JASON KRBEC

CV TECHNOLOGY
FIRE AND EXPLOSION PROTECTION

PROTECTING DUST COLLECTORS

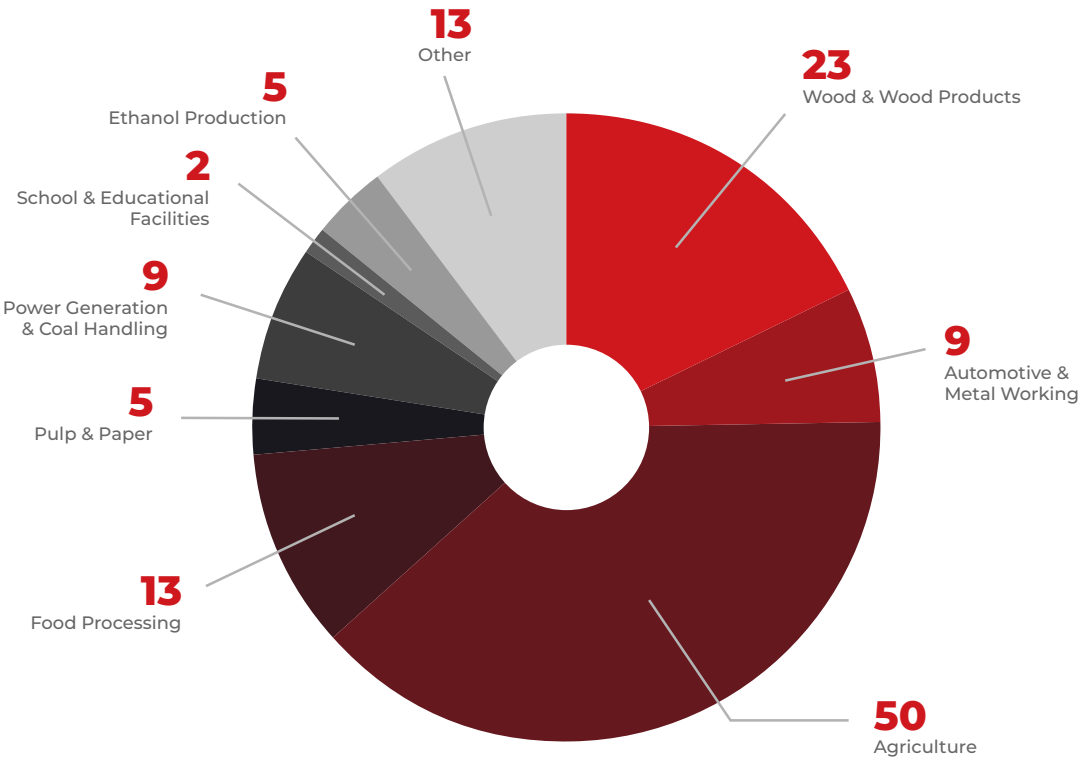
Complete Guide on How to Protect Your Dust Collector from Combustible Dust Incidents

There are many processes and situations where plant production lines require dust collectors because of combustible dusts.

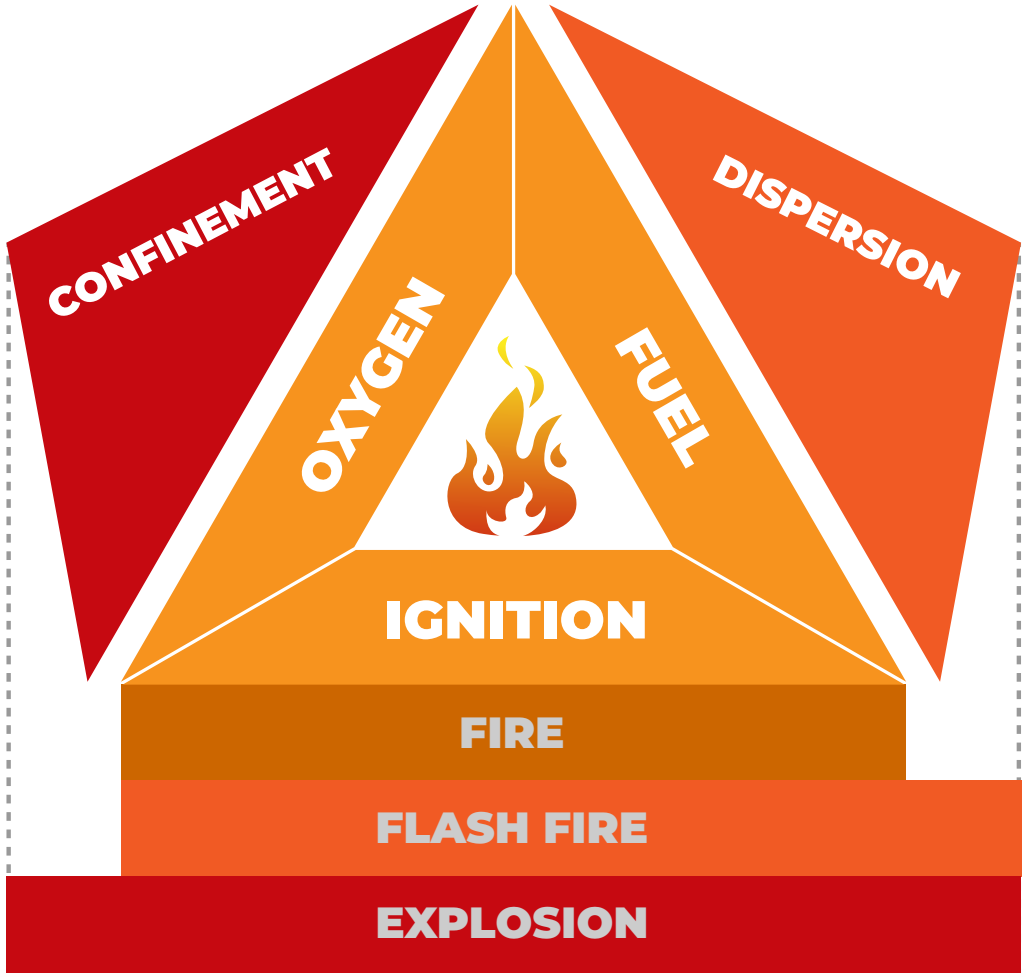
In some industries like food processing, raw food ingredients in powder form are batched, mixed, and shipped to stores. In others, a commodity like timber from a logging operation is sent to a wood processor to mill boards down to size. Maybe a plant makes its own potentially combustible material, for example creating spray-dried particles for milk powder or a nutraceutical. In each of these examples a dry combustible dust is a byproduct or created product that must be managed to meet regulations.

This means in many cases combustible dust safety and dust collection will play a role in a plant's overall safety management. Whether a large or small operation, the risks posed by combustible dusts are very real. One need only to look at past combustible dust incidents to see that we still have to closely consider how combustible dust must be handled in order to avoid tragic incidents that can damage not only property, but pose a danger to workers.

Reported Combustible Dust Incidents in the News 2021*



* Data from the 2021 Combustible Dust Incident Report by Dust Safety Science (www.dustsafetyscience.com)



Understanding why combustible dust is such an outsized risk in many industries requires understanding a few basics.

Many operators and plant personnel are familiar with the three components that create a fire: fuel, heat, and an oxidizing agent.

Fire protection is an important step to take in a plant to prevent damage and risks to workers, but if you add two more elements to the fire triangle, the risk and potential for not only plant damage and destruction, but also loss of life and injury to workers is increased. What are those two elements? Dispersion and confinement. Once you have these five elements, you can see that the explosion pentagon has been formed, as shown here.

Now that it's clear what components make up the explosion pentagon, taking away any one or more of those five elements can protect your process from deflagrations and potential explosions. Dust collectors by nature contain the fuel (dust), oxygen, dispersion, and confinement elements. That means that every effort should be made to keep the final ignition element away from a dust collector. Ignition sources can include:

- **Impact sparks**
- **Mechanical heating (friction)**
- **Material self-heating**
- **Open flames**
- **Hot work**
- **Incompatible chemical reactions**
- **Hot surfaces**
- **Incandescent lights**
- **Friction sparks**
- **Electrical equipment**
- **Static electricity**

The wood and wood products industry is subject to its own particular ignition dangers.

In recent years, there has been a disproportionate number of incidents related to the wood industry. Some typical dangers seen can include sparks generated from saws, sanders, planers, and milling equipment located upstream from the dust collection system. This makes both equipment maintenance and awareness of your industry's ignition dangers important information to consider.

Other factors besides ignition hazards can also contribute to combustible dust incidents.

According to data on some fire and explosion incidents related to dust collectors – an incident usually does not stem from a single cause. In the 2020 report "Variables Impacting the Probability and Severity of Dust Explosions in Dust Collectors," authors Adina Arymbayeva and Patrick van Hees compiled a list of these other factors that impacted incidents they studied that had sufficient investigative data.

The factors include:

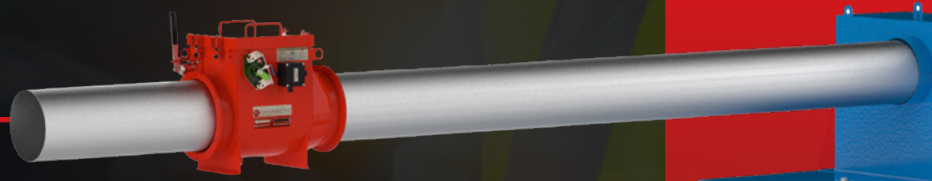
- **Accumulated dust**
- **Human error**
- **Equipment malfunction**
- **Design problems of dust collector**
- **Design problem of other equipment**
- **Lack of training**

It's important to note that in many cases more than one of these factors played a role in contributing to an incident. Ensuring that your plant is safe, means taking a myriad of factors into account, particularly when it comes to dust collection systems.

What were the **most frequent contributors** to dust explosions in the examined incidents according to the NFPA Research Foundation's report?

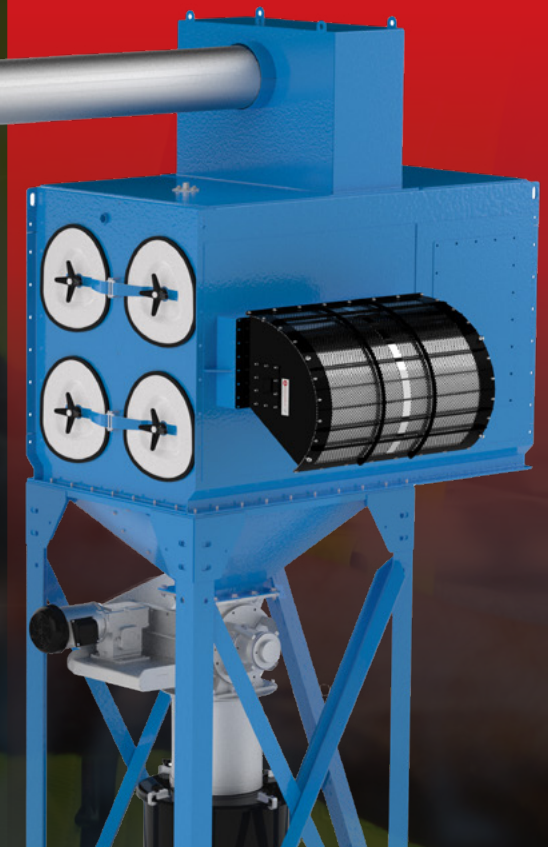
1. **Accumulated dust**
2. **Design problems of dust collector**
3. **Human error**

Besides the various errors and other factors that can contribute to a fire or explosion deflagration, knowing your process and your material are important tools.



To comply with regulations and authorities having jurisdiction (AHJs) when it comes to combustible dust safety, you must test your dust and document the Kst, PMax, dP/dtMax, MIE, MEC, MIT, LIT, and LOC, which can provide valuable information to figure out how your dust reacts under different conditions.

Kst is one of the most valuable of these test data because it shows a dust's normalized rate of pressure rise for a given volume, allowing comparisons between the explosion severity of different materials. As you can see in the chart on the following page, materials can have varying Kst levels, meaning that some materials by their very nature are more prone to deflagration and explosion.



Kst

Material	Kst
Magnesium	508
Aluminum	415
Powdered Dye	364
Fiberglass	216
Wood	205
Sugar	154
Soy	125
Corn	75
Peat	67
Sand	0

Dust explosion class	KSt (bar.m/s)	Characteristic reaction
ST-0	KSt 0	No explosion
ST-1	KSt 1-200	Weak explosion
ST-2	KSt 201-300	Strong explosion
ST-3	KSt 301+	Very strong explosion

Dust collection systems are very important to understand so that you can properly protect your process. A malfunctioning dust collector can stop production, create a safety hazard, and be expensive to repair or replace.

The combination of a dust collection system, good housekeeping, and proper safety equipment is what allows many modern processing plants to provide the foods, chemicals, pharmaceuticals, and many other products we use every day.

However, it's important to consider that while a dust collector may enhance safety in other plant areas by drawing dust away and containing the hazard, the collector itself must be adequately protected to safely continue its important work protecting your workers and facility.

A dust collector works by having dust laden air drawn to the inlet of the dust collector via a pneumatic conveying pipeline.

The dust-laden air then travels through filters located inside the dust collector where the dust and air are separated. The dust is either trapped in the filter media or may drop down to the bottom of the collector either by design or after the dust collector's filters are cleaned. The dust may accumulate at the bottom of the dust collector, while the cleaned air can be either released to the atmosphere or recirculated and reused in the plant.

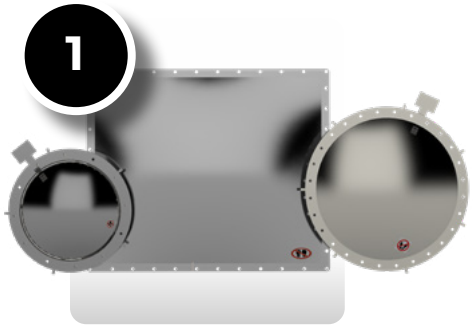
Plants can also use a cyclone to separate dust from the air, which does not require filters. Instead, a cyclone relies upon centrifugal force to separate the air from the dust. Some plants may choose to use a two-stage dust collection system with a cyclone and filter-style dust collector used in tandem to protect their plant. The cyclone would separate the heavier, larger dust particles, leaving finer dust particles for the filters.

So now that the dust is being managed in a facility via dust collection, it's important to decide what fire and explosion protections are necessary for the dust collector.

The first protection measures to consider are for the dust collector vessel itself., which includes the collector housing, filter media, and filter cleaning system along with connecting lines, one conveying dirty air into the dust collector from the process (inlet), the other one expelling the now clean air from the dust collector (outlet) to outside the plant or inside, depending on the application.

FIRE AND EXPLOSION PROTECTION: DUST COLLECTOR VESSEL

Options to protect a dust collector vessel



Explosion Vent

Flameless Vent

Chemical Suppression

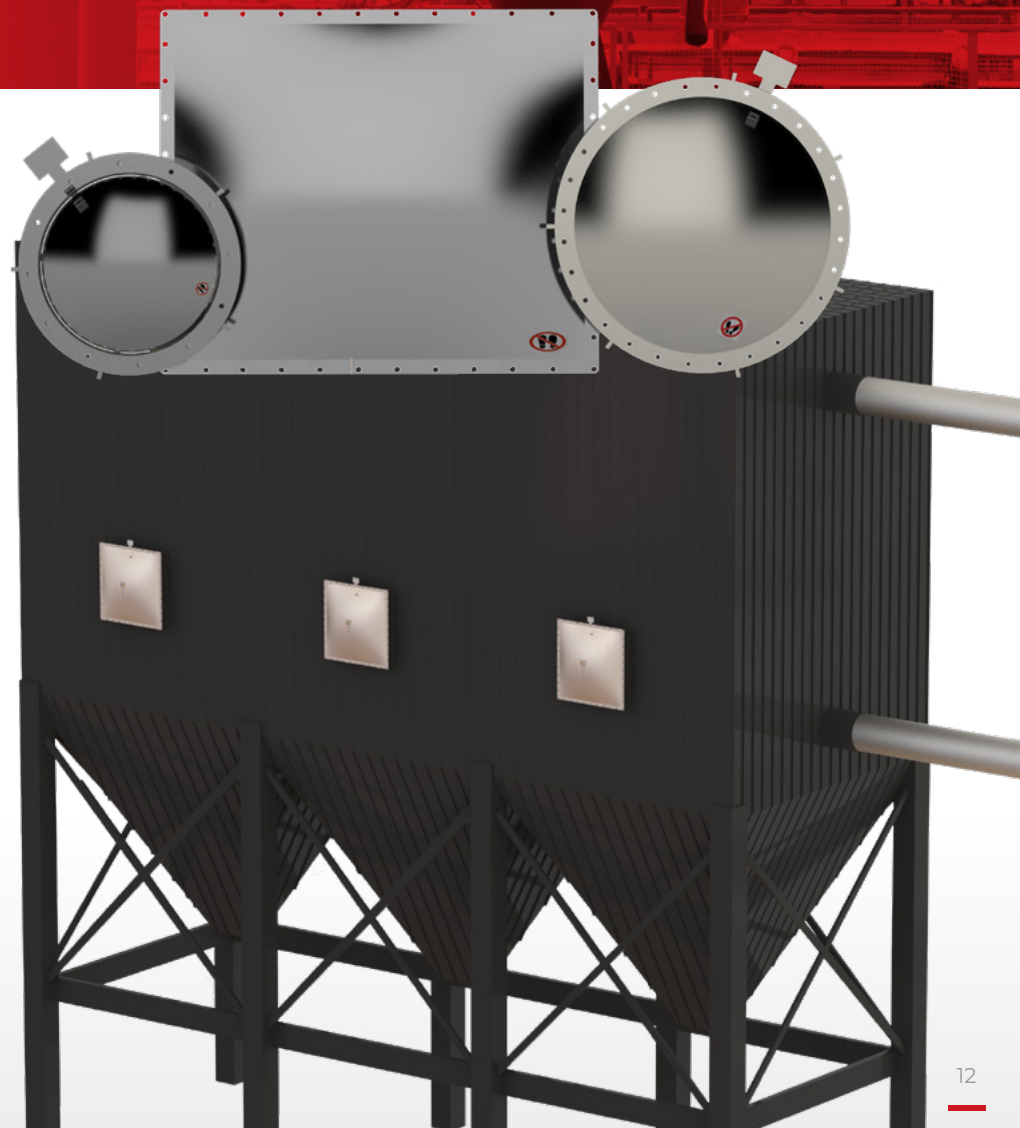
Fire and Explosion Protection: **Dust Collector Vessel**

1

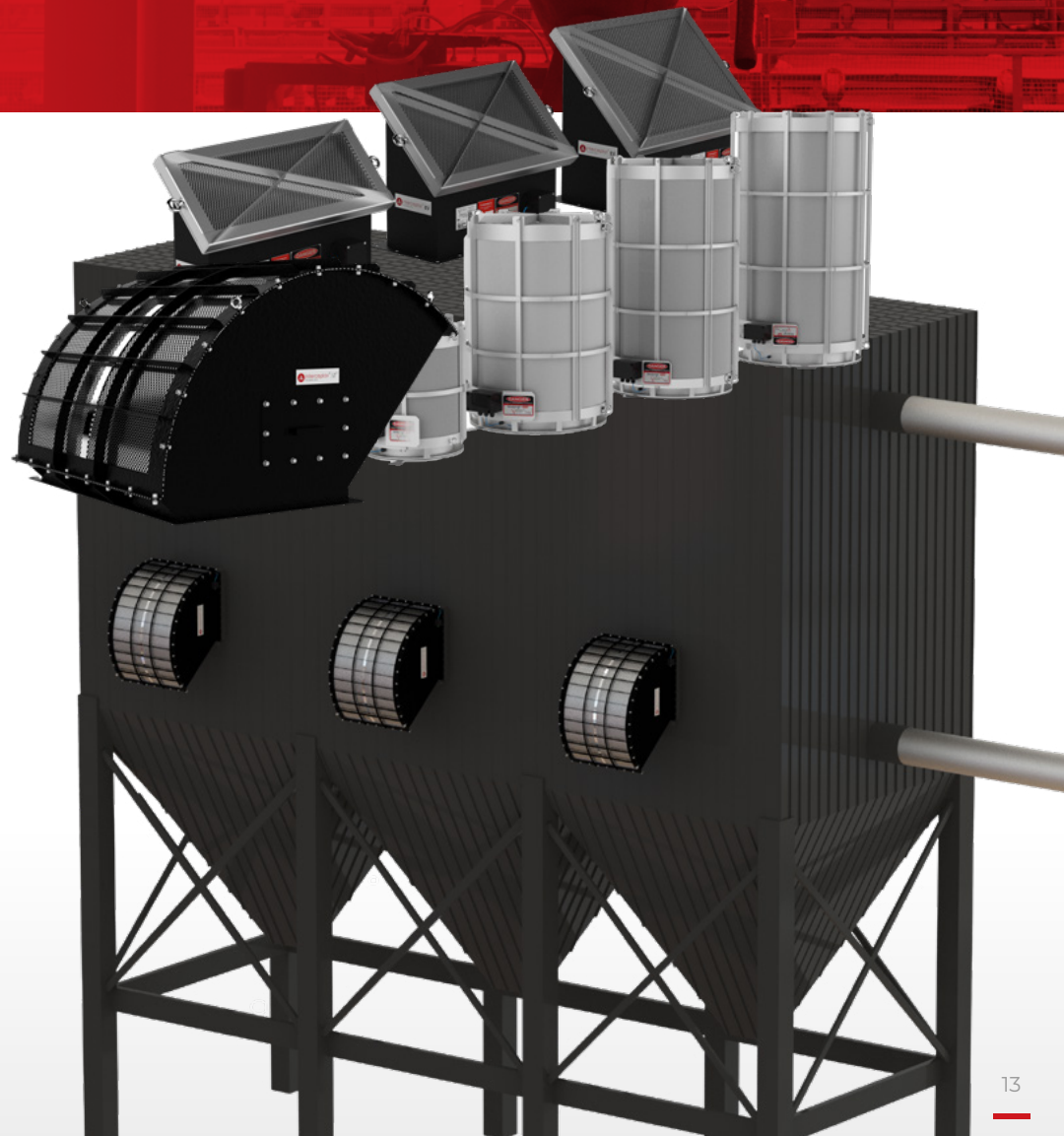
Option 1
Explosion Vents

An explosion vent is a simple, economical, and easy-to-implement protection that's installed on an outdoor dust collector vessel. The explosion vent relieves the pressure and exhausts flame during a deflagration. Each explosion vent's burst pressure can be customized to handle various process parameters.

Explosion vents available: **TLFG, TLST, SLFG, SDFG**



Fire and Explosion Protection: **Dust Collector Vessel**



2 Option 2
Flameless Vents

An explosion vent plus a steel mesh barrier for dust collector vessels in indoor areas or when there's not a safe area to vent a flame ball from a deflagration. This vent type can also be used outdoors, but is typically used indoors as it works by quenching the flame as it is exhausted in the flame arrestor (steel mesh). Flameless vents come in various design styles to suit the application and dust type being handled.

Flameless vents available: **Interceptor®-QR®, Interceptor®-LT®, Interceptor®-EV®**

Fire and Explosion Protection: **Dust Collector Vessel**

3

Option 3
Chemical Suppression

A less-economical, pressurized cylinder (bottle) containing suppressant (typically sodium bicarbonate) can be attached to the dust collector vessel and is used when a vessel is indoors and can't use a flameless vent because of vessel size or dust issues that disallow venting. These chemical suppression bottles activate when a sensor registers increased pressure, causing the suppressant to release into the vessel and extinguish the flame.

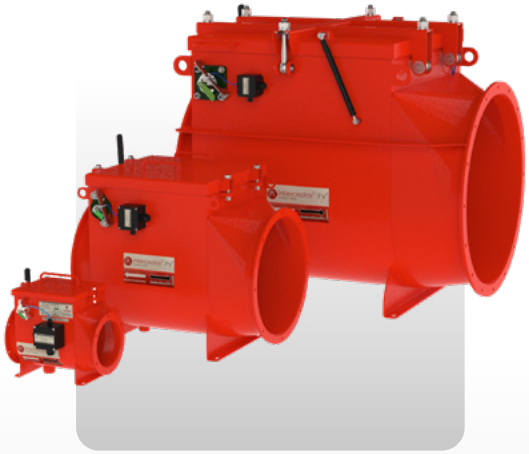
Chemical suppression available: **Interceptor®-HRD® Suppression Bottles**

FIRE AND EXPLOSION PROTECTION: DIRTY AIR LINE

Options to isolate the dust collector inlet:

1

Flap Valve



2

Chemical Isolation

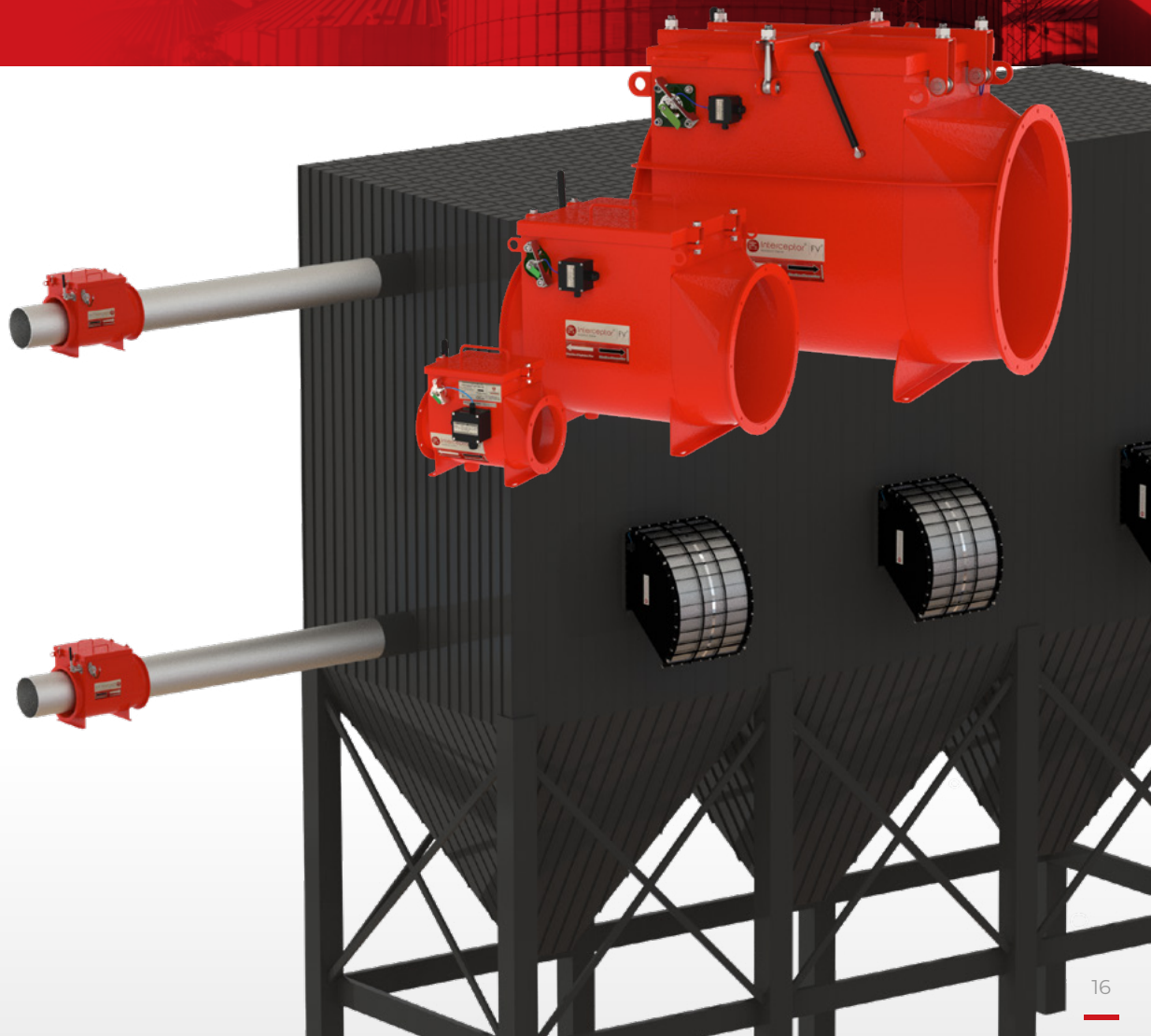
Fire and Explosion Protection: **Dirty Air Line**

1

Option 1
Flap valves

A simple, economical device installed into a section on the dirty air line leading to the dust collector. The valve slams closed and locks shut during a deflagration, closing the pipeline and separating and isolating the deflagration from reaching upstream, interconnected equipment or areas. During normal process flow, the valve is kept open mechanically, providing a low pressure drop across the valve. Newer models can even be installed horizontally or vertically to suit more applications and pipeline configurations.

Flap valve available: **Interceptor®-FV®**



Fire and Explosion Protection: **Dirty Air Line**

2 Option 2
Chemical Isolation

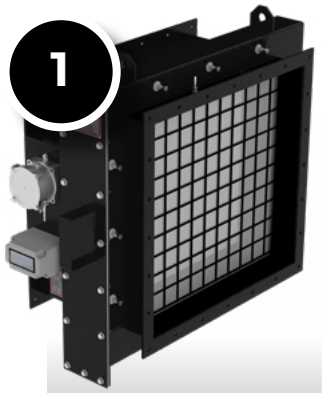
A less economical, pressurized cylinder (bottle) containing suppressant (typically sodium bicarbonate) can be attached to the dirty air line leading to the dust collector and is used when dealing with large pipelines, installation flexibility is required, and to retrofit an existing pipeline without impacting pressure drop or loss for existing system fans. These chemical suppression bottles activate when a sensor registers increased pressure, causing the suppressant to releases into the pipeline and isolates the flame from the dust collector.

Chemical isolation available: **Interceptor®-HRD® Isolation Bottles**

FIRE AND EXPLOSION PROTECTION: CLEAN AIR LINE

Options to isolate the clean air outlet:

1



Explosion Isolation Quench Valve

2

Flap Valve

3

Float Valve

Fire and Explosion Protection: **Clean Air Line**

1

Option 1
Explosion Isolation Quench Valves

An economical, flameless venting device that passively isolates clean air lines for situations where venting to safe areas isn't possible or when facilities decide to recycle the air and vent it into the facility. Helps to meet all the NFPA requirements for air recycling or for mill intakes.

Quench valve available: **Interceptor®-QV®**

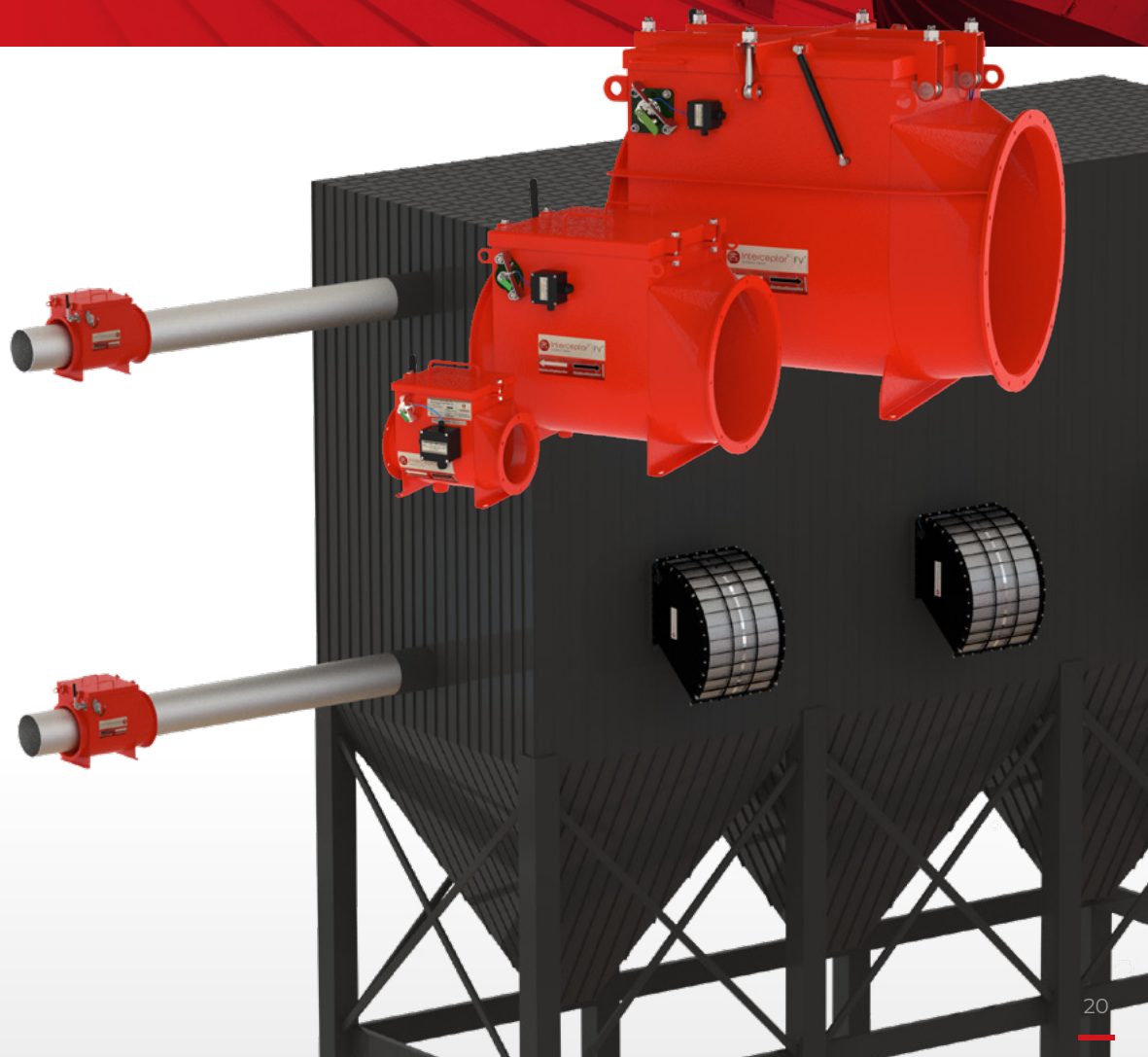
Fire and Explosion Protection: **Clean Air Line**

2

Option 2
Flap Valves

A simple, economical device installed into a section on the clean-air line. The valve slams closed and locks shut during a deflagration, closing the pipeline and separating and isolating the deflagration from reaching downstream, interconnected equipment or areas. During normal process flow, the valve is kept open mechanically, providing a low pressure drop across the valve. Newer models can even be installed horizontally or vertically to suit more applications and pipeline configurations.

Flap valve available: **Interceptor®-FV®**



Fire and Explosion Protection: **Clean Air Line**

3

Option 3
Float Valve

A passive float valve can be installed into a section on the clean air line. The valve is for demanding applications, including high-Kst materials and metal dusts and features a floating metal disc that pushes against the valve housing and closes it in reaction to a pressure wave. The valve can work in a single direction or bidirectionally, depending on the application requirements.

Float valve available: **Interceptor®-Ventex®**

FIRE AND EXPLOSION PROTECTION: INLET LINE

Spark Detection

A spark detector can be installed on the inlet line to prevent any flame or spark from entering the dust collector.

The infrared detector system is connected to a water line that will extinguish a spark or dangerous particle that can cause ignition in process flows within milliseconds, preventing a fire or dust explosion. The spark detector relies on a controller to relay activation, but the infrared technology allows the detector to see the particle temperature sooner than an ultraviolet detector.

Why isolate and protect the clean air exhaust and recirculate dust collector air?

In many instances, there could be benefits to recirculating the clean air exhaust from your dust collector back into your facility or other processes, but safely recirculating that air has been an issue. The process has been expensive, complicated, and potentially harmful if done incorrectly.

There are various requirements outlined in NFPA standards regarding recycled air:

NFPA 652

Combustible Dust

Recycling air is permitted if you meet a series of requirement, isolation being one of them.

NFPA 61

Agriculture and Food

Recycling air is permitted if you meet limited requirements and handle transfer of energy.

NFPA 654

Combustible Particulate Solids

Recycling air is permitted if you meet a series of requirement, isolation being one of them (identical to NFPA 652).

NFPA 664

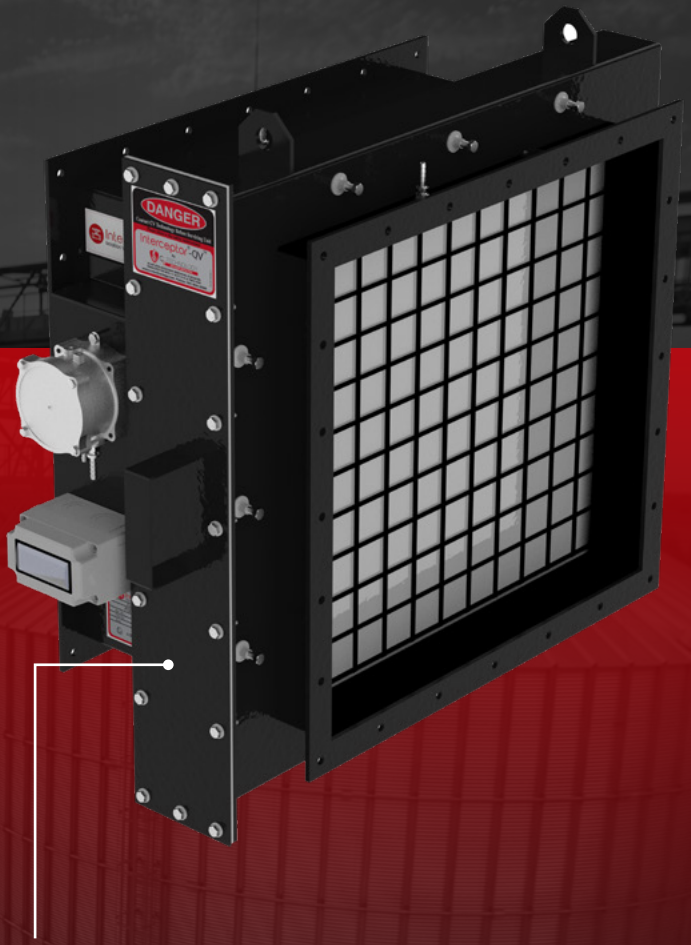
Wood and Wood Processing

Recycling air is permitted if you meet a series of requirement, isolation being one of them with additional steps.

To meet the stringent safety requirements for recycling a dust collector's clean air exhaust, the Interceptor®-QV® explosion isolation quench valve was created after 2 years of research and development.

What are the benefits?

- Allows energy saving by returning conditioned air back into a building (less air to treat with HVAC, retain heat for energy savings)
- Full NFPA 69-compliance to meet all fire and explosion safety regulations
- Testing certifications to EN 15089, with additional testing elements to the flameless vent standard EN 16009
- Minimal maintenance



The valve is based on **flameless vents and uses no moving parts** for passive isolation with very low pressure drop to cause issues exhausting or otherwise feeding the air back into other processes.

CV TECHNOLOGY®
FIRE AND EXPLOSION PROTECTION

ABOUT CV TECHNOLOGY

CV Technology specializes in complete **explosion and fire protection solutions** for the prevention and mitigation of explosions and fire hazards that result from the manufacturing and handling of dry bulk materials. Over the past 20 years in the industry, we have become one of the world leaders in superior fire and explosion protection design.

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FIRE AND EXPLOSION PROTECTION

WE CAN HELP YOU PROTECT YOUR DUST COLLECTOR

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