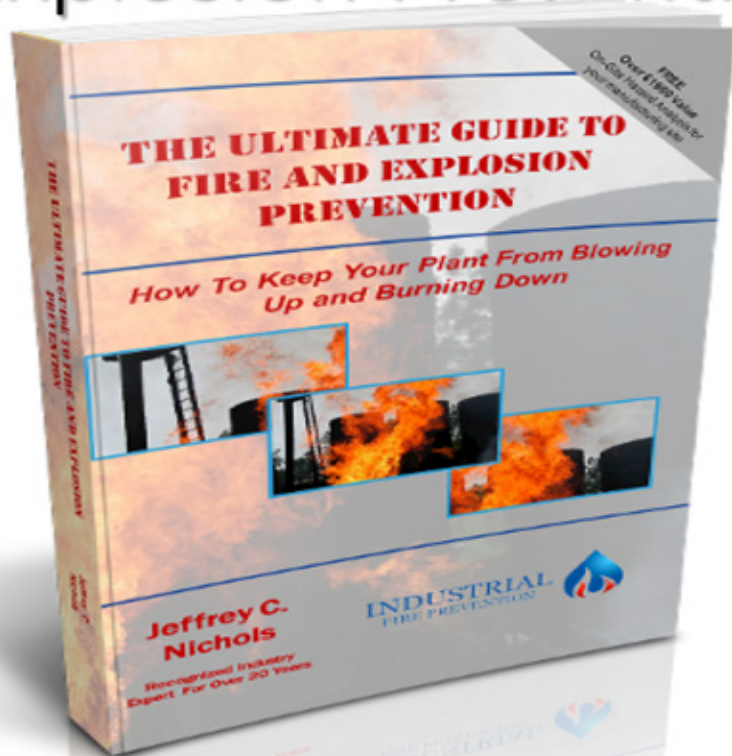
Jeffrey C. Nichols

Available online at www.sciencedirect.com

ScienceDirect

http://www.elsevier.com/locate/biombioe

ELSEVIER

BIOMASS & BIOENERGY

Inherent hazards, poor reporting and limited learning in the solid biomass energy sector: A case study of a wheel loader igniting wood dust, leading to fatal explosion at wood pellet manufacturer

CrossMark

..., *Jeffrey Nichols* [d]

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BIOMASS & BIOENERGY

TechnicalExclusive

Spark Detection: First Line of Defense for Preventing Combustible Dust Fires and Explosions

By Jeffrey C. Nichols

The Ultimate Guide to Fire and Explosion Prevention

THE ULTIMATE GUIDE TO FIRE AND EXPLOSION PREVENTION

How To Keep Your Plant From Blowing Up and Burning Down

Jeffrey C. Nichols

Recognized Industry Expert For Over 20 Years

INDUSTRIAL FIRE PREVENTION

Why Spark Detection?

Detect sparks and embers in the incipient stage

Prevent propagation

More than 30 % of fires are caused by sparks or burning embers

Total damage of a press line

Explosion in OSB panel production

Spark Detection

- Spark detection saves your process
- Spark Detection saves your facility
- Spark Detection saves lives
- Spark detection insures business continuity
- Spark detection saves your ASSets

Hazard recognition

FM Global Engineering Standards Department

Table 2 Losses by Equipment Type		
Equipment Type	Number	Gross Loss - %
Dust Collector	67	12
Impact Equipment	22	11
Boiler	11	18
Storage Silo	8	4
Processing Equipment	7	2
Conveyor	5	3
Dryer	8	40
Elevator	4	2
Spray Dryer	4	1
Various	30	7
Total	166	100

FM Global 7-76 Property Loss Prevention Data Sheets

Table 4. **Losses by Cause** (Ignition Source)

Cause Type	No. Losses
•Friction	50
•Spark	38
•Chemical Action	16
•Hot Work	13
•Burner Flame	10
•Electricity	6
•Static Electricity	6
•Overheating	4
•Hot Surface	2
•Unknown/No Data	21

Total 166

Spark Detection

- Spark Detection is part of a layered protection system design
- Spark Detection is part of a hierarchy of engineering controls
- Spark detection is the starting point of protecting your process
- Detecting sparks in the incipient stage prevents fires-
- Prevents fires from propagating to other parts of the process
- Prevents explosions
- Thus preventing catastrophic secondary explosions
- And ensuring business continuity
- And life safety

Best Practices in Process Safety Engineering Controls

Layered Safety Systems, Engineering Controls:

- **Prevention:** Spark, Ember, Flame, Temperature, Smoke, Combustion Gas Detection Systems, and various types of Suppression Systems.

- **Fire Protection:** Various types of suppression systems: Sprinkler and Deluge systems, water mist, Dry chemical, CO_2, and gas Inerting systems

- **Explosion Protection:** Explosion Venting, Suppression and Isolation Systems

- **Interlocks & Controls:** Diverters, Fire Dumps, Alarms, Deluge, E-stop, Sequential Process Shutdown

Fire Prevention

Reduce Probability of Occurrence, utilize Active Controls

Preventative Fire Systems are <u>pro-active</u>
and can include:

- **Spark & Hot Particle Detection & Extinguishment**
- Suppression, inerting, spark arrestor, diverter
- Flame Detection
- Heat & Smoke Detection
- CO / Combustible Gas detection
- Bearing Temperature & Belt Alignment
- Emissions Monitoring, Broken Bag Detection

Principle of IR spark detection and extinguishment
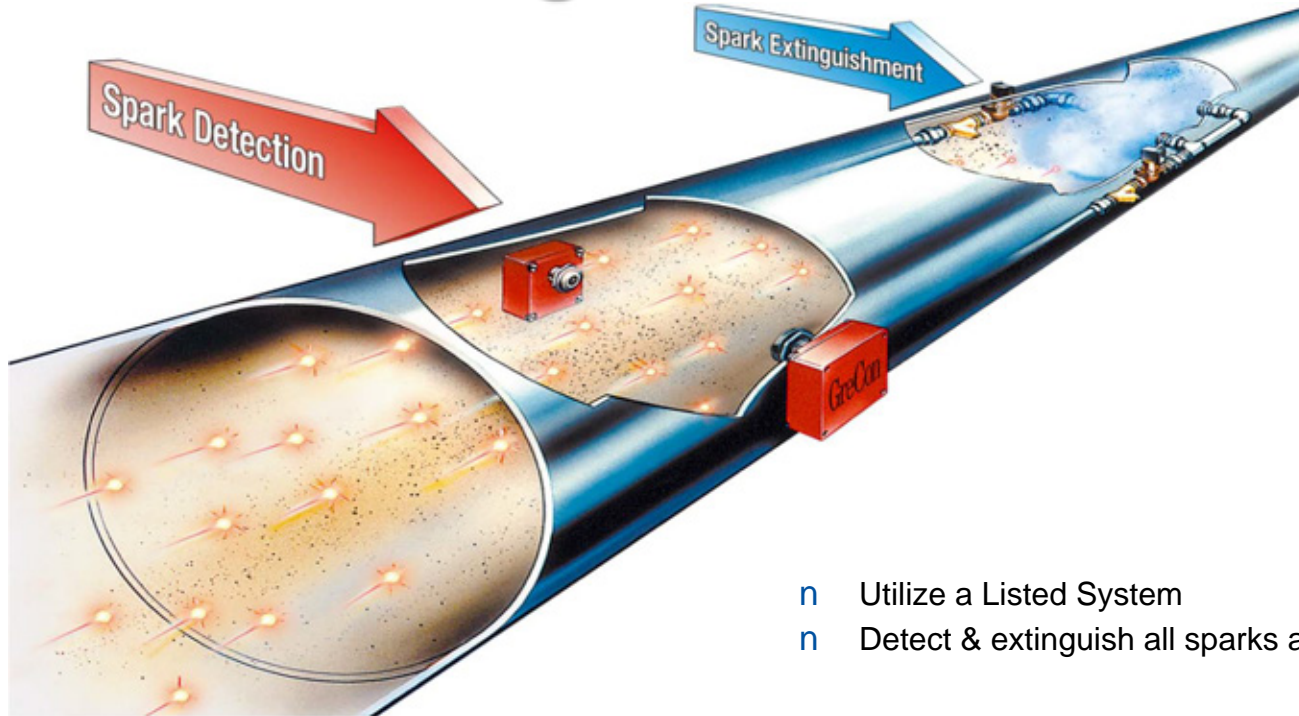
- n Utilize a Listed System
- n Detect & extinguish all sparks as per NFPA 664

NFPA 664 Standard for the Prevention of Fires and Explosions in Woodworking Facilities
Prescriptive Requirements
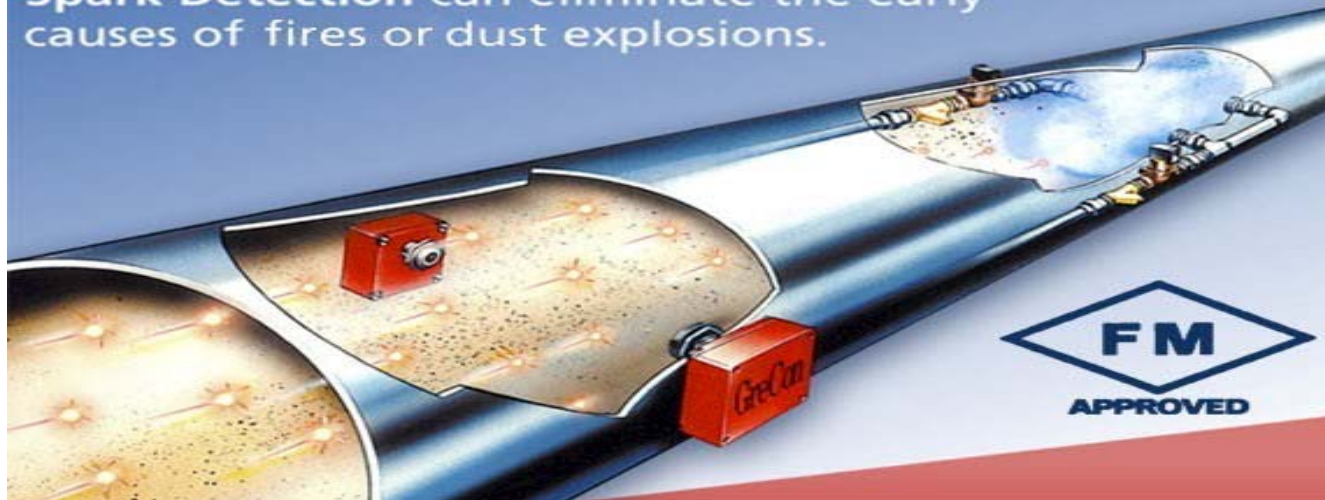
- **8.2.2.2.2* Ducts with a Fire Hazard.** Ducts conveying dry material released by equipment having a high frequency of generated sparks shall be designed and constructed in accordance with one of the following:

- (1) Equipped with a <u>listed spark detection and extinguishing system</u> installed downstream from the last material entry point and upstream of any collection equipment.

- (2)* Equipped with be a listed spark detection system actuating a <u>high-speed abort gate</u>, provided the abort gate can operate fast enough to intercept and divert burning embers to atmosphere before they can enter any collection or storage equipment.

- (3) Ducts conveying material to locations representing minimal exposure to personnel and the public at large shall be permitted without spark detection and extinguishing systems subject to a risk analysis acceptable to the Authority Having Jurisdiction.

Spark Detection & Extinguishing Systems

# Certifications & Approvals

- Certified according to ISO standards 9001
- TÜV-Atex approval
- VdS, EX, CE & FM Approvals, CSA, UL
- SIL (failure analysis) **Certification to a Safety Integrity Level 2**
- Customer support for enquiries by trade boards, insurance companies, experts and approval authorities
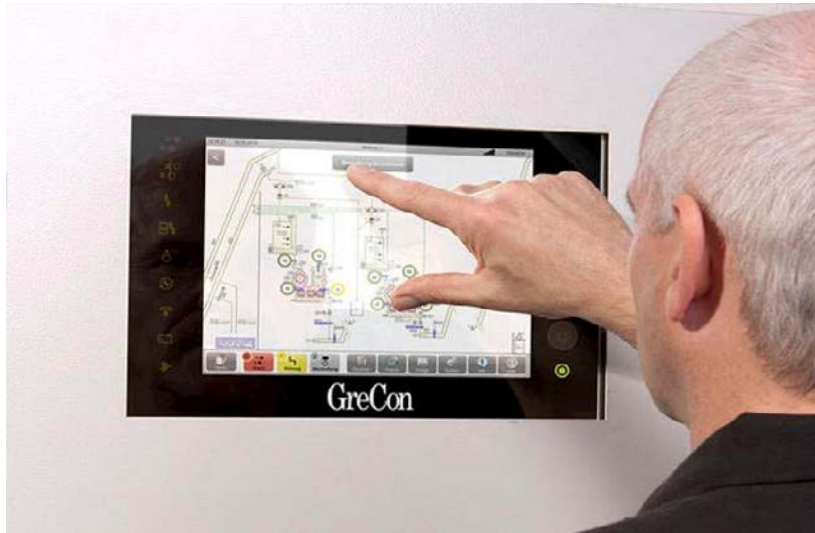
GreCon Control Consoles

- 1, 2, 4, 16, up to 36 zone Control Consoles
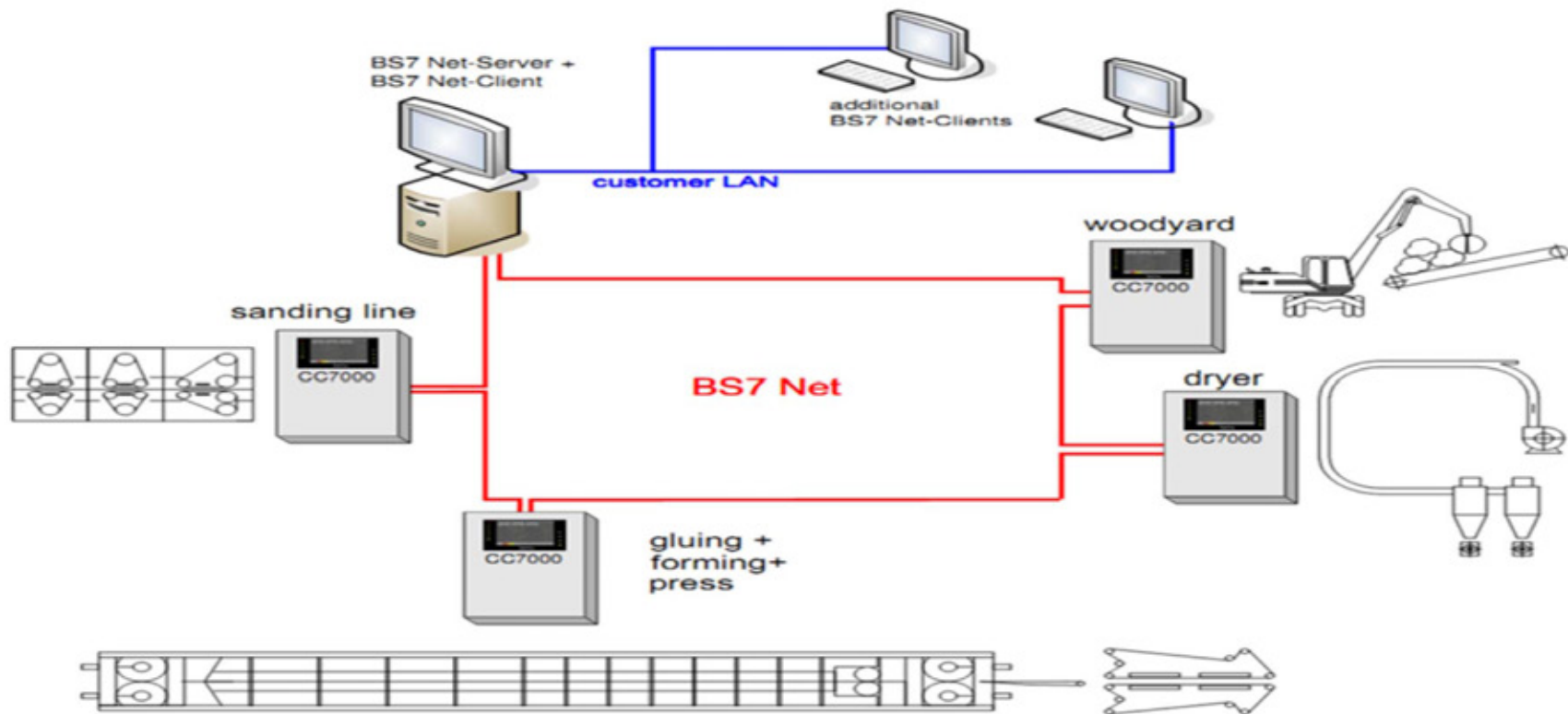- And up to two (2) 20 or 40 zone Extension Cabinets

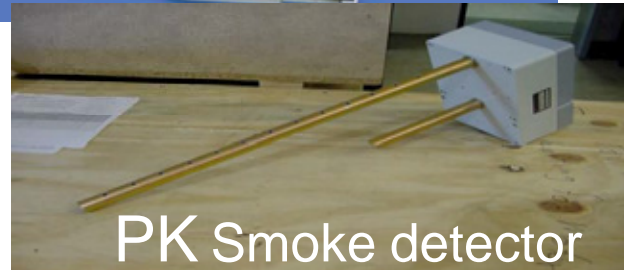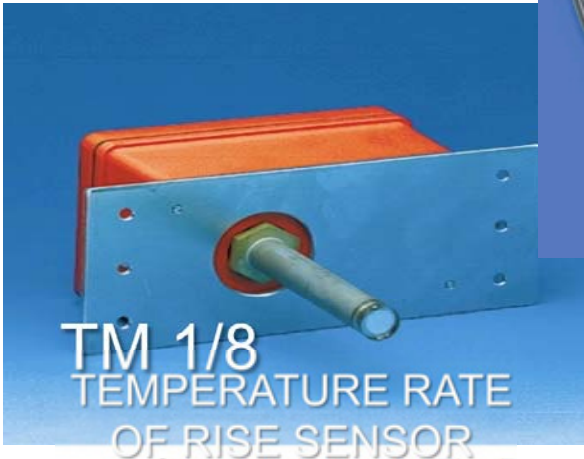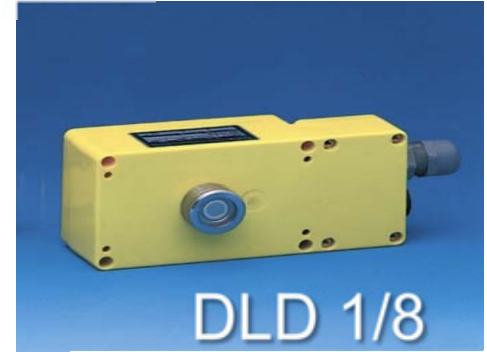# System Connections
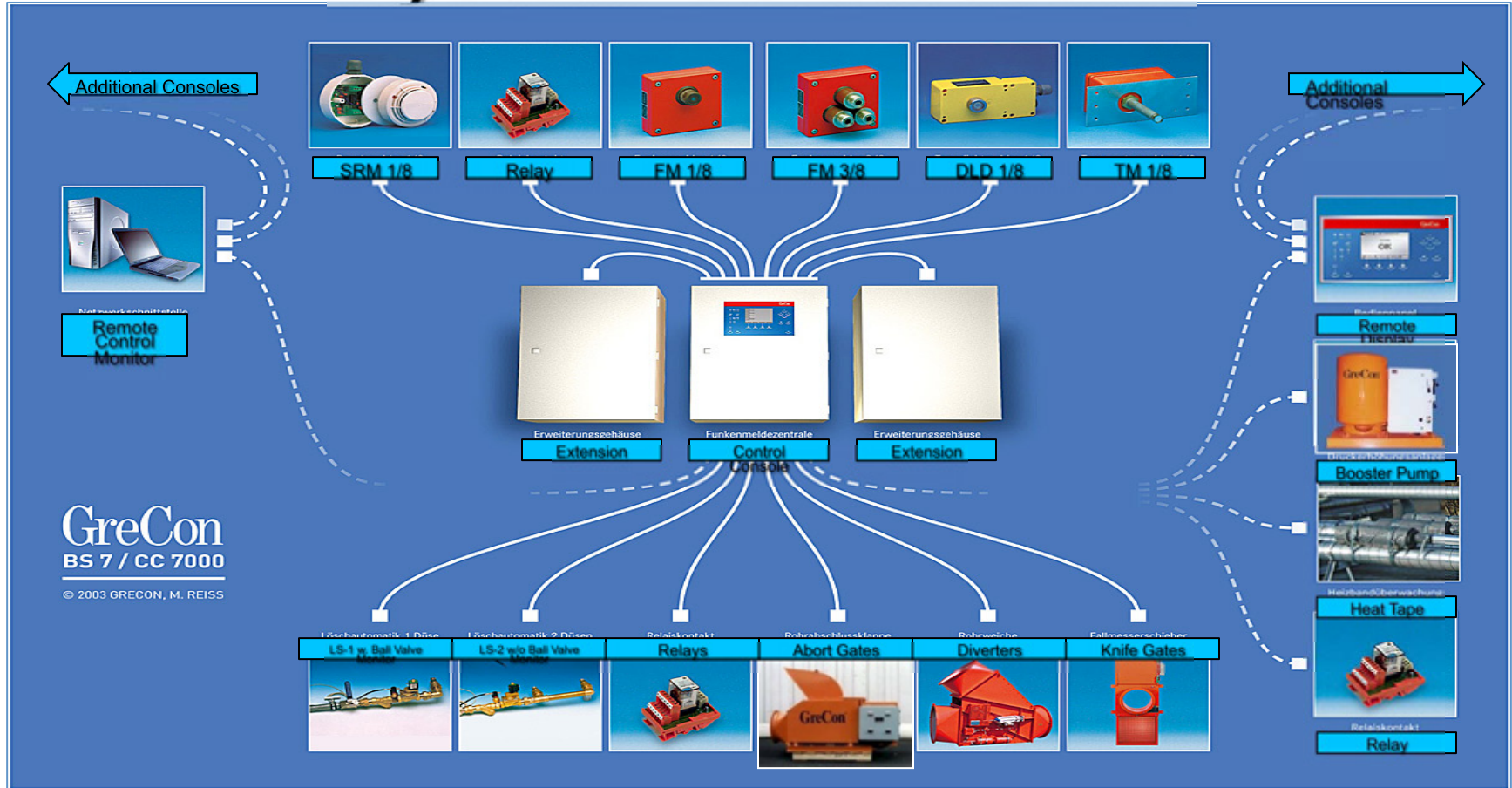
Touch Screen

q Industrial grade touch screen

q Easy navigation

q Easy to configure with any Windows based computer.

q Configuration upload via USB memory stick

q Built in SD Memory Card port.

q Uploads of Auto CAD, JPEG files depicting physical location of the zones.

q 4 standard languages EN, DE, SP, FR 16 additional languages upon request
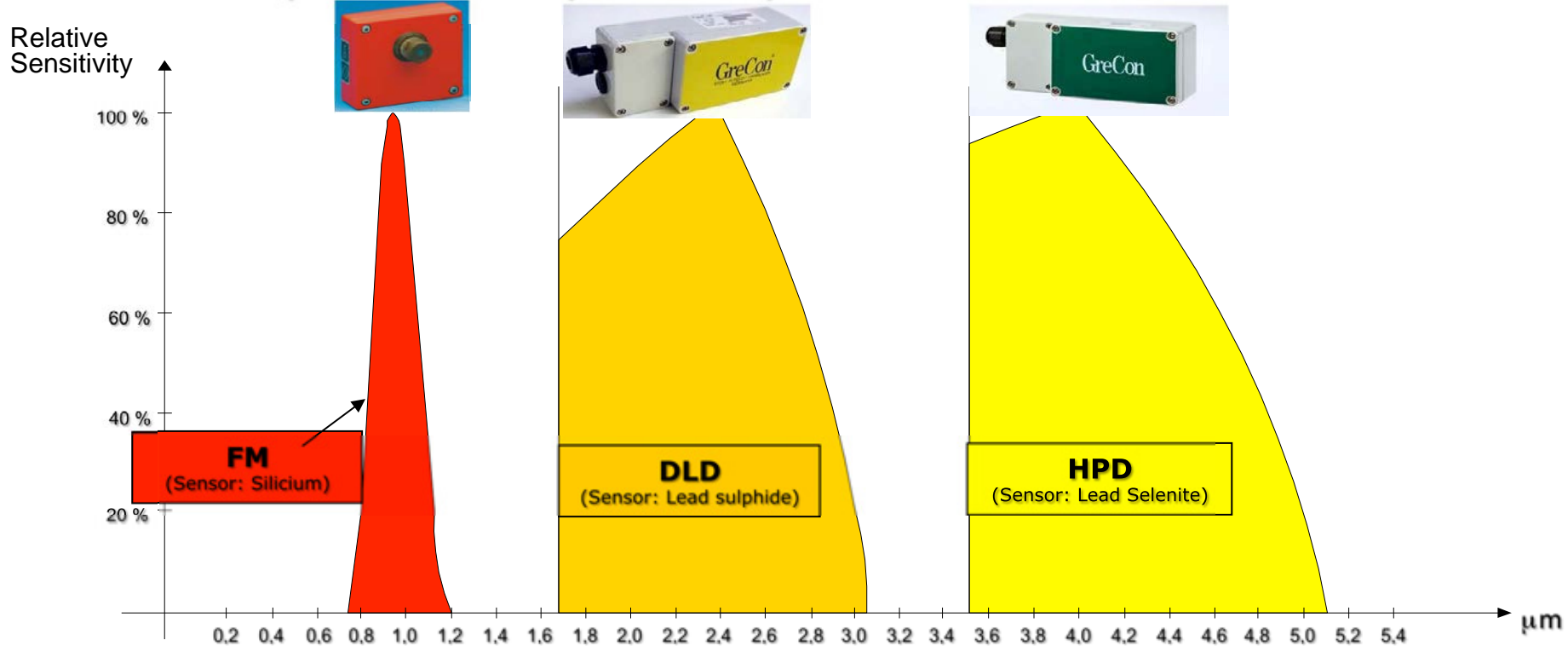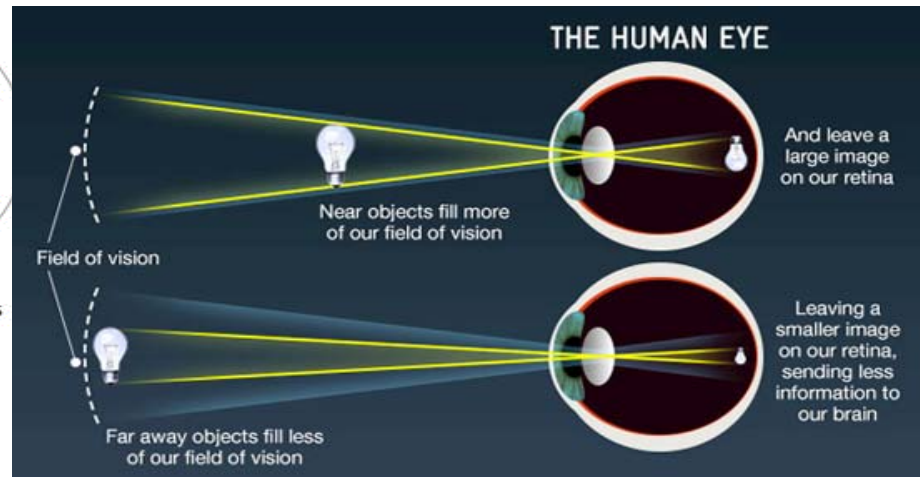
Example of a BS7Net-network

GreCon sensor types

FM 3/8

FM 1/8

DLD 1/8

TM 1/8
TEMPERATURE RATE
OF RISE SENSOR

PK Smoke detector

FD 1/8

Flame detector

Types of Detectors IR
Spectral Response Spark and Hot Particle

Relative Sensitivity

100 %
80 %
60 %
40 %
20 %

FM
(Sensor: Silicium)

DLD
(Sensor: Lead sulphide)

HPD
(Sensor: Lead Selenite)

0,2 0,4 0,6 0,8 1,0 1,2 1,4 1,6 1,8 2,0 2,2 2,4 2,6 2,8 3,0 3,2 3,4 3,6 3,8 4,0 4,2 4,4 4,6 4,8 5,0 5,2 5,4   µm

Optical Spark Detection

Spark detector FM 1/8

with silicium element

– Highly sensitive spark detector (Si element)

– Installation in transport ducts and drop chutes

– Reliable detection of ignition sources within the product flow, even at high material load and pollution including **Dense Phase** conveying

– Flush-mounted installation of the detector optics for maximum life

Spark Detector FM 1/8

Spark detector FM 3/8
with Si element and fibre optic cable

- Highly sensitive spark detector (Si element)

- For use at high operating temperatures (up to 600 °C) with fiber optic cables

- High detection reliability by using three detection elements

Spark detector FM 3/8 with fiber optic cables

Daylight detector DLD 1/8A
with lead sulphide element

– PbS element

– Installation in processes with **ambient light** egress

– Transfer points between mechanical conveyors, e.g. chutes, hoppers

– Bucket elevator infeed & outfeed chutes

Daylight Detector DLD 1/8A

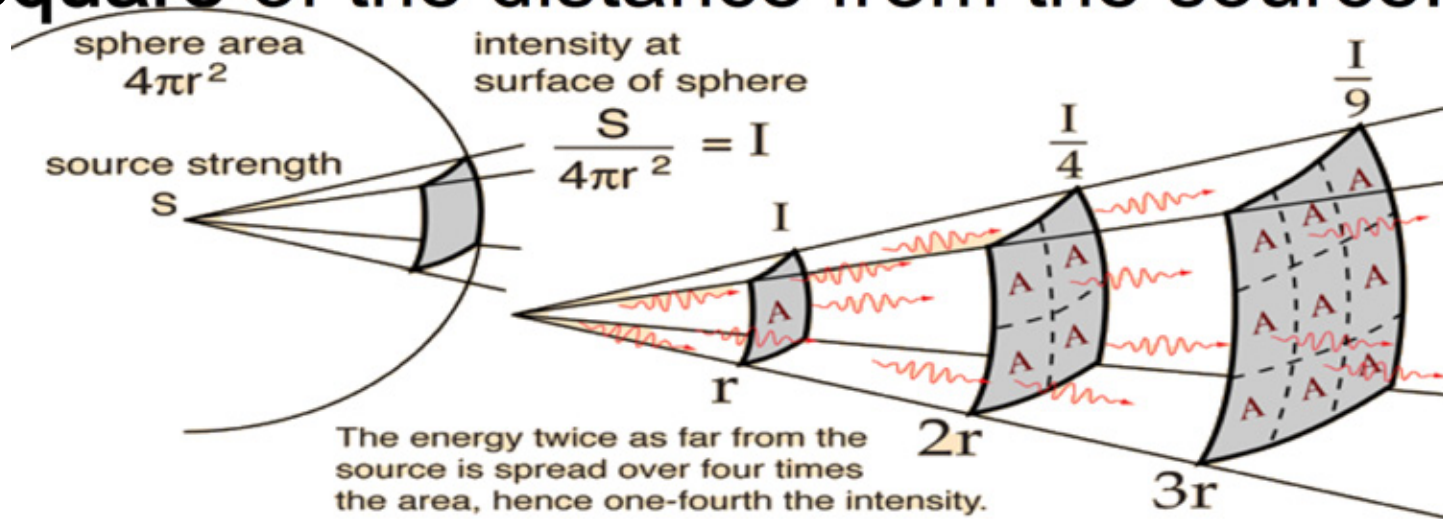# Example of hot particle detection

DLD 1/8
Sensor: Lead sulphide

Inverse Square Law
Intensity is inversely proportional to the **square** of the distance from the source

Physics: Inverse square law

Intensity is inversely proportional to the **square** of the distance from the source.

sphere area
$4\pi r^2$

intensity at
surface of sphere

$$\frac{S}{4\pi r^2} = I$$

source strength
S

$\frac{I}{4}$

$\frac{I}{9}$

I

A

r

A   A
A   A
A   A

A   A
A   A
A   A
A   A

The energy twice as far from the
source is spread over four times
the area, hence one-fourth the intensity.

2r

3r

Physics: temperature detection in pneumatic conveying systems = *dangerous theory!*

Type of Dust	Ignition Temperature†	
	Cloud °C	Layer °C
Agricultural Dusts		
Cellulose	480	270
Cellulose, alpha	410	300
Wheat flour	440	440
Wheat starch, edible	430	—
Wood flour, white pine	470	260

n250 °C

n400 °C

Lesson: **Detect ALL sparks as per NFPA 664**

Detect and extinguish every spark

- NFPA specifies in its Standard 664 paragraph A. 8.6.2.2, *"The spark extinguishing system should activate every time a single spark is detected."*

- Industry expert, Dr. Vahid Ebadat of Chilworth Technology, Inc., a firm that investigates explosions, concurs saying *"...the 'bottom-line' response to this question would be a suggestion to consider the above-quoted guidance from NFPA 664, and detect and extinguish every single spark"* (see http://pbs.canon-experts.com/2011/08/).

Thermo detector TM 1/9

for temperature monitoring

- Collateral trigger functions

- Alarm upon fire-typical temperature rise

- Alarm upon exceeding of a set temperature threshold

Thermo detector TM 1/9

Flame detector FD 1/8

for detection of open flames

- Detection with dual UV/IR technology
- Insensitive to light ingress
- Heated optic for application in difficult conditions
- Early alarm by UV channel in case of arising fire (manual extinguishment)
- If the fire continues to spread, the UV alarm will be confirmed by the IR channel (automatic extinguishment)
- Application for **press extinguishment**, for example

Flame detector FD 1/8

Combustion gas detector BGM 1/8

for selective detection of smoldering-fire-characteristic gas emissions

– Detection with three
   semiconductors

– Detection of hydrocarbons (H_2)
   and nitrogen oxides (NO)

– Suppression of temporary fire-
   pretending phenomena

– Insensitive to heavy dust exposure

– Used to monitor silos

Combustion gas detector BGM 1/8

Extinguishment Assembly

Nozzle

Strainer

High Speed
Solenoid Valve
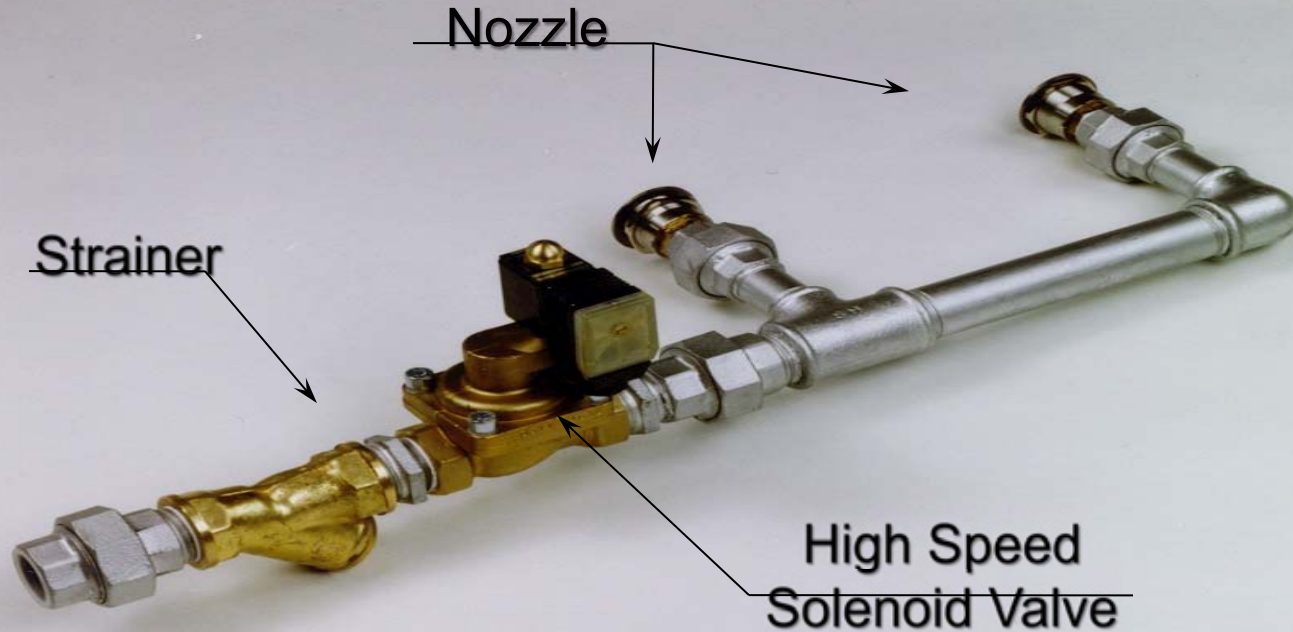
Wear

- To minimise the wear GreCon uses flat mouted optics and also water nozzles.

- With this geometry and a well considered installation place there is no wear at these two imported items!
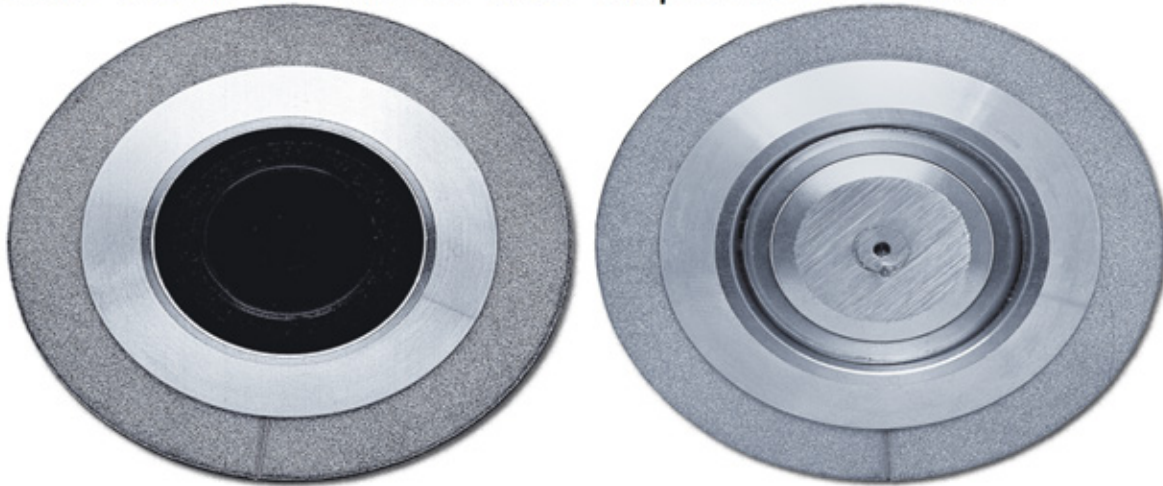
Extinguishing Concept:
Atomization of water droplet for maximum cooling effect with minimum water

- The finer the water droplet, the more surface area
- The finer the droplet size, the more cooling effect
- The finer the water atomization, the less water gathers in the ductwork
- Minimal use of water by optimum adaptation of cooling effect and throw distance

Optimum drop size for best extinguishing effect

Quantity

Drop size

0.1 mm
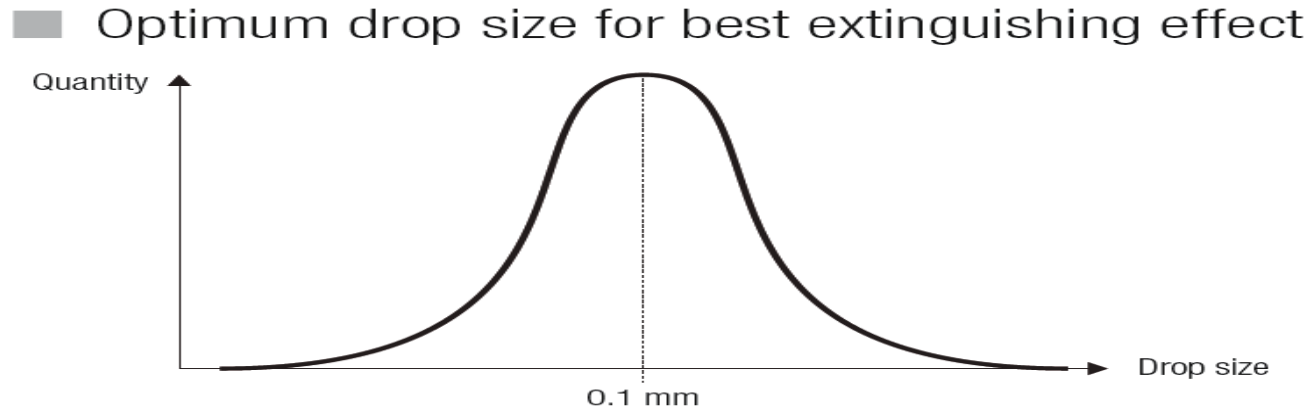
Reduction of reaction distance
By Ultrahigh-Speed Extinguishment

Normal extinguishment

4 to 7 m

Ultrahigh speed extinguishment (UHS)

< 2 m*

* Ø 400 mm at 25 m/s
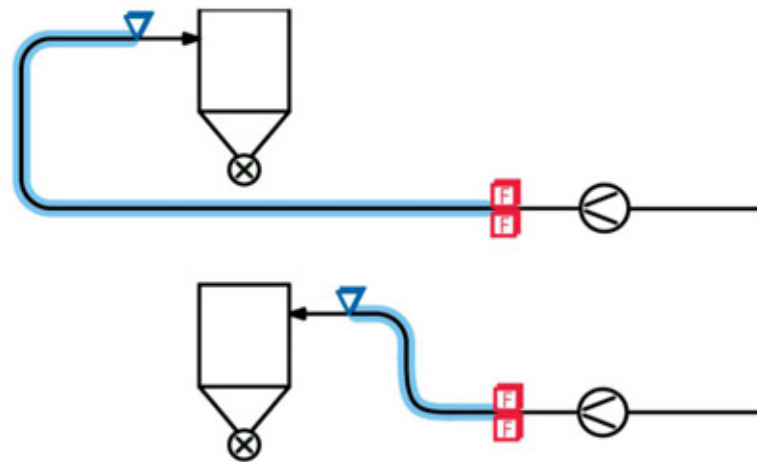
GreCon Abort Gate

•Used primarily in return air systems - Abort Gates safely exhaust hazardous air to the atmosphere, thereby protecting plant and personnel.

• Activated from the sensors - A spring-loaded gate closes in less than 500 milliseconds.

Plywood Veneer Dryer Solution

- Problem definition:
  - Due to the above described construction of the drier with its numerous internal components, a complete optical monitoring of the drier is impossible.
  - A temperature monitoring for fire detection is too slow.

- Solution:
  - Due to the permanent circulation of the drying air, it is to be assumed that sparks are carried away when fire arises.
  - To detect the sparks, spark detectors are installed in several important areas. These are:

    - drying area
    - cooling area
    - outgoing air of drying area
    - outgoing air of cooling area
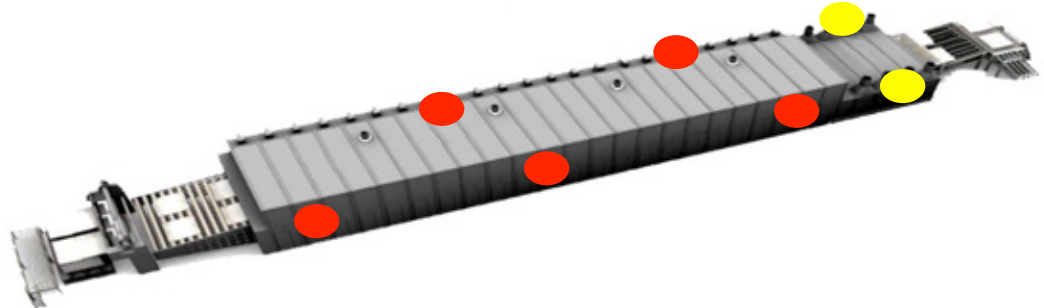
Planer Solution
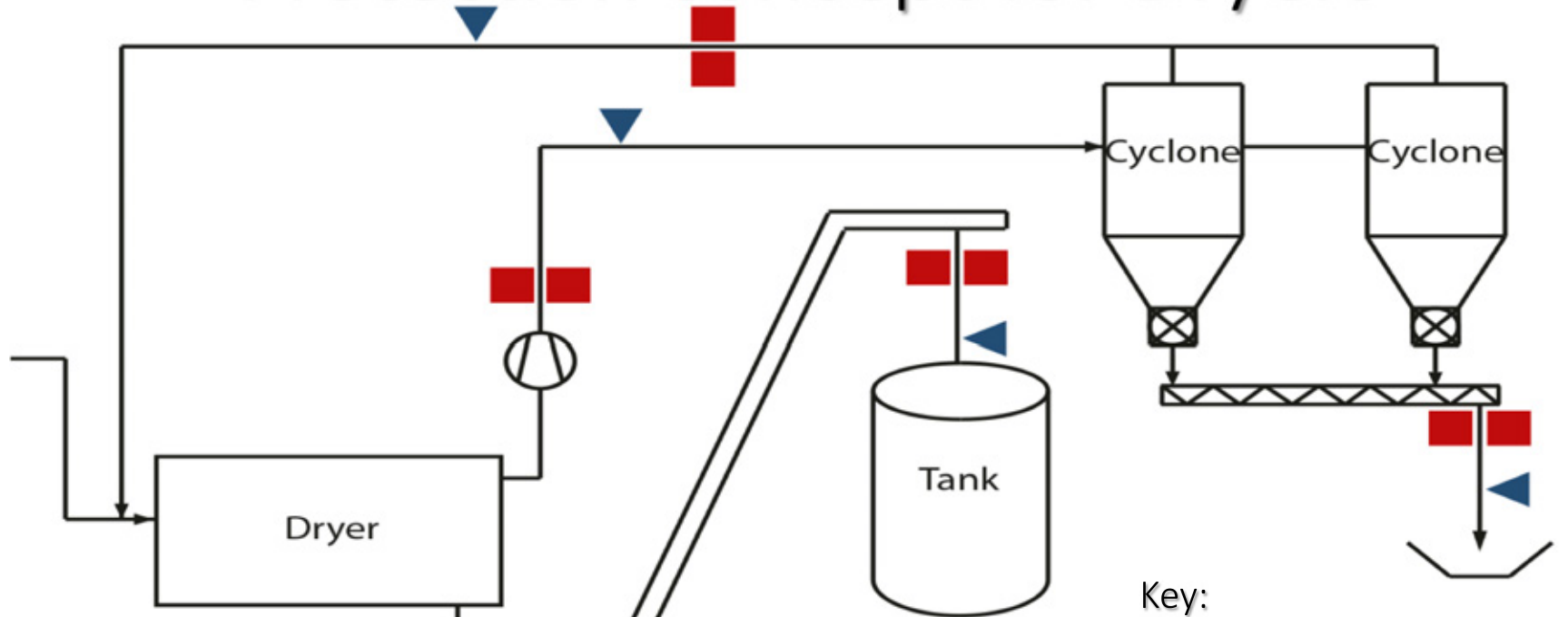
Protection concept for Milling processes

Key:
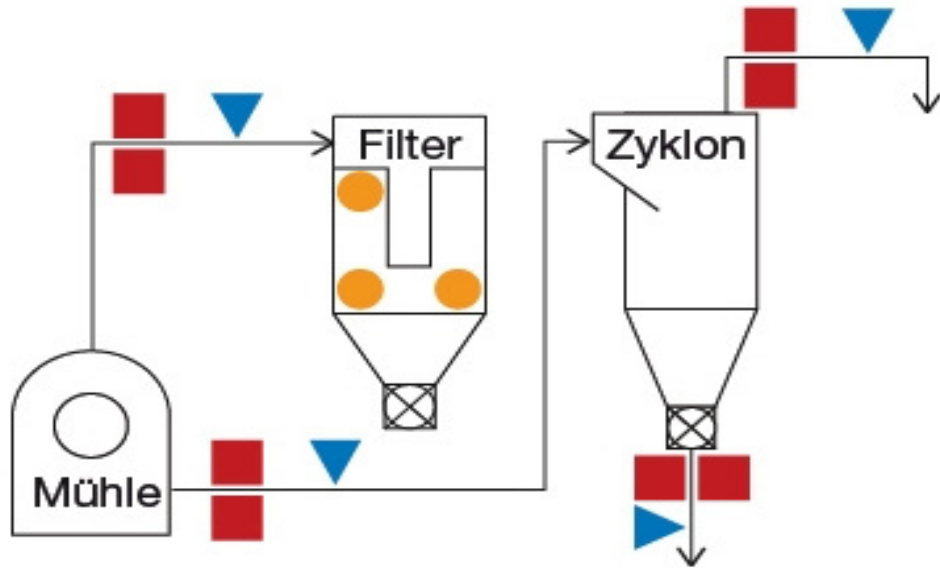
Spark Detector FM 1/8

q Extinguisment Device
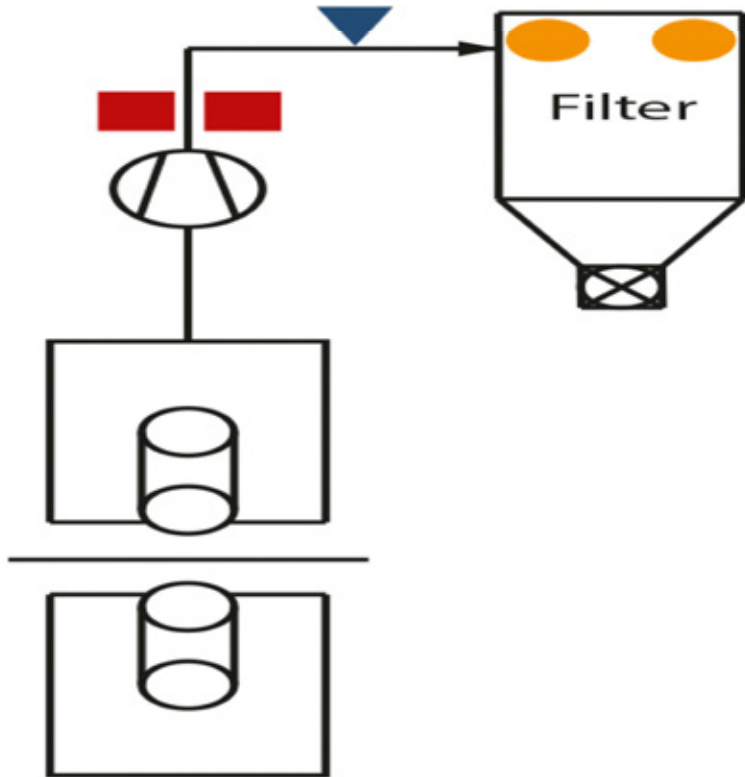
Thermo Detector

Application example "Milling"

Application example "drying"

Copyright Industrial Fire Prevention, LLC

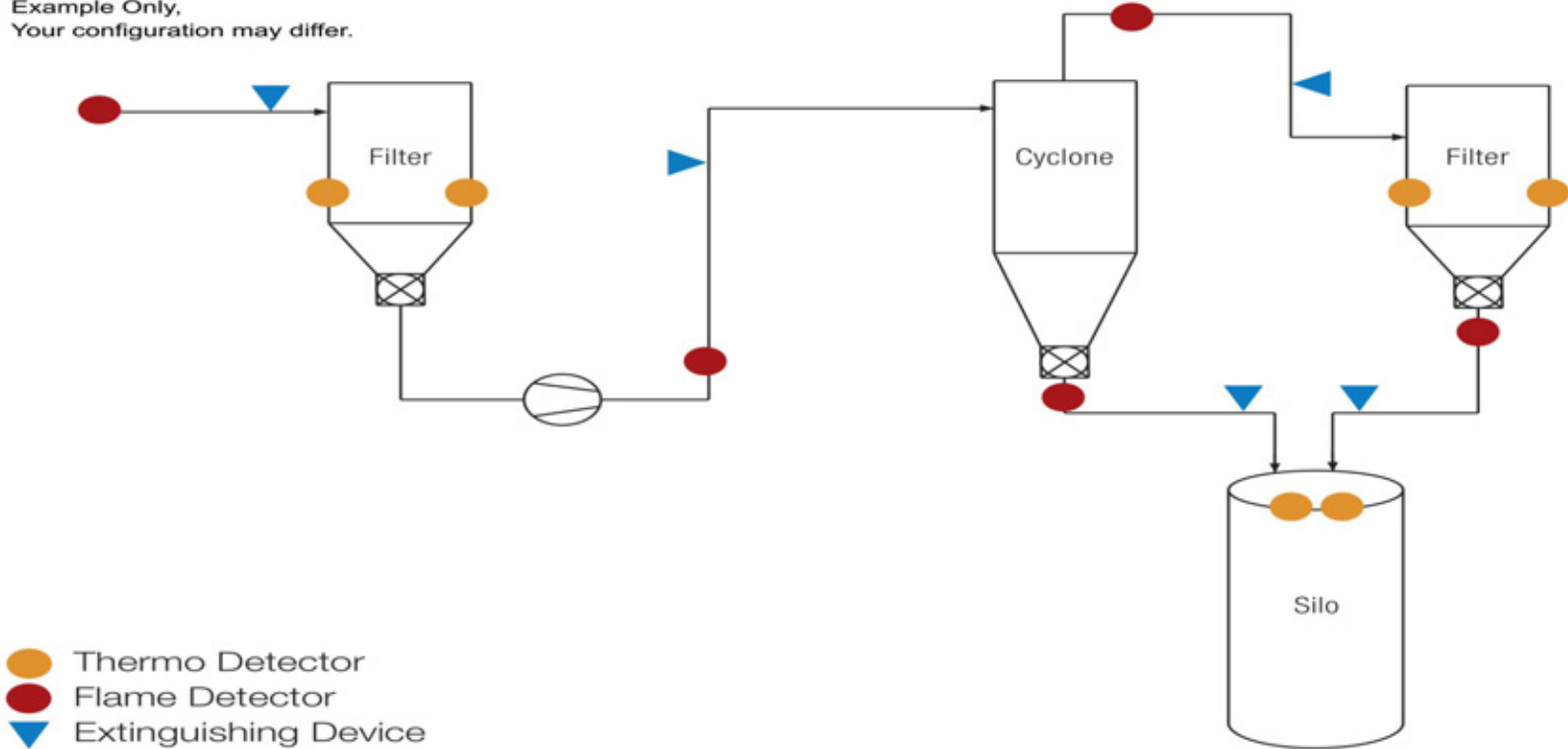# Protection concept for Sanding processes

Key:

Spark Detector FM

Thermo Detector

Extinguishment Device

Application example "Sanding"
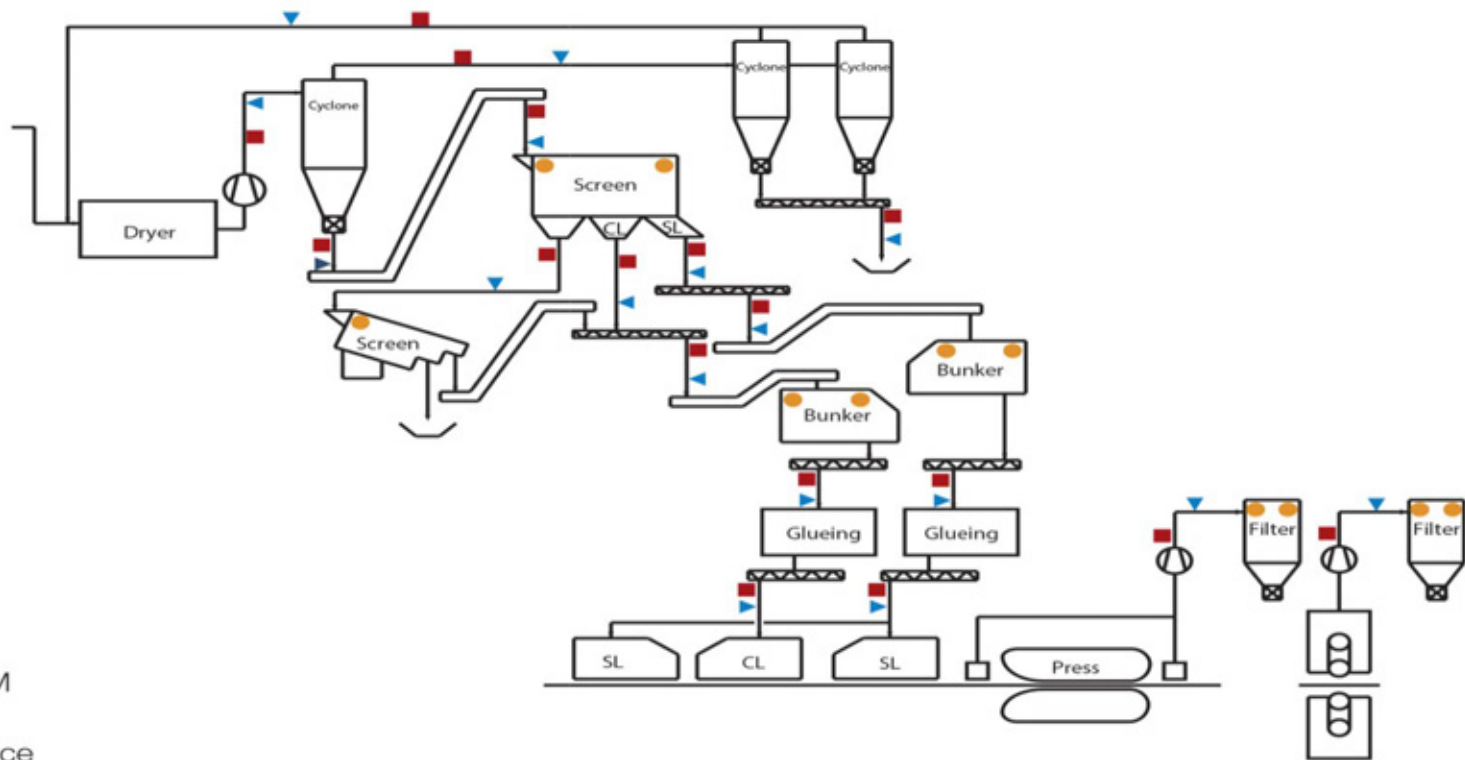
Application Plywood

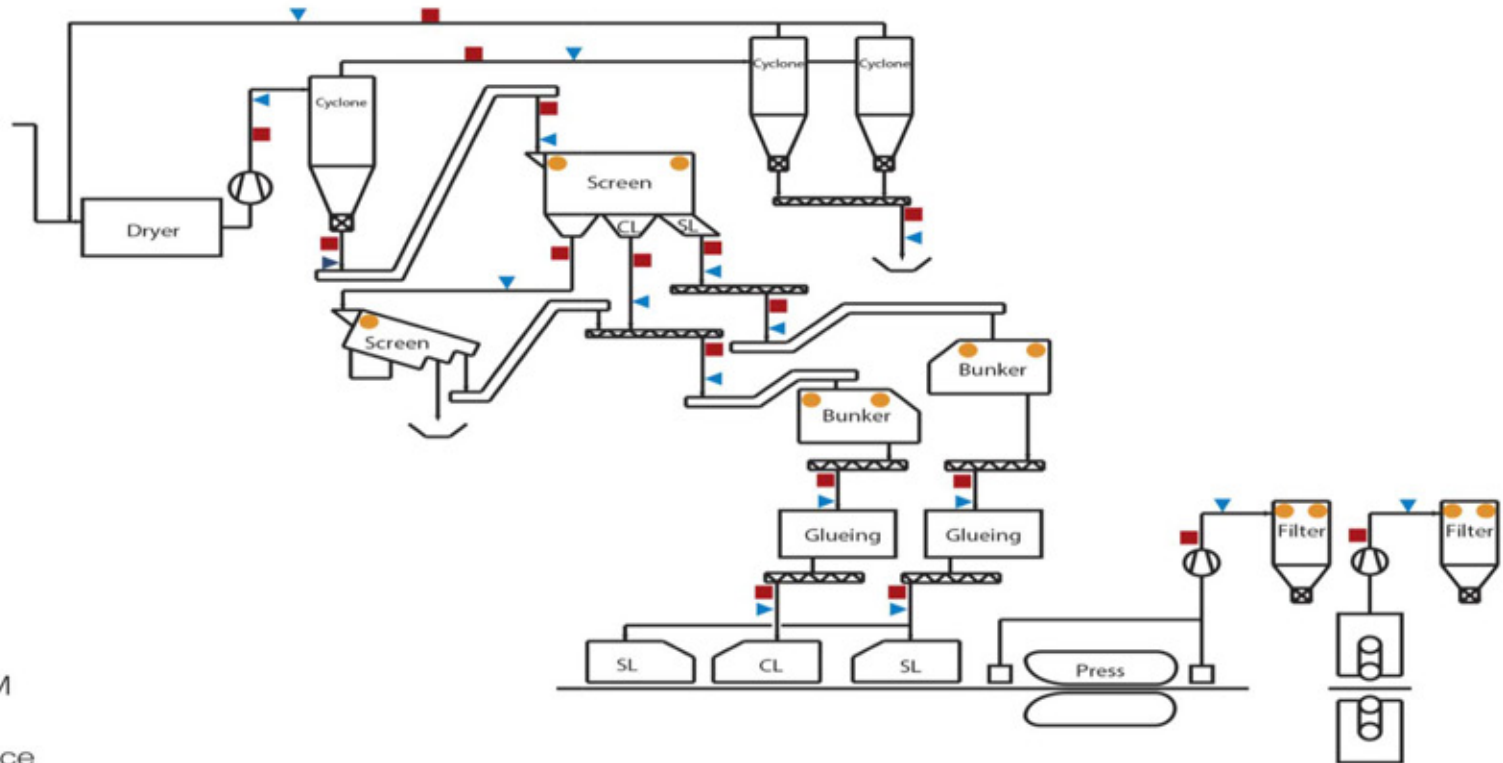Example Only,
Your configuration may differ.

Filter

Cyclone

Filter

Silo

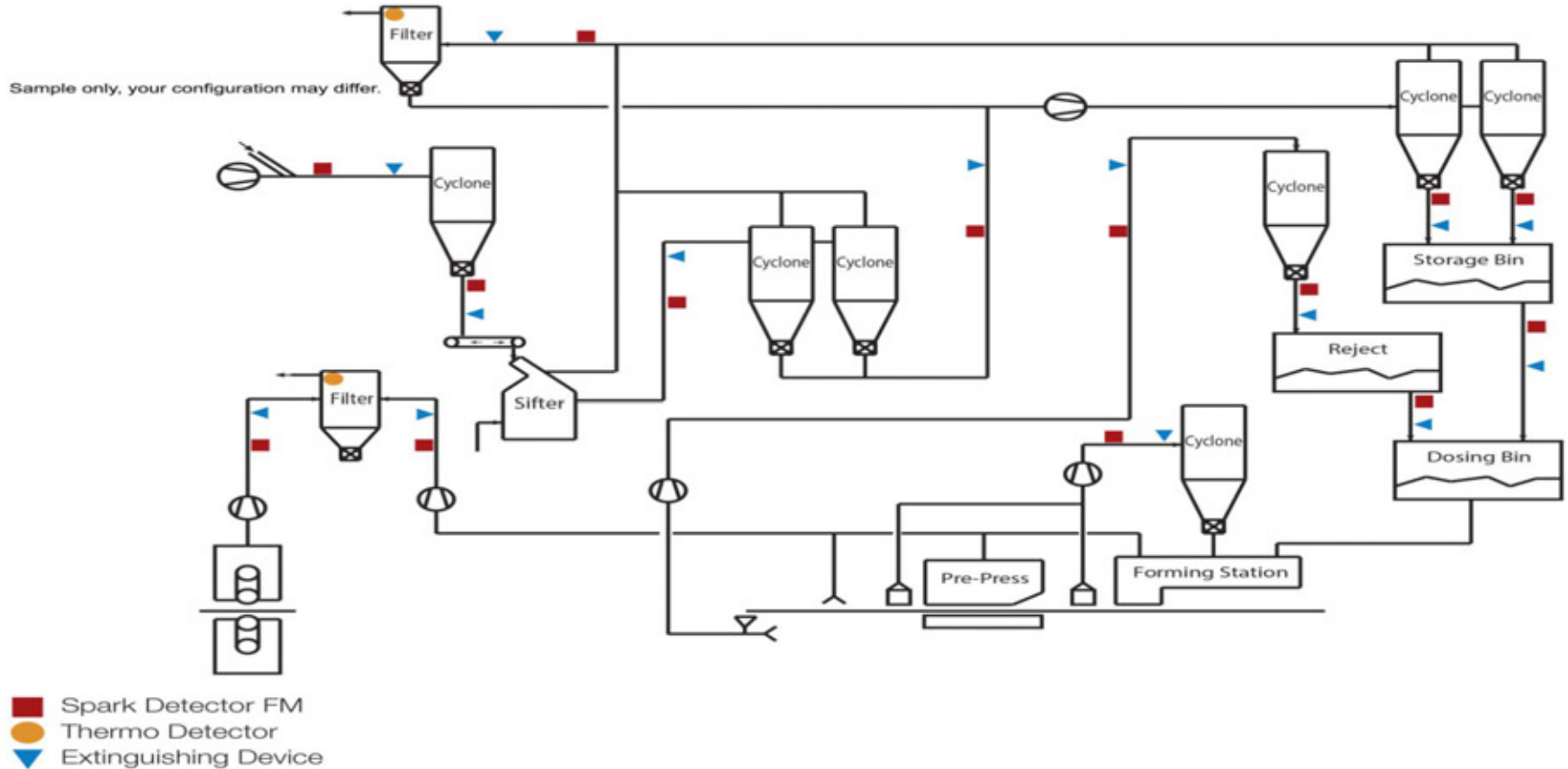Thermo Detector
Flame Detector
Extinguishing Device

Application OSB

Example Only,
your configuration may differ.

Spark Detector FM
Thermo Detector
Extinguishing Device

Application PB

Copyright Industrial Fire Prevention, LLC

Application MDF

Sample only, your configuration may differ.

Spark Detector FM
Thermo Detector
Extinguishing Device

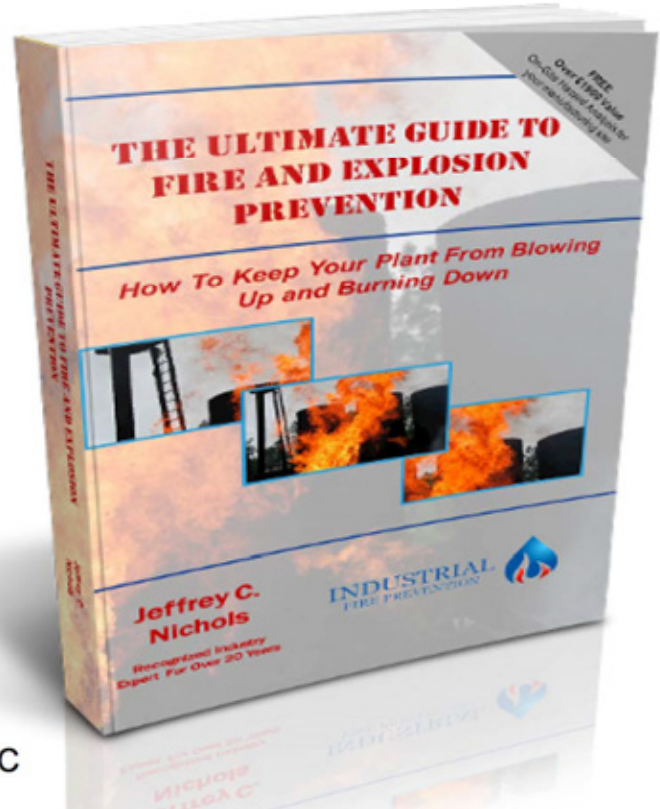For a Free copy: **The Ultimate Guide to Fire and Explosion Prevention**

Contact us at:

Industrial Fire Prevention, LLC

1-800-367-0063

www.info@IndustrialFirePrevention.com

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