

2021

COMBUSTIBLE DUST INCIDENT REPORT

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POTATO STARCH EXPLOSION AT FIRE PROTECTION SYSTEMS FACILITY

Singapore

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FIVE MISCONCEPTIONS ABOUT COLLECTING COMBUSTIBLE DUST

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**DUST
SAFETY
SCIENCE**

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MEMBER COMPANIES



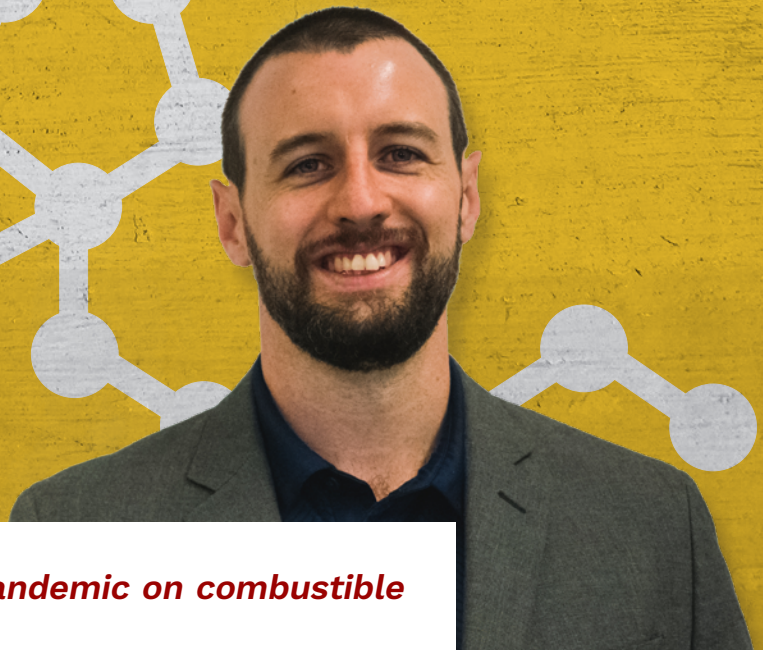
PARTNERS



LETTER FROM THE AUTHOR

DR. CHRIS CLONEY

Managing Director, DustEx Research Ltd.



What will be the impact of the global pandemic on combustible dust safety moving forward?

One way to answer this question is to explore the past. But has there ever been anything like this before?

Our writing team recently published an article for [Canadian Forest Industries](#) exploring four catastrophic dust explosions which occurred in a five-month period between May and September 1919.

In total, 71 lives were lost and another 60 workers were injured in the four tragedies:

- Milwaukee Works Explosion (Milwaukee, WI., May 20, 1919),
- Douglas Starch Works Explosion (Cedar Rapids, IA., May 22, 1919),
- Dominion Grain Elevator Explosion (Port Colborn, Ontario, Aug 9, 1919), and
- the Murray Grain Elevator Explosion (Kansas City, MO., September 13, 1919).

Dust explosions were certainly not uncommon at the time, but it was rare to have such serious events so frequently... and only a 15 hour train ride apart.

Why did these incidents occur in such a short time span and close proximity?

No one knows for certain, though we believe that industrial ramp-up from recent global events, namely World War One and the Spanish Flu played a role.

Workers were coming back, industry was revving up, and people were eager to get on with their lives... only to return to a standstill as hundreds of lives were impacted by these tragic events.

Please make time for safety in your organization and in your day.

As I reflect on our current global situation, I can't help but think about the old quote: "Those who do not learn from the past are doomed to repeat it". It is my sincere hope that the incident reporting can bring dust safety to the forefront and we can avoid reliving these events in the years ahead.

Stay safe,

Chris

P.S. Have feedback on the incident reporting? Email me at chris@dustsafetyscience.com.

"Direction is more important than speed. Too many of us are going nowhere fast"

- Unknown

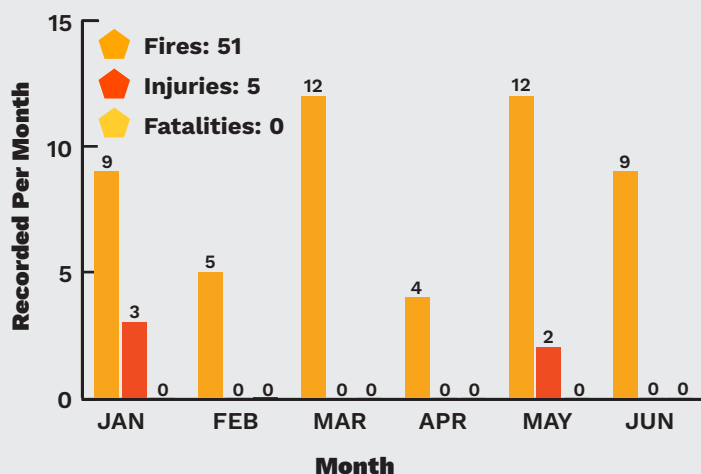
INCIDENT DATA OVERVIEW

	UNITED STATES					CANADA					INTERNATIONAL				
	2017	2018	2019	2020	2021 (JAN-JUNE)	2017	2018	2019	2020	2021 (JAN-JUNE)	2017	2018	2019	2020	2021 (JAN-JUNE)
Fires	117	158	175	116	38	15	17	22	14	3	37	38	53	35	10
Explosions	28	37	37	26	13	4	4	1	7	2	36	27	37	27	13
Injuries	52	40	42	35	13	9	1	4	2	4	102	73	72	51	27
Fatalities	6	2	1	1	1	0	0	0	0	0	7	21	7	9	7

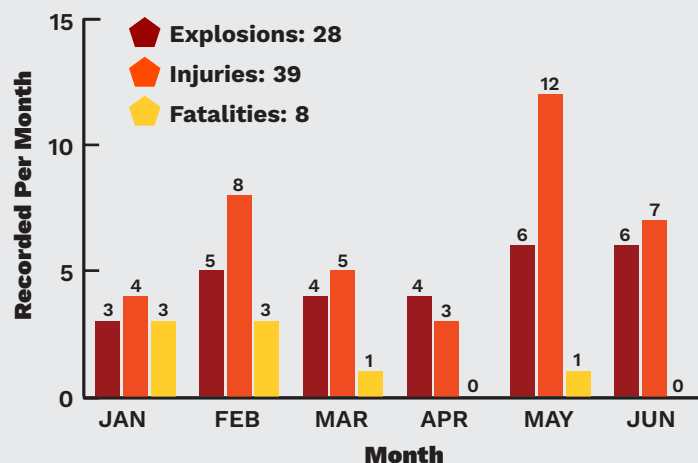
2021 RECORDED INCIDENTS

(January - June)

Fire Incidents Worldwide



Explosions Incidents Worldwide



LOSS HISTORY - UNITED STATES

Loss history from dust explosions in the United States over the last six years is given in the following table. This data has been collected in the incident database and reported in the 2016 to 2021 combustible dust incident reports.

YEAR	EXP./YEAR	INJ./YEAR	FAT./YEAR
2016 (entire year)	31	22	3
2017 (entire year)	28	43	6
2018 (entire year)	37	30	2
2019 (entire year)	37	27	1
2020 (entire year)	26	23	1
2021 (projected)	26	22	2
6 year average	30.8	27.8	2.5

This data gives an average of 31 dust explosions per year, 28 injuries and 1 to 6 fatalities over the last five years. Note that dust fires are excluded in this analysis.

2021 GLOBAL LOSS OVERVIEW

In the first half of 2021, all of the fatalities recorded occurred due to dust explosions. Of the injuries, 89% occurred due to explosions and 11% occurred due to fires. Some of the more severe incidents include:

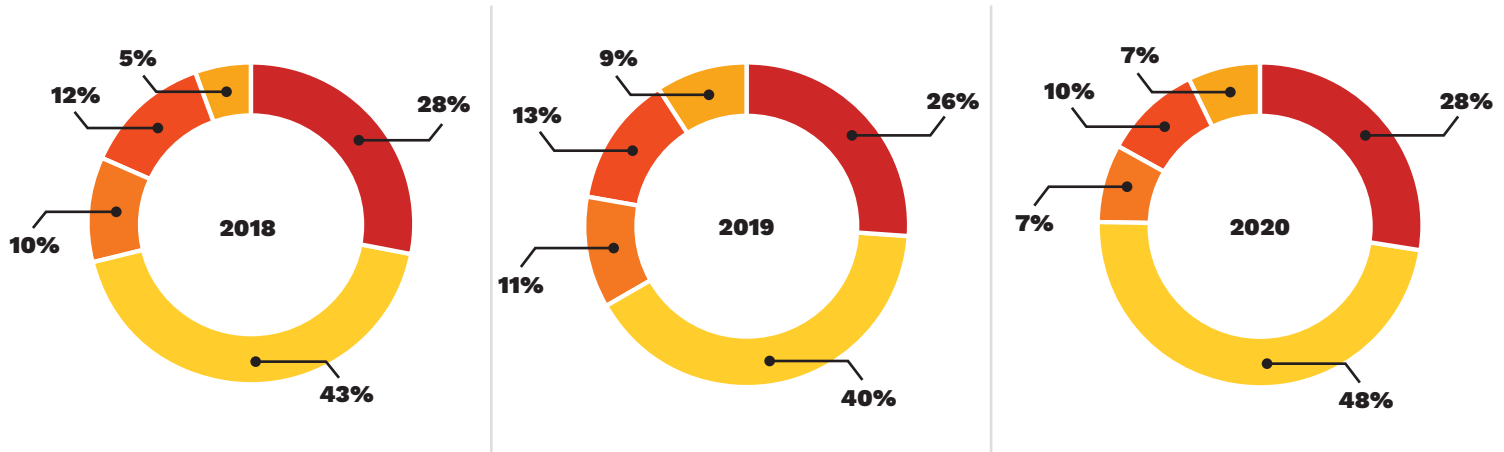
- [One killed in seed cleaning dust explosion](#) (Silverton, OR)
- [Three injured in grain elevator fire](#) (Brooks, Alberta)
- [Three killed in power plant explosion](#) (Angren, Uzbekistan)
- [Several killed in potato starch explosion](#) (Tuas, Singapore)

Limited information has been available for damages from dust explosions and fires. From the information that is available only two incidents resulted in more than \$1,000,000 in losses:

- [Fatal explosion causes \\$1.4M in damages](#) (Silverton, OR)
- [Animal feed fire causes \\$2M in damages](#) (North Java, NY)

MATERIALS INVOLVED

Wood Products Food Products Metal Other Unknown



DISCUSSION POINTS

From the global incident data, food and wood products made up over 60% of the fires and explosions recorded. These materials also resulted in 61% of the injuries and 62% of the fatalities. A breakdown of the fires, explosions, injuries and fatalities for each type of material is given as follows:

	FIRES	EXP.	INJ.	FAT.
WOOD	12	7	9	1
FOOD	25	10	18	4
METAL	4	1	4	0
COAL	2	2	5	3
PAPER	4	0	0	0
PLASTIC	0	1	1	0
CARBON	0	1	0	0
OTHER	2	4	7	0
UNKNOWN	2	2	0	0
TOTAL	51	28	44	8

The four injuries from metal dust involved an explosion at a zinc powder facility. The three fatalities and three injuries from coal dust involved in an explosion at a thermal power plant. The other two injuries from coal dust involved an explosion at a carbon production facility.

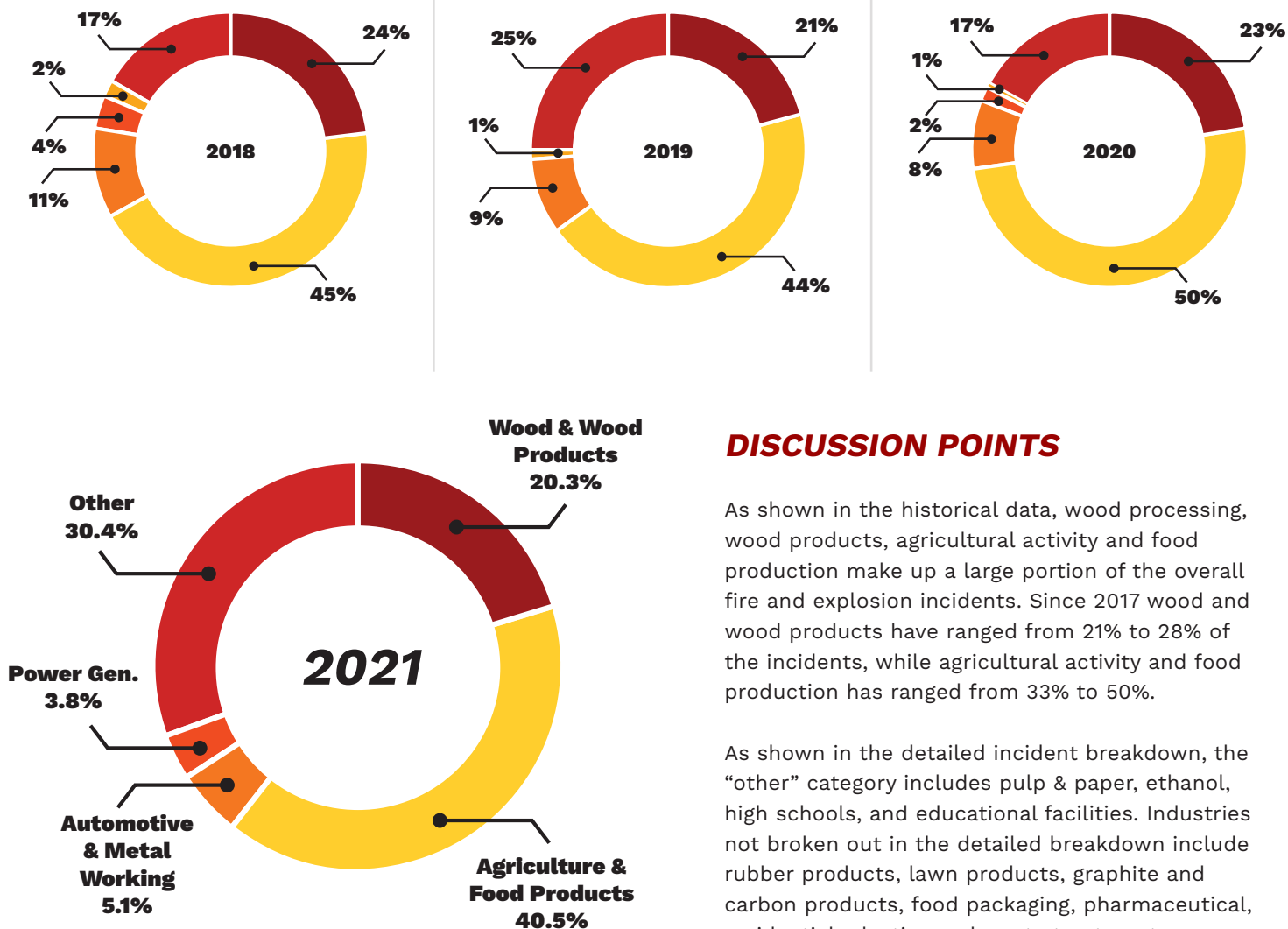
Under the category “other”, two injuries came from separate explosions involving rubber dust. Four workers were injured in an unspecified chemical dust explosion at a pharmaceutical plant. One worker was also injured in a sulfur dust explosion at a tire manufacturing plant.

2021 MID-YEAR DETAILED ANALYSIS

Wood	24.1%	Plastic	1.3%
Food	44.3%	Carbon	1.3%
Metal	6.3%	Other	7.6%
Coal	5.1%	Unknown	5.1%
Paper	5.1%		

INDUSTRIES INVOLVED

■ Wood & Wood Products
 ■ Agriculture & Food Products
 ■ Automotive & Metal Working
 ■ Power Generation
 ■ Mining
 ■ Other



DISCUSSION POINTS

As shown in the historical data, wood processing, wood products, agricultural activity and food production make up a large portion of the overall fire and explosion incidents. Since 2017 wood and wood products have ranged from 21% to 28% of the incidents, while agricultural activity and food production has ranged from 33% to 50%.

As shown in the detailed incident breakdown, the “other” category includes pulp & paper, ethanol, high schools, and educational facilities. Industries not broken out in the detailed breakdown include rubber products, lawn products, graphite and carbon products, food packaging, pharmaceutical, residential, plastics and waste treatment.

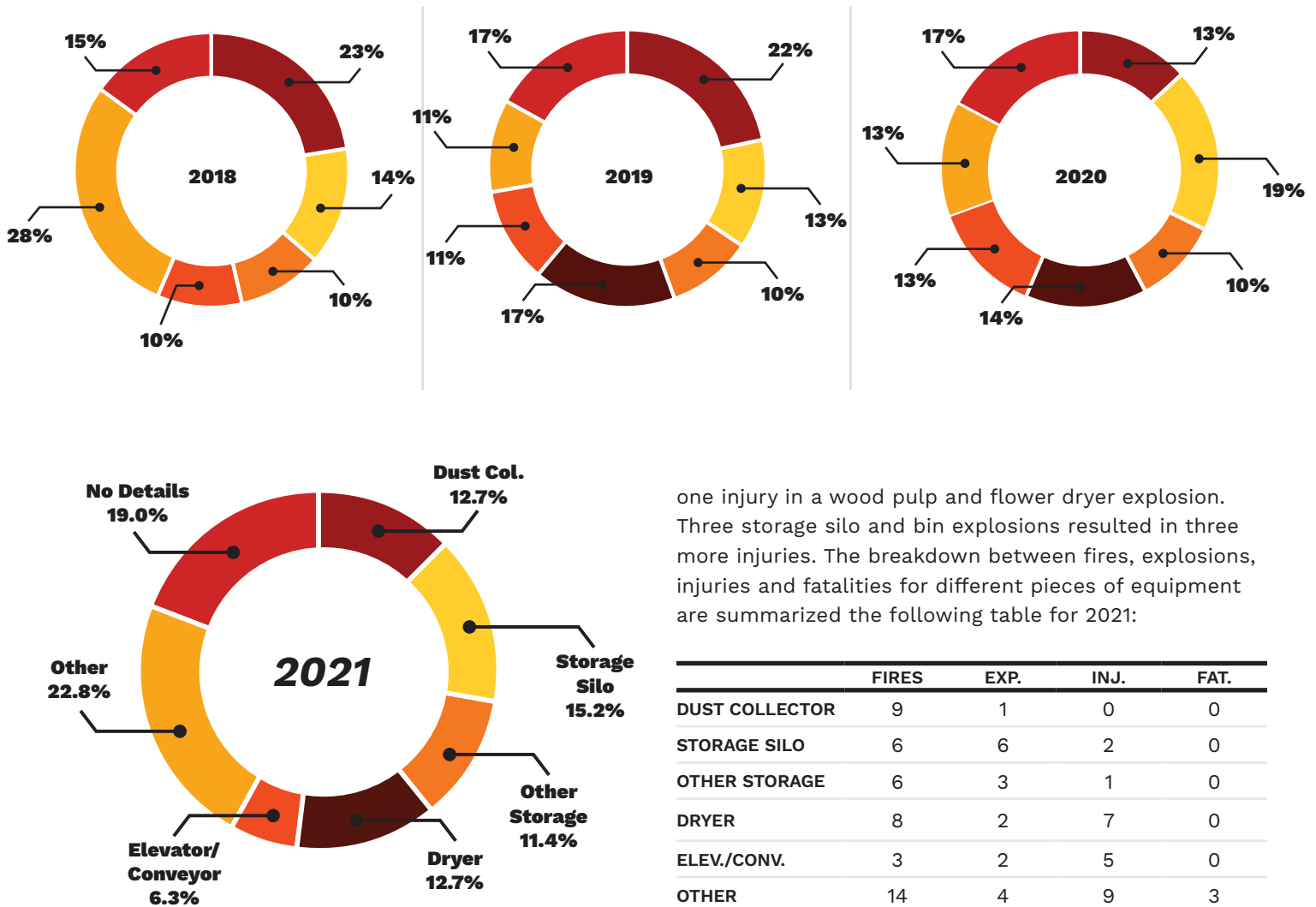
2021 DETAILED ANALYSIS

■ Wood & Wood Pro.	20.3%	■ Power Generation	3.8%
■ Agriculture	29.1%	■ Ethanol	2.5%
■ Food Processing	11.4%	■ Automotive	1.3%
■ Pulp & Paper	5.1%	■ Schools and Edu.	1.3%
■ Metal Working	3.8%	■ Other	21.5%

Combined, the overall “other” category of industries makes up 45% of the injuries and 37% of the fatalities reported in the first half of 2021. Wood and wood products, agriculture and food processing, and automotive and metalworking make up 20%, 25% and 2.3% of the injuries, respectively. Fatalities were recorded in wood and wood products, agricultural, power generation and fire protection system manufacturing industries.

EQUIPMENT & CAUSES

■ Dust Collector
 ■ Storage Silo
 ■ Other Storage
 ■ Dryer
 ■ Elevator/Conveyor
 ■ Other
 ■ No Details



one injury in a wood pulp and flower dryer explosion. Three storage silo and bin explosions resulted in three more injuries. The breakdown between fires, explosions, injuries and fatalities for different pieces of equipment are summarized the following table for 2021:

	FIRES	EXP.	INJ.	FAT.
DUST COLLECTOR	9	1	0	0
STORAGE SILO	6	6	2	0
OTHER STORAGE	6	3	1	0
DRYER	8	2	7	0
ELEV./CONV.	3	2	5	0
OTHER	14	4	9	3
NO DETAILS	5	10	20	5
TOTAL	51	28	44	8

DISCUSSION POINTS

In the first half of 2021, storage silos demonstrated the highest percentage of combustible dust incidents with six fires and six explosions reported. This is a higher percentage than the 2017 and 2018 reports which found that dust collection systems had the highest percentage of incidents occur. So far in 2021, only 13% of the fires and explosions occurred in dust collection systems.

Dryers had the largest number of injuries in the first half of 2021 with four injuries in a pharmaceutical dryer explosion, one injury in a grain dryer explosion and

Equipment labeled under “Other” had 23% of the total incidents, 20% of the injuries and 37% of the fatalities. These incidents include an explosion involving a potato starch mixer which killed three and injured seven, and an explosion in a coal handling system which injured two.

Incidents where no details were provided for the equipment made up 19% of the total reported. However, these incidents made up 45% of the reported injuries and 62% of the reported fatalities.



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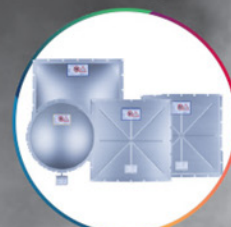
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2021 OSHA CITATIONS

ISSUE DATE	INDUSTRIAL ACTIVITY	STATE	VIOLATIONS	INT. PEN.	CUR. PEN.	INSPECTION	STATUS	CITATION LINK
Jun 11	Flavoring Syrup and Concentrate Manufacturing	WI	1	\$9,753	\$6,827	1506514.015	Open	More Info
May 25	Wood Kitchen Cabinet and Countertop Manufacturing	GA	8	\$54,614	\$38,230	1504673.015	Open	More Info
May 21	Carbon and Graphite Product Manufacturing	PA	2	\$9,557	\$4,900	1512202.015	Open	More Info
May 13	Wood Window and Door Manufacturing	NJ	12	\$26,332	\$14,482	1502444.015	Open	More Info
May 10	Other Industrial Machinery Manufacturing	IL	7	\$55,978	\$55,978	1501977.015	Open	More Info
Apr 6	Spring Manufacturing	TX	6	\$61,580	\$30,000	1513252.015	Closed	More Info
Feb 25	Powder Metallurgy Part Manufacturing	PA	3	\$4,681	\$2,500	1499344.015	Closed	More Info
Jan 25	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	OH	3	\$35,108	\$18,783	1486453.015	Open	More Info
Jan 5	Rice Milling	IL	1	\$3,856	\$3,856	1486891.015	Open	More Info

Inspections Resulting In Citations: 9
Total Citations: 43

Total Initial Penalties: \$261,4596
Total Current Penalties: \$175,556

Initial Penalty/Citation: \$6,080
Initial Penalty/Inspection: \$29,051

*Information was collected from OSHA Data & Statistics by searching for “dust” within inspection details from citations made using the General Dusty Clause.



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POTATO STARCH EXPLOSION AT FIRE PROTECTION SYSTEMS FACILITY IN SINGAPORE

FEBRUARY 25, 2021

Three Fatalities and Seven Injuries

BACKGROUND

The company involved is a registered L3 contractor with BCA Singapore in Fire Protection Works and L1 contractor with BCA Singapore for Electrical Works. It was founded in 2010 and offers services that include supplying, designing, installing and maintaining all types of fire protection and electrical systems.

INCIDENT DESCRIPTION

On February 25, 2021, a dust explosion and fire were reported at an industrial building in Tuas, Singapore.

Singapore Civil Defence Force firefighters arrived at 11:25 a.m. and found the building smoke-logged. After entering the building to locate the fire, they extinguished it with two water jets.

Employees were working on an industrial mixer when the explosion occurred. A representative of the Manpower Ministry's Occupational Safety and Health Division confirmed that the explosion involved potato starch powder.

A logistics manager in the next building said he heard a "very loud explosion," followed by two smaller ones. He ran out of his office and saw black smoke billowing from a gaping hole in the wall of the building next door. Several workers were running out screaming.

The fire forced the evacuation of 65 people. These workers – some of whom lived in the dormitories at the site – were later rehoused.

Continued on next page....

OUTCOME

Ten workers suffered burns. Three died while another five remained in critical condition. Two were discharged after being treated. Videos showed several workers with their clothing burned off and visible burn injuries.

The National Trades Union Congress and the Migrant Workers' Centre contacted affected migrant workers and their companies to render whatever assistance necessary. A fundraising campaign launched by migrant worker advocacy group ItsRainingRaincoats raised more than S\$600,000 for the three men killed in the incident, exceeding its goal of S\$300,000.

The Ministry of Manpower appointed an inquiry committee to examine the factors that led to the fire and explosion. This committee was also tasked with making recommendations including policy, regulatory or Workplace Safety and Health (WSH) Act measures to prevent the recurrence of similar incidents.

On March 3, the Minister of State for Manpower announced that the government had begun inspections of almost 500 companies for potential combustible dust hazards in the wake of the Tuas explosion.

These investigations coincided with a safety time-out called by the Workplace Safety and Health Council: this measure was intended to give employers an opportunity to assess their business processes and ensure that their machinery was well-maintained and correctly used. The WSH commissioner said the call for safety time-out is an important step to remind employers and workers “not to take safety lightly.”

On March 19, three companies were issued stop-work orders after they were found to have inadequate control measures, despite “significant risk” of combustible dust explosions.

The following month, the Ministry of Manpower announced that between May and June, it would carry out 400 worksite safety inspections targeting high-risk sectors including construction and manufacturing. This was due to the fact that over 3,200 workplace safety and health contraventions were found during inspections between January and April, almost double the 1,800 contraventions recorded the same period last year.

On May 19, Enterprise Singapore officially launched SS 667:2020 – Code of Practice for Handling, Storage and Processing of Combustible Dust. Over a week later, the National University of Singapore Alumni Safety, Health and Environment (SHE) Society hosted a virtual workshop that shared the critical aspects of combustible dust, including the nature of combustible dust, process safety concerns, risk management approaches, and relevant local and international standards.

Incident Database: [Explosion at Singapore Fire System Manufacturer Kills Three Workers](#)

GRAIN DUST EXPLOSION AT CEREAL FACILITY IN BUENOS AIRES, ARGENTINA

MAY 28, 2021

No Injuries

BACKGROUND

The company involved is an agribusiness headquartered in Buenos Aires, Argentina. It was founded in 1977 and specializes in the harvesting, processing, and sale of cereal and other grain products.

INCIDENT DESCRIPTION

On May 28, 2021, a local news agency reported an explosion at a cereal factory in Buenos Aires, Argentina.

In video footage of the incident, which occurred at 9:05 a.m., one can hear a loud noise as a water wheel explodes, followed by a cloud of dust. An employee who was present at the time managed to escape without injury.

Firefighters immediately went to the scene. After confirming that the employee was unhurt, they dealt with the aftermath of the explosion, remaining at the scene for hours.

OUTCOME

The cause of the explosion is under investigation.

Incident Database: [Employee at Cereal Factory Barely Escapes Dust Explosion Without Injury](#)

RUBBER DUST EXPLOSION AT FACILITY IN JONESBOROUGH, TENNESSEE

JANUARY 6, 2021

One Injury

BACKGROUND

The company involved produces a wide range of synthetic compounds for the transportation, tire, industrial and rolls market.

INCIDENT DESCRIPTION

On January 7, 2021, a local news agency reported reported an explosion and fire at a rubber manufacturing plant in Jonesborough, Tennessee.

Firefighters arrived shortly after Washington County 911 officials received a fire alarm call at 1:52 a.m. They found flames coming from the roof and decided to mount an external attack rather than send crews into the building.

A large track hoe was brought in to remove some sheeting on the back wall and get better access to the fire. Throughout the day, tankers and fire trucks from various departments brought almost 3.5 million gallons of water to the scene.

Company officials said there had been recent work on the plant's sprinkler system.

OUTCOME

One employee was injured and airlifted to a burn centre.

Continued on next page....

The cause of the explosion was unknown but believed to have started during manufacturing. The fire was expected to burn for days. Officials warned nearby farmers to keep their livestock away from a nearby creek due to toxins from the runoff water.

Incident Database: [One Worker Injured in Explosion at Tennessee Rubber Manufacturer](#)

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DUST EXPLOSION AT SUGAR BEET FACILITY IN WAHPETON, NORTH DAKOTA

MARCH 15, 2021

Two Injuries

BACKGROUND

The company involved is an agricultural cooperative with members in Minnesota and the Dakotas. It was established in 1974 and specializes in turning sugar beet into powdered sugar products.

INCIDENT DESCRIPTION

On March 16, 2021, a dust explosion was reported at a sugar beet processing facility in Wahpeton, North Dakota.

Crews from several area fire departments responded to the incident, which occurred at about 916 a.m. after an equipment failure in an area of the plant used for packaging powdered sugar. They remained at the scene until 11:00 a.m.

OUTCOME

Two workers required hospital treatment for smoke inhalation. There was no information about property damage.

This facility experienced a dust explosion on October 6, 2020, covered in [Fire Ignites in Boiler Vacuum at North Dakota Sugar Beet Plant](#).

Incident Database: [Two Workers Treated for Smoke Inhalation After Sugar Plant Dust Explosion](#)

DUST EXPLOSION AT SEED CLEANING FACILITY IN SILVERTON, OREGON

MARCH 23, 2021

One Fatality, One Injury

BACKGROUND

The company involved is a seed cleaning and crop preparation business in Silverton, Oregon. It was founded in 2009 and employs approximately five people.

INCIDENT DESCRIPTION

On March 23, 2021, a local news agency reported a dust explosion at a seed cleaning and crop preparation services company in Silverton, Oregon.

First responders were called out at about 9:00 a.m. Seeing the second and third floors engulfed in flames and wall fragments in the surrounding yard, they quickly upgraded the fire to a 3-alarm response, calling in additional units from nearby communities. According to another local news source, the fire sent a plume of smoke into the sky that could be seen from miles away.

OUTCOME

During suppression operations, the Marion County Sheriff's Officer arrived with three deputies. Additionally, the Deputy State Fire Marshal arrived and multiple mutual and auto aid agencies also arrived and assisted with suppression activities.

The deceased employee had been on the third floor, removing a tarp that covered a seed waste and chaff bunker. This bunker funneled waste seed and chaff to a conveyor which took it to the outside of the structure. The seed cleaner was not in operation and they were in the process of dismantling the bunker for new equipment to be installed.

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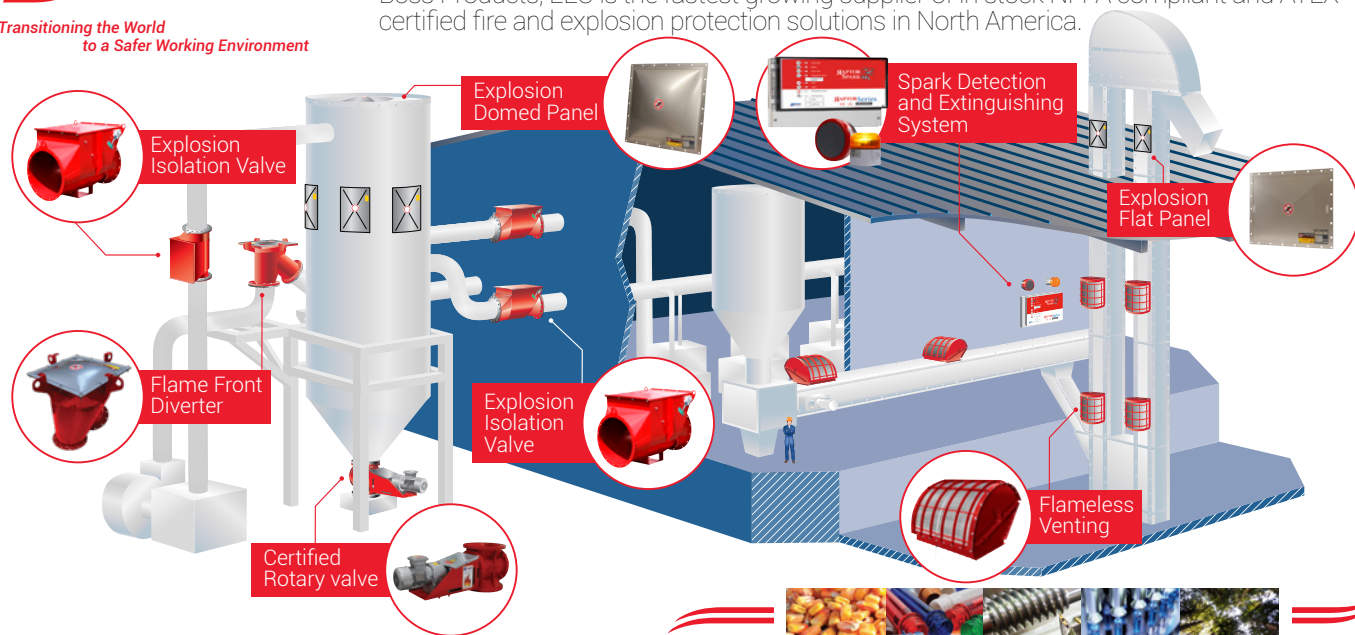
One worker advised that he had heard a large explosion and, when he investigated the situation, found the deceased with traumatic injuries. The business owner was able to show video surveillance of the ground floor directly under where the deceased man was working. While watching the video, dust could be observed coming from the doorway of the lower area of the bunker. There were periods of light dust, no dust and then heavy dust coming from the doorway. The video showed four quick flame bursts coming from the door area, followed by a rapid expansion in volume associated with an explosion.

Investigation of the bunker doorway showed extreme charring on the top and bottom of heavy timbers used for the floor. This heavy charring appeared to be indicative of slow burning that may have started many hours earlier.

Incident Database: [Dust Explosion at Crop Preparation Plant Kills One and Injures Another](#)

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THE DAY CEDAR RAPIDS SHOOK- THE DOUGLAS STARCH WORKS PLANT EXPLOSION OF 1919

This article was originally published on the [Dust Safety Science website](#). This is an abridged version.

Douglas & Company was founded in 1894 by brothers George and Walter Douglas. It produced cooking starch and oil, laundry starch, soap, and animal feed. Walter died on the Titanic in 1912 but George continued to develop the business and by 1914, the Douglas Starch Works was the biggest starch company in the world.

In May 1919, the plant employed over 650 people and produced 20,000 bushels of corn per day. It was such a major regional employer that no one wanted to imagine what would happen if disaster ever struck.

ALL ACROSS THE CITY, HOMES AND COMMERCIAL BUILDINGS SHOOK IN THEIR FOUNDATIONS.

The clock in the timekeeper's office read close to 6:30 p.m. when a massive explosion rocked the building, which was located on First Street SW, just off of C Street SW. The walls collapsed, pieces of the factory were hurled up to two miles away, and smoke billowed in the evening sky.

Glass windows shattered, sending shards flying over the shocked residents below. Over 200 homes were damaged. Across the Cedar River, a young child was thrown from a couch and died as the impact rocked their home. One man standing on a bridge spanning the river was thrown to the ground while those working in the plant suffered serious injury and some men were killed.

CO-WORKERS, FAMILY MEMBERS AND FRIENDS SCoured THE WRECKAGE FOR THEIR LOVED ONES.

Twenty-four-year-old James Newbold was talking to a coworker when the explosion hit. The co-worker was blown to safety but chunks of broken concrete hit Newbold and buried him alive. Rescuers later uncovered his body in the ruins of the packing building and identified him by his signet ring.

Another employee, David Hartman, was at work in the basement of the dry starch building when he was buried under a mountain of debris. The wrench he had been holding at the time was later found by searchers (which included his brother) moments before they discovered his body.

C.C. Pugh, a Des Moines resident who was in Cedar Rapids at the time, shared his recollections months later in a letter to the Gazette, which was the city's leading newspaper.

"The main explosion seemed to lift great buildings and hold them in tension for a moment, letting them drop with their own weight. Quickly, a haze gathered, holding within its folds an acrid odor, in places almost stifling.

"The details have been given through the papers all over the state, but to know the real effect one had to have been there. Rolling clouds of smoke, permeated with gas, hung in fantastic form for hours (before) drifting away slowly to the east, reddened from the reflection of the leaping flames and turning orange as they floated on, gathering mist and vapor."



Courtesy of Brucemore, a National Trust Historic Site [Cedar Rapids, IA]

AT FIRST, RESIDENTS THOUGHT THAT THE CITY WAS UNDER GERMAN ATTACK.

World War I had ended only six months previously, and people were still struggling to believe that the nightmare was really over. Now they were wondering if they'd been right to be skeptical.

It would later be claimed that a small fire, not a German bomb, ignited cornstarch inside the factory. However, no one knew this at the time. As the smoke cleared and rescue efforts were underway, all that anyone knew was that 43 workers were killed, along with a small child, and 30 others injured. People wanted answers.

A COMMUNITY PULLS TOGETHER.

George Douglas and his wife, Irene, were enjoying dinner when the explosion occurred. He hurried to the site while she immediately started preparing their home at Brucemore mansion for use as a hospital if the number of injured people was greater than local hospitals could handle.

When word of the disaster spread, people poured into town to help with rescue efforts. The fire that raged after the explosion obstructed their progress, and even once the flames were extinguished, residual heat and the sheer devastation kept rescue efforts going on for weeks. Men who were tasked with sifting through the rubble ran through one set of shoes after another due to the still-

hot metal debris. The electric searchlights set up to guide them at night cast an eerie glow over the entire explosion site while a steam shovel normally used to handle coal at the plant was given a more sobering task.

The Cedar Rapids Chamber of Commerce put together two committees to support rebuilding efforts as well as help those who had lost loved ones in the disaster. In 1919, only 20% of Cedar Rapids women worked outside the home, making them financially dependent on their husbands, fathers, brothers and sons, and the Chamber was anxious to provide them with necessary support. The American Red Cross also set up a disaster relief committee to render emergency aid and help affected families.

DISBELIEF AND QUESTIONS: HOW WAS THIS DISASTER ALLOWED TO HAPPEN?

At the time, there was very little regulation for factories that handled or produced combustible dust, so people began insisting that fire and workplace safety laws and practices receive more attention from the Iowa government.

On May 27, an inquiry presided over by Coroner D.W. King ended with the jury finding that the victims had been killed by a "fire of unknown origin followed by an explosion." No one was ever held criminally responsible for the disaster.



Courtesy of Brucemore, a National Trust Historic Site [Cedar Rapids, IA]



Courtesy of Brucemore, a National Trust Historic Site [Cedar Rapids, IA]

At the end of August, Joseph Hubbell, manager of the National Inspection Company of Chicago, commented on the disaster in an issue of the National Underwriter. It was his opinion that the explosion occurred in the plant's wet process buildings, where some dry starch may have built up.

He wrote:

"It is now ascertained that projecting air blasts through the doors and conveyors connecting these sections filled them with a starch dust cloud, caused by smashing and upsetting of conveyors, packages, bins, and the like, and went to the end with increasing speed and compression until the building structure gave way.

"It seems clear that as these explosions are initiated almost entirely by manufacturing operations having to do with the dry starch, the grinding mill was probably the cause here. It is clear that the proximity of the mill to other departments and its connection to these by spouts, conveyors and doorways, afforded an easy avenue of spread for drafts and ignition."

CEDAR RAPIDS HAS NEVER FORGOTTEN THOSE KILLED IN THE EXPLOSION.

In May 2019, 100 years to the day after the disaster, staff and volunteers at the Brucemore museum (the former home of George Douglas) arranged for a wreath to be laid at a monument to the victims in Linwood Cemetery. They also coordinated a public chalking project that marked locations that were affected by the explosion, including the former homes of the victims.

Although over 100 years have passed since the tragedy, dust explosions are as big a risk to health and safety as they were in 1919. Until safety takes priority over cost or convenience, there is always the risk that history could repeat itself.

LOOKING TO LEARN MORE ON THIS TOPIC? CHECK OUT THESE RESOURCES!

[Dangerous Dust: The Port Colborne Grain Elevator Explosion of 1919](#)

[The Milwaukee Works Explosion Investigation and Lessons Learned](#)

[Forgotten Disaster: The Murray Grain Elevator Explosion of 1919](#)

[DSS 137: Case Study – The Murray Grain Elevator Explosion of 1919](#)

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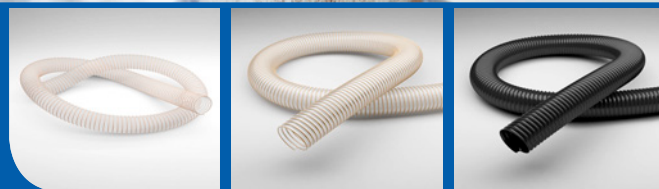
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DSS134:

FIVE MISCONCEPTIONS ABOUT COLLECTING COMBUSTIBLE DUST WITH CHRISSY KLOCKER



In this episode of the Dust Safety Science podcast, Chrissy Klocker, Applications Engineering Manager at [Donaldson Company](#) based in St. Paul, Minnesota, shared five misconceptions surrounding the collection of combustible dust.

Chrissy did a presentation on common dust collection and combustible dust misconceptions at the 2021 Global Dust Safety Conference. She speaks from a position of experience and authority: in her current position at Donaldson Company, she helps the field sales team and end users mitigate the challenges that combustible dust presents in their processes and applications.

MISCONCEPTION #1: FLAME-RETARDANT (FR) MEDIA ELIMINATES THE RISK OF AN EVENT IN A DUST COLLECTOR

FR media is filter media treated with a flame retardant, so that when it is exposed to an ignition source like a flame, it will self-extinguish. In dust collectors, the media is never completely free of caked-on dust, so when a spark or ember hits it, that dust will burn.

“When the dust is burning, the media can’t get rid of that ignition source, so it can’t self-extinguish,” Chrissy says. “The burning will continue... You would need additional fire protection measures both on the prevention side and the protection range.”

She pointed out that by the time the filters need changing, the dust collector fan is usually running at 100% capacity. The new, replacement filters don’t have the same level of

resistance across the filter cake that the old ones did. “One of the challenges with a lot of systems is if that fan is not dampened back to close off some of that airflow, you can end up pulling way more airflow than you expect. When you’re running a process that generates sparks, having a higher capture velocity can result in having more sparks being drawn into your system, and therefore more ignition sources.”

FR media is most effective before the dust cake starts to form. By dampening back the fan to ensure that the system is not pulling in as much air, the media can do its job without exposing the system to spark hazards.

MISCONCEPTION #2: FANS START FIRES

In Chrissy’s experience, this misconception is due to the fact that the fan area suffers the most damage during dust collector fires. The reality is that damage is concentrated in this area because it moves the highest volume of air, making it a key point in the system.

“I think a lot of customers are missing the big picture of how the airflow is moving through the collector,” she says.

When the fan is sucking material through, it also sucks embers and sparks into the system, but doesn’t directly cause the fire. If a fan did actually create a spark, it would simply fly out of the outlet, where the bigger concern would be where the fan was exhausting. In order for the fan to create a fire in the system the spark it creates would have to travel upstream against the airflow which is not very likely.

MISCONCEPTION #3: AN EXPLOSION VENT IS ALL THAT'S NEEDED

Chrissy acknowledged that explosion vents are an important safety component, but they aren't the only one needed to prevent or control combustible dust events. "[If] you have an explosion event, do you have the proper mitigation strategies to stop that deflagration or hazard from extending to other pieces of process equipment? Do you have the isolation valve? Do you have fire protection?" she says.

There are different dust collection and mitigation strategies out there, and choosing the right one for a specific application is critical. In some cases, an explosion vent may not be the best choice, especially with pharmaceutical dust which can produce toxic gasses. You want to make sure you're choosing a strategy that works for the dust, the process, the employees and the dust collector.

MISCONCEPTION #4: THERE ARE NO RISKS TO ADDRESS WITH DUST COLLECTORS SMALLER THAN EIGHT CUBIC FEET

[NFPA 652](#) states that if a dust collector is greater than eight cubic feet, it must be placed outside. Consequently, people assume that if they get a smaller machine, they won't have to be concerned with NFPA recommendations.

Although this seems like an easy way out, it can actually make things a little more complicated. An explosion in a smaller machine can still cause injuries, and when it's not outside, people in the surrounding area can be injured. The machine doesn't have the same mitigation strategies as its larger counterparts, so factors like housekeeping and worker practices in the vicinity become a lot more important.

MISCONCEPTION #5: THE ONLY MITIGATION CHOICES ARE THE PRESCRIPTIVE ACTIONS OUTLINED IN THE NFPA STANDARDS

"NFPA standards are written so that they can be adopted by a city or a state and then used as part of their code," Chrissy explains. "But they aren't actually code. And so when you read the standards, it often seems like this is the mandate, this is what you have to do."

There are actually two compliance methods:

- **Prescriptive:** Using the methods outlined in the standards.
- **Performance-based:** Facility managers can devise their own mitigation strategy based on their risk assessment and dust hazard analysis.

With the performance-based method, one achieves the same goals as the prescriptive strategies by tailoring them to the facility's application and process.

Mistakes and misconceptions happen in all industries, but in facilities handling combustible dust, they can lead to injury and death. Continuous learning and willingness to work with experts can reduce risk and help ensure everyone goes home safely at the end of the day.

LOOKING TO LEARN MORE ON THIS TOPIC? CHECK OUT THESE RESOURCES!

[DSS115: NFPA Definitions of Combustible Dust with Eric Brideau](#)

[DSS041: The Five Critical Elements of a Great Dust Hazard Analysis Report with David Hakes](#)

[NFPA 652: Standard on the Fundamentals of Combustible Dust](#)

[Donaldson: Dust Safety Professional Member and Combustible Dust Experts](#)

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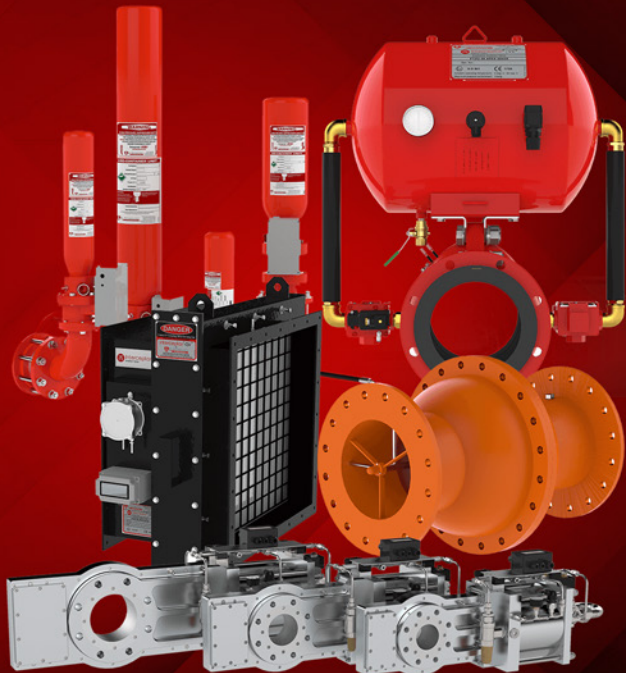
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DSS114:

ALTERNATIVES TO ABORT GATES ON DUST COLLECTOR DIRTY SIDE DUCTING WITH NICK SCHLENTZ



Nick Schlentz, President at [Boss Products](#), LLC, based out of Schertz, Texas, has been involved in different material handling industries for years. He's also a member of [NFPA 61](#), the standard for prevention of fires and dust explosion in agricultural and food processing facilities.

As President at Boss Products, LLC, Nick is involved in the development and production of abort gates. When Corey Gardiner appeared in [Episode #105](#), he talked about challenges his company encountered with their abort gates and lessons learned from those issues. In this episode, Nick discusses alternatives to abort gates on duct collector dirty side ducting.

ABORT GATES EXPERIENCE CHALLENGES, ESPECIALLY ON THE DIRTY SIDE OF DUST COLLECTORS.

"Our recommendation and thoughts on abort gates are that they should only be installed on the clean side, because they're just too high risk of failure," he says. "The blade fluttering is the most common issue for all abort gates, whether it's installed on the dirty or clean side, but we've observed that it's typically caused by poor duct design or using the undersized abort gates for the volume."

He also noted that abort gates may often be running in systems with excessively high flow velocity, which may cause problems.

"We want to be seeing something 3000 to 3,500 feet per minute, maximum. Then what happens though, is that that might be just too slow for material transport. That's

a real issue. Also, elbows play a major role. Sometimes, elbows get installed too close. They have moderate or short radius and it becomes a really big issue at elevated speeds."

Other challenges were:

- Contractors installing smaller ducting and abort gates to save money
- Damage from material and corrosive dust

Nick was quick to explain that when applied and installed correctly, abort gates are excellent pieces of equipment. On the clean side of dust collection systems, they divert fire, flames and smoke away from the workplace, keeping it safer.

GOOD, BETTER, BEST: ABORT GATE ALTERNATIVES.

Boss Products typically handles the dirty side prevention systems.

"We typically offer these in a good, better and best approach," he says. "The better and best solutions that we offer replace the abort gate with an isolation system and we use what's called a firebreak shutter. It's basically a gate, or a knife gate that drops very quickly and it's actually fire-rated and certified for this type of application. So it's an isolation approach instead of diversion."

He defined a 'good solution' as a detect and water spray system only, which is the most common one that he sees. In his opinion, a better solution is to detect and then spray and isolate at the same time, although this method

will shut down the system every time an event occurs. In Nick's opinion, the best solution is the one that detects and then sprays. If something makes it past the water spray, the system would detect and isolate it using a physical barrier. He acknowledges, however, that this system might not make financial sense for smaller shops, which is where the 'good' and 'better' options come in.

"It's better to have a good solution than no solution," he says.

Nick pointed out that in accordance with [NFPA 68](#), prevention systems need properly-sized explosion vents as well as inlet and outlet isolation.

"You have to make sure that those valves are used as intended and are certified for that use," he says. "We actually just finished a certification on our new offering for inlet isolation valves that are certified for isolating the inlet and the outlet push and flow, unlimited elbows, horizontal, vertical and all other angles."

ENSURE YOUR SOLUTION IS TESTED IN REAL WORLD CONDITIONS.

He added that there has recently been a lot of discussion about anomalies being discovered in the testing procedures, which were not observing real-world conditions.

"We've had discoveries made in our testing and all of our valves have been certified for these real-world installations."

Boss Products, LLC has also brought to market a certified and explosion-tested rotary valve that meets all the NFPA compliance and exceeds all the requirements, especially for the composite or non-metallic material. This product addresses issues with hopper isolation, especially in the woodworking industry.

"NFPA compliant valves that you typically see on the market use really tight tolerance rotor blades and

they're just a maintenance nightmare for fibrous and large materials and they just clog," Nick says. "So what people typically do is use a flex tip rotary valve that's not compliant and it won't isolate the flame. We have certified explosion testing documentation on what we all offer and it's proven within the guidelines of the parameters of this test to isolate and reform."

PRIORITIZE FIRE AND EXPLOSION PROTECTION INTO ACTUAL SYSTEM DESIGNS.

"If the actual safety components were just as important as the performance of the dust collection system and that planning was made for proper performance, (it's) going to eliminate a lot of these failures that you're seeing here on the market."
























LOOKING TO LEARN MORE ON THIS TOPIC? CHECK OUT THESE RESOURCES!

DSS105: Safety Share – Failed Testing of High-Speed Abort Gates with Corey Gardiner





























National Fire Protection Association
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	<p>Conversion Technologies</p> <p>2190 N Norcross Tucker Rd, Suite 202 Norcross, GA 30071</p> <p>Phone: (770) 263-6330 Email: cti@conversiontechnology.com</p> <p>       </p>	<p>Conversion Technology Inc. (CTI) is an expert in combustible dust safety. Our engineers are available to conduct Dust Hazard Analyses and code compliance reviews to provide risk-based, real-world solutions.</p>






























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Phone: +44 (0)1962840570
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SINTROL Dust Monitors

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Phone: +358 50 463 5452
Email: info@sintrolproducts.com



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WOOD & WOOD PRODUCTS

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	LINK
Mar 2	Azek Building Products	Wilmington, OH	Explosion	Wood Dust	1	0	Dryer	No Details	
Mar 14	Maine Woods Pellet Company	Athens, ME	Fire	Wood Dust	0	0	Dryer	No Details	
Mar 18	Tilo Industries	Buffalo Township, PA	Fire	Wood Dust	0	0	Silo	No Details	
May 2	Logistec USA Inc.	Brunswick, GA	Explosion	Wood Dust	0	0	Unknown	No Details	
May 27	Modern Cabinet Company	Poughkeepsie, NY	Fire	Wood Dust	0	0	Dust Collector	\$250,000	
May 29	Trinity River Lumber Company	Weaverville, CA	Fire	Wood Dust	0	0	Unknown	No Details	
Jun 5	Unknown	North Plains, OR	Fire	Wood Dust	0	0	Sawdust Hopper	No Details	
Jun 16	Unknown	Auberry, CA	Fire	Wood Dust	0	0	Unknown	No Details	












INCIDENT SUMMARY - INCIDENTS: 8 | FIRES: 6 | EXPLOSIONS: 2 | INJURIES: 1 | FATALITIES: 0

AUTOMOTIVE & METAL WORKING







DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
Jan 28	P Kay Metals	Lewiston, ID	Fire	Metal Dust	0	0	Dust Collector	\$5,000	
Jan 29	Metalcraft of Mayville	Beaver Dam, WI	Fire	Metal Dust	0	0	Dust Collector	No Details	
Feb 19	Webb-Stiles Company	Valley City, OH	Fire	Metal Dust	0	0	Vacuum	No Details	
Mar 27	Bridgestone Firestone	LaVergne, TN	Explosion	Sulfur	1	0	Unknown	No Details	

INCIDENT SUMMARY - INCIDENTS: 4 | FIRES: 3 | EXPLOSIONS: 1 | INJURIES: 1 | FATALITIES: 0

AGRICULTURE







DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
Jan 12	Unknown	Owensboro, KY	Fire	Grain Dust	0	0	Unknown	No Details	
Feb 19	ADM Farmview	Fremont, NE	Fire	Grain Dust	0	0	Grain Bin	No Details	
Mar 4	Reisdorf Brothers, Inc.	North Java, NY	Fire	Grain Dust	0	0	Grain Machine	\$2,000,000	
Mar 23	Riches Seeds	Silverton, OR	Explosion	Grain Dust	1	1	Unknown	\$1,400,000	
Mar 25	Nunn-Better Milling Company	Evansville, IN	Fire	Grain Dust	0	0	Grain Bin	No Details	
Mar 26	Poulin Grain	Swanton, VT	Fire	Grain Dust	0	0	Grain Silo	No Details	
May 3	Dakota Mill and Grain	Fort Pierre, SD	Fire	Grain Dust	0	0	Grain Bin	No Details	
May 5	Perdue Farms	Salisbury, MD	Fire	Grain Dust	0	0	Soybean Dryer	No Details	
May 11	North Star Feeds	Atchison, KS	Fire	Grain Dust	0	0	Grain Bin	No Details	
May 12	Unknown	Bedford, VA	Fire	Grain Dust	0	0	Grain Silo	No Details	
May 14	Landus Cooperative	Jefferson, IA	Explosion	Grain Dust	0	0	Grain Silo	No Details	

AGRICULTURE CONTINUED

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
May 18	JR Simplot Company	Mountain Home, ID	Explosion	Grain Dust	1	0	Unknown	No Details	
May 22	Boyd Station LLC	Danville, PA	Fire	Grain Dust	0	0	Grain Dryer	No Details	
May 24	South Bend Ethanol	South Bend, IN	Fire	Grain Dust	2	0	Grain Dryer	No Details	
Jun 1	Christensen Farms	Sleepy Eye, MN	Explosion	Grain Dust	0	0	Grain Silo	No Details	
Jun 1	Farmer's Co-op of Hanska	New Ulm, MN	Explosion	Grain Dust	1	0	Grain Bin	No Details	
Jun 29	Alto Pekin LLC	Pekin, IL	Fire	Grain Dust	0	0	Corn Dryer	No Details	




INCIDENT SUMMARY - INCIDENTS: 17 | FIRES: 12 | EXPLOSIONS: 5 | INJURIES: 5 | FATALITIES: 1

FOOD PROCESSING

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
Jan 22	Washington Potato Plant	Warden, WA	Fire	Potato Dust	0	0	Dehydrator	No Details	
Mar 15	Minn-Dak Farmers Cooperative	Wahpeton, ND	Explosion	Powdered Sugar	2	0	Unknown	No Details	
Mar 18	Perfection Pet Foods	Visalia, CA	Fire	Ground Pet Food	0	0	Dog Food Prod. Equip.	\$200,000	
Apr 20	Domino Sugar	Baltimore, MD	Fire	Sugar Dust	0	0	Silo	No Details	
May 23	Riceland Foods	Stuttgart, AR	Fire	Grain Dust	0	0	Grain Bin	No Details	
Jun 10	Alfagreen Supreme	Toledo, OH	Fire	Dehydrated Alfalfa	0	0	Unknown	No Details	




INCIDENT SUMMARY - INCIDENTS: 6 | FIRES: 5 | EXPLOSIONS: 1 | INJURIES: 2 | FATALITIES: 0

PULP & PAPER

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
May 24	Packaging Corporation of America	International Falls, MN	Fire	Paper Dust	0	0	Paper Machine	No Details	
Jun 17	Georgia-Pacific LLC	Brookhaven, MS	Fire	Paper Dust	0	0	Debarker	No Details	
Jun 27	Georgia-Pacific	Green Bay, WI	Fire	Paper Dust	0	0	Con. System	\$50,000	

INCIDENT SUMMARY - INCIDENTS: 3 | FIRES: 3 | EXPLOSIONS: 0 | INJURIES: 0 | FATALITIES: 0

POWER GENERATION & COAL HANDLING

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
Feb 22	Aurora Energy	Fairbanks, AK	Fire	Coal Dust	0	0	Unknown	No Details	
Apr 20	Edgewater Power Plant	Sheboygan, WI	Fire	Coal Dust	0	0	Dust Collector	No Details	
Apr 22	ADA Carbon Solutions	Coushatta, LA	Explosion	Coal Dust	2	0	Coal Handling System	No Details	



INCIDENT SUMMARY - INCIDENTS: 3 | FIRES: 2 | EXPLOSIONS: 1 | INJURIES: 2 | FATALITIES: 0

SCHOOLS & EDUCATIONAL FACILITIES

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
Jan 25	Basehor-Linwood High School	Basehor, KS	Fire	Wood Dust	0	0	Dust Collector	No Details	








INCIDENT SUMMARY - INCIDENTS: 1 | FIRES: 1 | EXPLOSIONS: 0 | INJURIES: 0 | FATALITIES: 0

ETHANOL PRODUCTION

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
Jan 7	POET Biorefining	Ashton, IA	Fire	Grain Dust	0	0	Hammer Mill	\$10,000	
May 7	CHS Ethanol	Rochelle, IL	Fire	Grain Dust	0	0	Dust Col.	No Details	



INCIDENT SUMMARY - INCIDENTS: 2 | FIRES: 2 | EXPLOSIONS: 0 | INJURIES: 0 | FATALITIES: 0

OTHER

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT.	EQUIPMENT	DAMAGES	
Jan 6	HEXPOL Rubber Compounding	Jonesborough, TN	Explosion	Rubber Dust	1	0	Unknown	No Details	
Jan 13	Profile Products LLC	Conover, NC	Fire	Unknown	0	0	Bagger and Auger Systems		
Jan 27	NAC Carbon Products	Punxsutawney, PA	Explosion	Carbon Dust	0	0	Unknown	No Details	
Apr 5	Avedis Zildjian Co.	Norwell, MA	Fire	Unknown	0	0	Dust Collector	No Details	
May 12	Pactiv Inc.	Temple, TX	Fire	Unknown	0	0	Storage Silo	No Details	
Jun 8	Humane Manufacturing	Janesville, WI	Explosion	Rubber Dust	1	0	Silo	No Details	
Jun 8	San Francisco Southeast Treatment	San Francisco, CA	Fire	Sludge Dust	0	0	Unknown	No Details	




INCIDENT SUMMARY - INCIDENTS: 7 | FIRES: 4 | EXPLOSIONS: 3 | INJURIES: 2 | FATALITIES: 0

WOOD & WOOD PRODUCTS

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT	EQUIPMENT	DAMAGES	LINK
Mar 11	Forestview Kitchens	Breslau, ON	Fire	Wood Dust	0	0	Dust Collector	No Details	
Jun 3	MarDan Lumber Sales	Armstrong, BC	Fire	Wood Dust	0	0	Unknown	No Details	







INCIDENT SUMMARY - INCIDENTS: 2 | FIRES: 2 | EXPLOSIONS: 0 | INJURIES: 0 | FATALITIES: 0

AGRICULTURE

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT	EQUIPMENT	DAMAGES	
Jan 20	Unknown	Brooks, AB	Fire	Grain Dust	3	0	Grain Elevator	No Details	
Apr 2	Alliance Grain Terminal	Vancouver, BC	Explosion	Grain Dust	1	0	Silo	No Details	
Jun 26	Hylife Ltd.	Killarney, MB	Explosion	Grain Dust	0	0	Unknown	No Details	




INCIDENT SUMMARY - INCIDENTS: 3 | FIRES: 1 | EXPLOSIONS: 2 | INJURIES: 4 | FATALITIES: 0

WOOD & WOOD PRODUCTS

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT	EQUIPMENT	DAMAGES	LINK
Feb 6	Unknown	Prinzersdorf, Austria	Explosion	Wood Dust	0	0	Silo	No Details	
Mar 18	Pronorm	Vlotho, Germany	Fire	Wood Dust	0	0	Chip Bunker	No Details	
Mar 30	Unknown	Volkersdorf, Austria	Fire	Wood Dust	0	0	Diesel Engine	150000 euros	
Apr 27	Popp	Pegnitz, Germany	Fire	Wood Dust	0	0	Sawdust Compressor	No Details	
May 3	Vakaru Medienos Grupe	Klaipeda, Lithuania	Explosion	Wood Dust	7	1	Unknown	No Details	
Jun 18	Unknown	Weihenzell, Germany	Explosion	Wood Dust	1	0	Conveyor Belt	No Details	




INCIDENT SUMMARY - INCIDENTS: 6 | FIRES: 3 | EXPLOSIONS: 3 | INJURIES: 8 | FATALITIES: 1

AGRICULTURE

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT	EQUIPMENT	DAMAGES	
Jan 9	R H Hall	Ringaskiddy, Ireland	Fire	Grain Dust	0	0	Grain Silo	No Details	
Mar 5	Unknown	Buenos Aires, Argentina	Fire	Grain Dust	0	0	Grain Dryer	No Details	
Mar 7	AFA Maciel	Aldao, Argentina	Fire	Grain Dust	0	0	Grain Dryer	No Details	

INCIDENT SUMMARY - INCIDENTS: 3 | FIRES: 3 | EXPLOSIONS: 0 | INJURIES: 0 | FATALITIES: 0

FOOD PROCESSING

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT	EQUIPMENT	DAMAGES	
Feb 4	Heygates Ltd.	Bugbrooke, UK	Fire	Flour Dust	0	0	Dust Collector	No Details	
Feb 18	British Sugar	Bury St. Edmunds, UK	Fire	Sugar Dust	0	0	Conveyor System	No Details	
May 28	Ceres Tolvas	Buenos Aires, Argentina	Explosion	Grain Dust	0	0	Water Wheel	No Details	


INCIDENT SUMMARY - INCIDENTS: 3 | FIRES: 2 | EXPLOSIONS: 1 | INJURIES: 0 | FATALITIES: 0

PULP & PAPER

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT	EQUIPMENT	DAMAGES	
Mar 29	Unknown	Saharanpur,, India	Fire	Paper Dust	0	0	Unknown	No Details	










INCIDENT SUMMARY - INCIDENTS: 1 | FIRES: 1 | EXPLOSIONS: 0 | INJURIES: 0 | FATALITIES: 0

POWER GENERATION & COAL HANDLING

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT	EQUIPMENT	DAMAGES	
Jan 20	Angren Thermal Power Plant	Angren, Uzbekistan	Explosion	Coal Dust	3	3	Unknown	No Details	

INCIDENT SUMMARY - INCIDENTS: 1 | FIRES: 0 | EXPLOSIONS: 1 | INJURIES: 3 | FATALITIES: 3

OTHER

DATE	COMPANY	LOCATION	TYPE	FUEL	INJ.	FAT	EQUIPMENT	DAMAGES	
Feb 1	Unknown	Deutsch-Wagram, Austria	Explosion	Wood Dust	0	0	Unknown	No Details	
Feb 5	De Veste Condominium Complex	Terneuzen, Netherlands	Explosion	Wood Dust	0	0	Silo	No Details	
Feb 18	LyondellBasell	Kerpen, Germany	Explosion	Plastic Dust	1	0	Unknown	No Details	
Feb 25	Stars Engrg	Tuas, Singapore	Explosion	Potato Starch	7	3	Mixer	No Details	
Apr 5	Hansgrohe	Schiltach, Germany	Explosion	Unknown	0	0	Extraction System	10000 euros	
Apr 15	Unknown	Wiesental, Germany	Explosion	Unknown	0	0	Dust Collector	100000 euros	
May 11	Sakai Chemical Industry Company	Fukushima, Japan	Explosion	Zinc Powder	4	0	Unknown	No Details	
Jun 5	Unknown	Mettupalayam, India	Explosion	Chemical Dust	4	0	Dryer	No Details	
Jun 21	Unknown	Eschenz, Switzerland	Fire	Unknown	0	0	Dryer	No Details	

INCIDENT SUMMARY - INCIDENTS: 9 | FIRES: 1 | EXPLOSIONS: 8 | INJURIES: 16 | FATALITIES: 3



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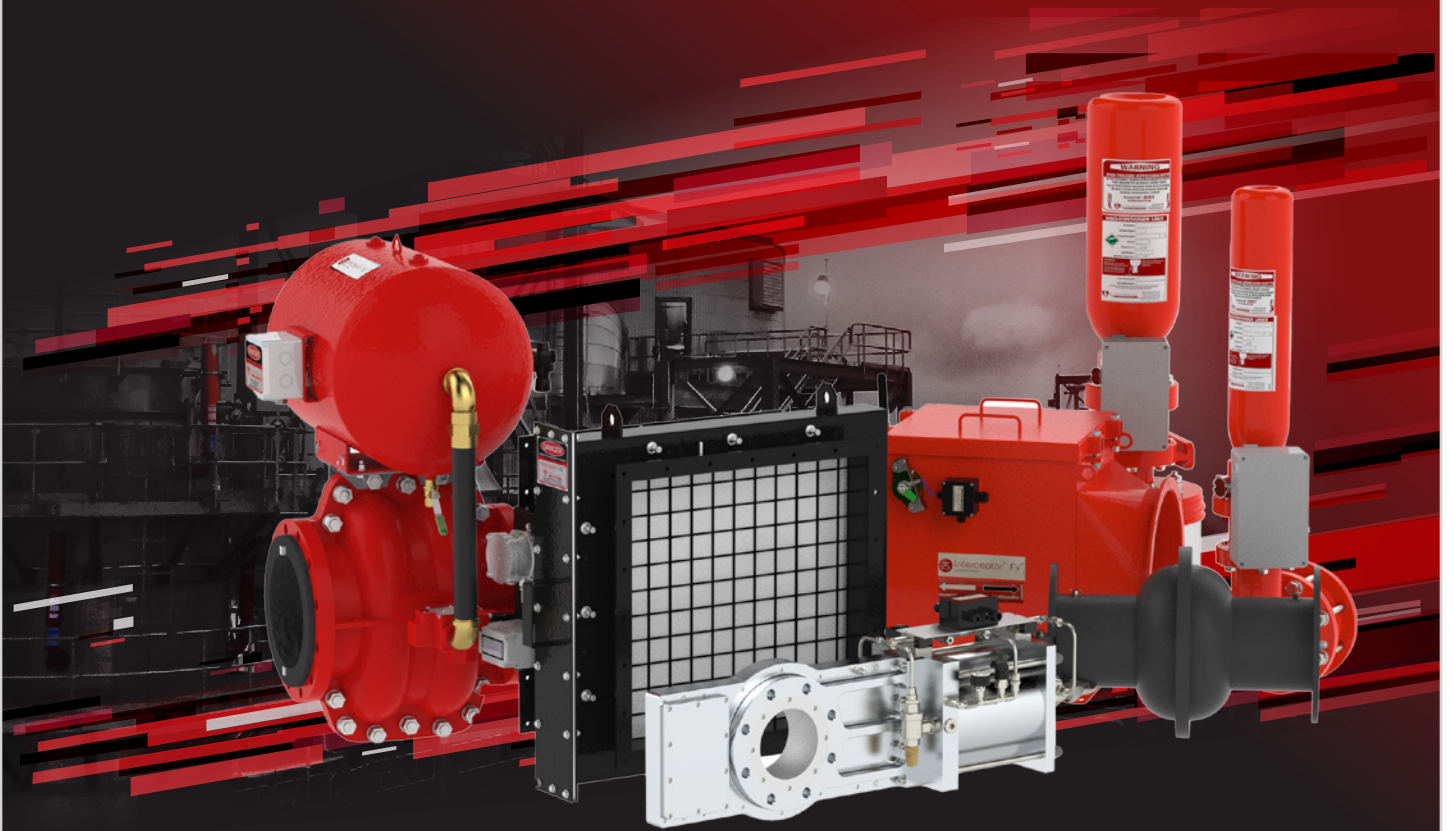
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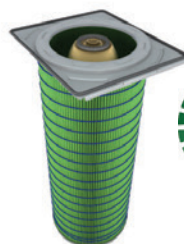
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