AIR POLLUTION CONTROL

NFPA 652

Crucial Elements to Include in Your Combustible Dust Hazard Analysis

NFPA 652 requires that you complete a Dust Hazard Analysis (DHA). If you have not done this, your people and facility may be at high risk. The NFPA standards states, “The owner/operator shall demonstrate reasonable progress in each of the 5 years.”

Dust collection systems are one of the most critical elements to be included in a dust hazard analysis because they are a leading cause of combustible dust incidents. According to FM Global statistics, more than half of all dust explosions originate in the dust collector. An unprotected dust collector can reach high pressures that can fragment the housing and send a pressure wave, heat, flames, and dangerous projectiles into the workplace.

THIS eBOOK WILL DISCUSS:

But first, do you need a DHA?

Quite simply, the answer is **Yes** if you are creating or handling a material that is combustible and/or explosible.

If you don't know whether you are handling combustible dust, you must have a representative sample tested following the plan outlined in NFPA 652. If you are not handling combustible dust, you must maintain documentation that demonstrates that. Assuming you need a DHA, read on…

> **You need a DHA if you are creating or handling a material that is combustible and/or exposible.**

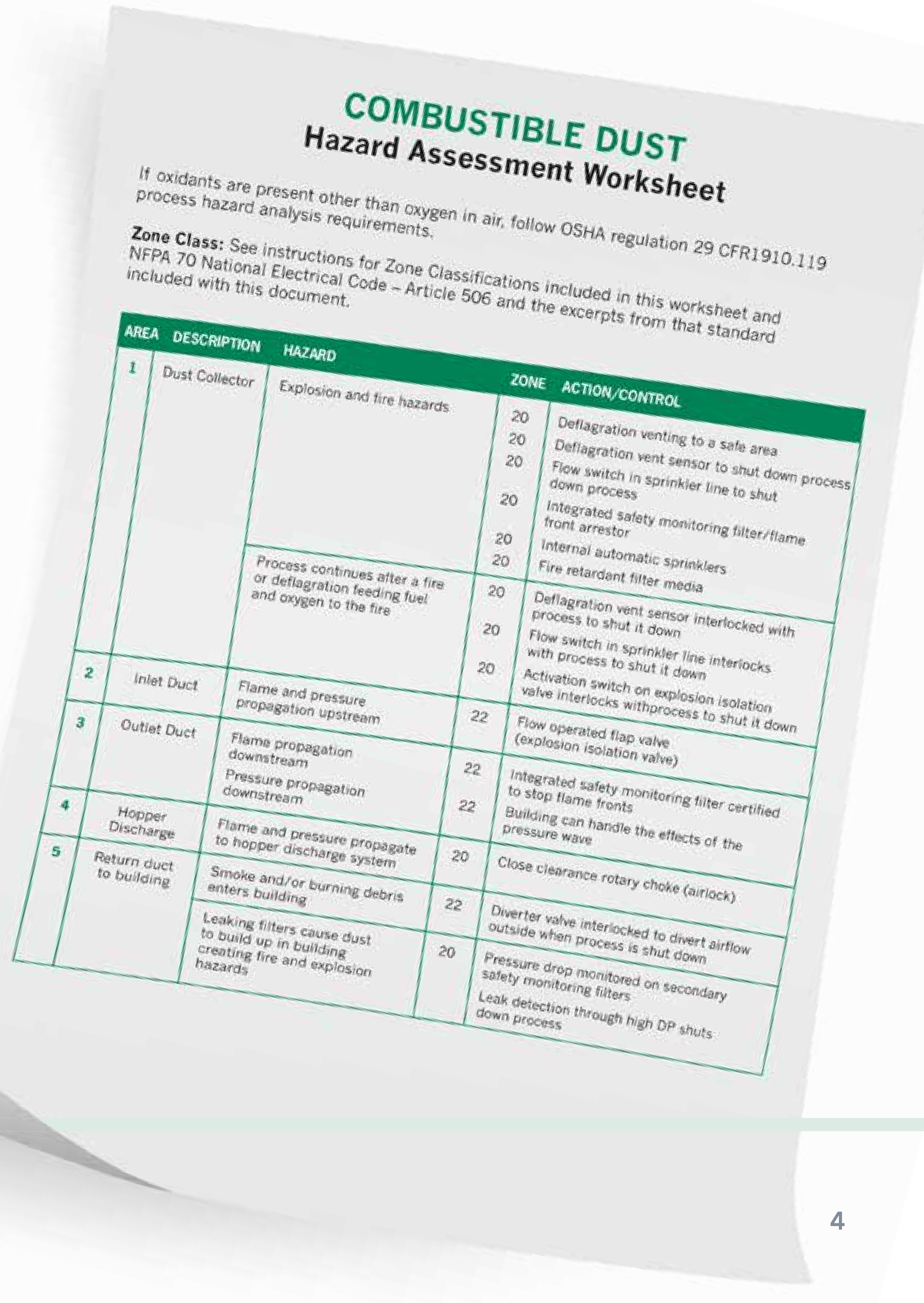
DUST HAZARD ANALYSIS:
Using a simple checklist analysis to help identify dangers

NFPA understands that hazards can't be completely eliminated, but the objective should be to achieve the following Life Safety Goals:

1. Ignition has been prevented
2. Under all fire scenarios, no person other than those in the immediate proximity of the ignition is exposed to untenable conditions due to the fire and no critical structural element of the building is damaged to the extent that it can no longer support its design load during the time needed to evacuate the occupants.

One common method to document a DHA is a simple worksheet that documents all possible hazards associated with your dust collector along with the control used to mitigate the hazards.

The sample shows commonly used columns and rows, but you can add any as needed to cover all hazardous areas of your dust collection system. You want to look at each area and determine whether all five factors in the explosion pentagon are present – fuel(dust), ignition source, oxygen, confinement, and dispersion.



COMBUSTIBLE DUST
Hazard Assessment Worksheet

If oxidants are present other than oxygen in air, follow OSHA regulation 29 CFR1910.119 process hazard analysis requirements.

Zone Class: See instructions for Zone Classifications included in this worksheet and NFPA 70 National Electrical Code – Article 506 and the excerpts from that standard included with this document.

AREA	DESCRIPTION	HAZARD	ZONE	ACTION/CONTROL
1	Dust Collector	Explosion and fire hazards	20	Deflagration venting to a safe area
			20	Deflagration vent sensor to shut down process
			20	Flow switch in sprinkler line to shut down process
			20	Integrated safety monitoring filter/flame front arrestor
			20	Internal automatic sprinklers
			20	Fire retardant filter media
		Process continues after a fire or deflagration feeding fuel and oxygen to the fire	20	Deflagration vent sensor interlocked with process to shut it down
			20	Flow switch in sprinkler line interlocks with process to shut it down
			20	Activation switch on explosion isolation valve interlocks withprocess to shut it down
2	Inlet Duct	Flame and pressure propagation upstream	22	Flow operated flap valve (explosion isolation valve)
3	Outlet Duct	Flame propagation downstream	22	Integrated safety monitoring filter certified to stop flame fronts
		Pressure propagation downstream	22	Building can handle the effects of the pressure wave
4	Hopper Discharge	Flame and pressure propagate to hopper discharge system	20	Close clearance rotary choke (airlock)
5	Return duct to building	Smoke and/or burning debris enters building	22	Diverter valve interlocked to divert airflow outside when process is shut down
		Leaking filters cause dust to build up in building creating fire and explosion hazards	20	Pressure drop monitored on secondary safety monitoring filters
				Leak detection through high DP shuts down process

THE QUESTIONS TO ASK FOR EACH AREA ARE:

- ☑ Is the particulate exposible in this segment?
- ☑ Is the particulate suspended in air?
- ☑ Is the concentration dense enough to support a deflagration?
- ☑ Is there an ignition source strong enough to ignite the dust cloud?
- ☑ Is there any hazard control already in place?

Ultimately you want to identify all hazards and select suitable controls. Each control should be listed and you should maintain the associated vendor documentation.

Consult appendix B of NFPA 652 for further guidance on performing a DHA.

Note that the above example does not depict all possible controls for the hazards listed or all possible hazards that could be associated with your dust collector. A complete dust hazard analysis would include process machinery that produces dust as well as hazards external to the dust collection system. History has shown that many incidents with dust collector fires and explosions occurred after a fire outside the collector produced flames or sparks that were sucked in.

If you aren't sure your dust is combustible, you must have a representative sample tested following the plan outlined in NFPA 652.

1 Dust Collector Housing

This area provides the biggest potential for a deflagration to occur. The main reason is that so much dust is airborne in this area each time the filter is cleaned or pulsed. At the moment of pulse-cleaning, which happens every few moments, dust falls away into the housing-hopper plenum, causing a cloud that becomes potential fuel for a deflagration.

The dust collector housing is also continually fed oxygen and possible ignition sources from the process side. Once again, this process produces the components needed to produce all five factors in the explosion pentagon – fuel, ignition source, oxygen, confinement, and dispersion.

THE FOLLOWING SAFETY CONTROLS HELP CONTROL THESE EXPLOSIONS:

Deflagration venting: This is the most cost effective mitigation option if the dust type and explosivity factors allow it. Many factors such as the volume of the housing being vented, Kst rating of the dust (the deflagration index of a dust cloud, or rate of pressure rise), and the Pmax (Max pressure for an unvented dust explosion) value are taken into consideration and applied to the collector design per NFPA 68 “Explosion Protection by Deflagration Venting” guidelines. Be sure that the vent has sensors integrated into the controls that shut down the fan if there is a deflagration event. The fan is the source of the oxygen that helps fuel the fire.

Integrated Safety Monitoring Filter system: This system keeps the flame front from entering back into the building.

Explosion isolation valves and suppression systems: Along with interlock activation switches, these valves are required for some hazardous dust types or collector locations. For example, they might be required if there is a process taking place upstream of the collector where someone is working. Another case would be whether the facility could be damaged if the pressure wave or flame front made its way back to that process point from a dust collector explosion. They are more costly than deflagration vents and integrated monitoring filters.

Another danger to plan for is a fire that continues to burn in the housing after the deflagration because it is being fed with fuel. To prevent this from happening, it’s a good idea to install automatic sprinkler systems with flow alarm switches along with fire retardant filters. As discussed above, installing interlock systems will shut down the fans and processes that the collector is servicing.

2 Dust Collector Hopper

The dust collector hopper is another prominent area for an explosion to occur.

That's because there is a much higher chance that the hopper has the dispersion concentrations required to cause an explosion. There can be a large volume of dust in the open area of the hopper, in the filters or in the dust collector housing above the hopper.

Make sure that the hopper isn't being used to store combustible dust. That dust should either be discharged into a closed system that has a container that can handle the required reduced pressure (Pred) that occurs with an explosion. Or the dust should be discharged into an open container such as a dump hopper that is equipped with an NFPA compliant rotary airlock.

IMPORTANT DOS AND DON'TS

- **DON'T** store combustible dust in a hopper
- **DO** empty hopper frequently
- **DO** discharge dust into a closed system that can handle high pressure
- **DO** use NFPA compliant rotary airlocks for dump hoppers

3 Inlet Ducting

If a dust collector is installed properly, the velocities in the inlet ductwork should not meet all the conditions of the explosion pentagon.

Higher duct velocities (conveying velocities) usually keep the dust moving and therefore lower the chances of a large enough concentration of dust to be present for a deflagration to occur. However, there is always a chance.

This area is a gateway to the process area where operators are working, and explosions that occur in the main dust collector housing will send pressure, smoke, flames and burning debris through the inlet ducting and back upstream, if they are not blocked. Installing a flow-activated explosion isolation valve in the inlet ducting prevents this from happening.

EXPLOSION ISOLATION

System or single device that prevents the propagation of explosion effects from one volume to an adjacent volume.

4 Outlet/Return Ducting

As with inlet ducting, if it isn't installed properly, the velocities in the outlet ductwork can reach all the conditions of the explosion pentagon.

The return ducting is supposed to be the clean duct side of the dust collection system, so there should be only a minute chance of a deflagration event occurring here. But if an explosion happens in the main dust collector housing, the flame and pressure waves can be propagated back into the building, which puts employees, facility and equipment at risk.

An Integrated Safety monitoring filter acts as a flame front in the event of an explosion. It prevents flame propagation back into the work area and also makes it possible for a facility to safely discharge air from the dust collector back into the building.

EXPLOSION MITIGATION:
Methods used to reduce damage from the explosion after the explosion has started.

9

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