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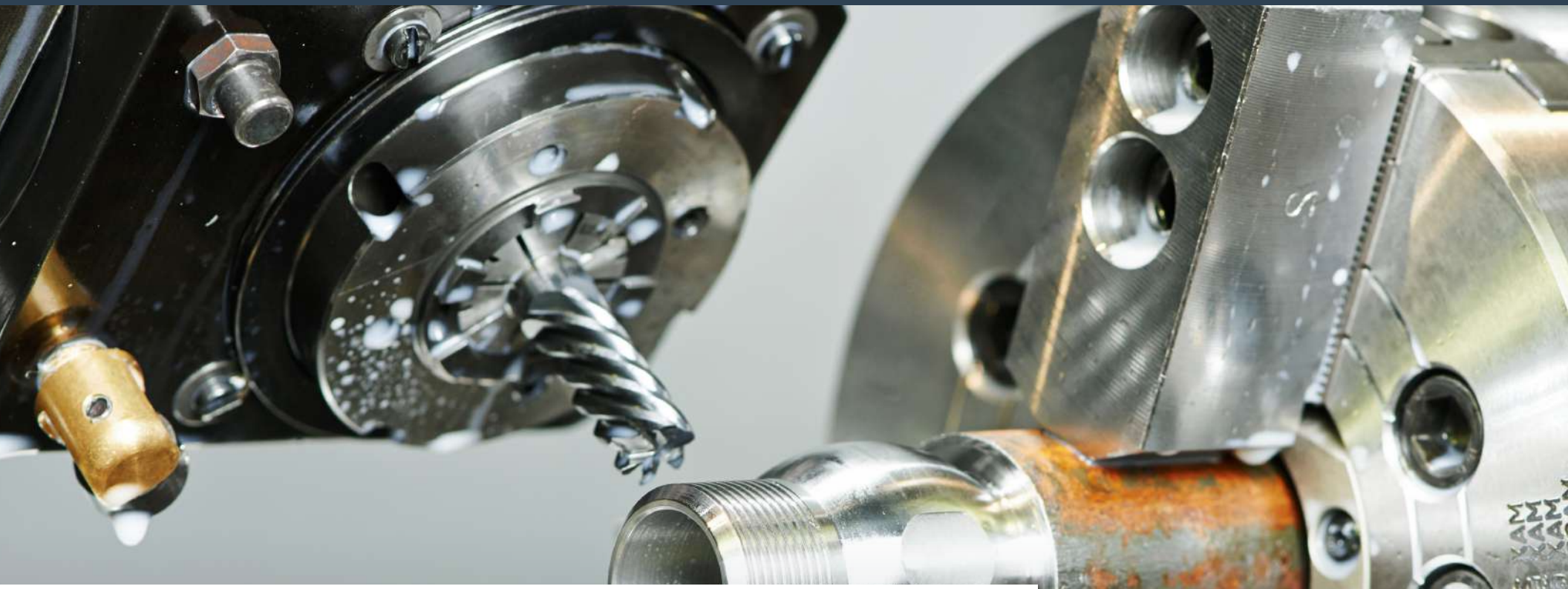
AIR POLLUTION CONTROL

7 KEYS TO SELECTING

an Equipment Supplier for Collecting Combustible Metal Dust



CONTROLLING DANGEROUS METAL DUSTS
WHAT YOUR EQUIPMENT SUPPLIER NEEDS TO KNOW

The potential for a combustible dust explosion is a reality in any industrial manufacturing facility. But operations with processes that generate combustible metal dusts are especially at risk and require special consideration when selecting an equipment supplier.

The metals of most concern include alkali metals and transition metals including aluminum, magnesium, niobium, tantalum, titanium, zirconium and hafnium. Metals such as carbon steel, stainless steel and mixtures of metals can also be hazardous.

This book lists important considerations for determining whether a dust collector equipment supplier has the knowledge necessary to keep your operation safe and compliant.

1 Does the supplier offer both wet and dry collection systems?

A manufacturer that offers both types of product lines is more likely to give unbiased advice on the best equipment for a given application, because it will not have a vested interest in one over the other.

This is important because wet scrubbers and dry media dust collectors are two very different technologies used to capture combustible dusts generated during metalworking processes. Both types of collectors have inherent advantages and disadvantages, and the choice is not always clear cut.

Certain metal dusts are better suited for a wet collector because of their higher Kst values and volatility of the metal. For example, titanium and, in some cases, aluminum can be difficult to handle with dry dust collection. That's because such metals have a reactive characteristic that can cause them to combust. A wet scrubber can keep the metal neutralized and nonreactive in the water. However, wet collectors have their challenges, such as reactive metals potentially turning into gases that can cause explosions. The manufacturer and supplier must fully understand the application and be able to size the vortex and necessary accessories to ensure you are getting the right collector to protect your employees and workplace.

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2 Will the supplier provide a written guarantee of filtration efficiency?

There are many different methods used to measure filtration efficiency. Sometimes a dust collector supplier might say that a system offers 99 percent filtration efficiency at a certain particle size or that it uses MERV 15 filters.

These ratings are useful for comparing different systems, but mass density efficiency, defined as the weight per unit volume of air, is the best predictor of a collector's compliance.

For example, OSHA might require that emissions will not exceed 5 milligrams per cubic meter at the discharge of the dust collector. Similarly, the EPA doesn't care about percentage efficiency claims. It wants to know that emissions will be at or below required thresholds, typically stated as grains per cubic foot or milligrams per cubic meter. To make sure your collector will provide the filtration efficiency that you need to keep your facility safe and compliant, verify that the supplier will provide a written guarantee of performance stating that the equipment you select will satisfy OSHA, EPA or other applicable emissions requirements.

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3 How does the supplier approach NFPA compliance?

When dealing with combustible dust, it's imperative that the dust collection supplier has knowledge and experience in applying NFPA 484: Standard for Combustible Metals.

Because there is no formal supplier certification, it's up to you to inquire about specific experience and capabilities. Equipment manufacturers and suppliers must thoroughly understand the explosion potential of metals and the controls needed to protect workers and the facility.

NFPA 484 covers all metals and alloys in a form that is capable of combustion or explosion, and it outlines procedures that are used to determine whether a metal is in a combustible or noncombustible form. It also applies to processing or finishing operations that produce combustible metal powder or dust such as machining, sawing, grinding, buffing and polishing.

A part that contains multiple metals or alloys is subject to the requirements of the metal that its combustion characteristics most closely match. The standard also defines exclusions such as the transportation of metals or the primary production of aluminum, magnesium and lithium. The explosibility properties of some metals are listed in the accompanying table.

Dry media collectors are inherently at higher risk of a combustible dust explosion than wet collectors. As a result, they require more ancillary explosion protection equipment to meet NFPA standards. Make sure the collector manufacturer has tested its equipment for NFPA compliance and has experience in configuring and installing dust collection systems that meet all applicable requirements.

Explosibility Properties of Common Metals

Material	Median Diameter (µm)	Kst (bar-m/s)	Pmax (bar g)
Aluminum	<10	515	11.2
Bronze	18	31	4.1
Iron	12	50	5.2
Iron (carbonyl)	<10	111	6.1
Magnesium (electrolytic)	16	157	6.3
Magnesium	28	508	17.5
Magnesium	240	12	7
Niobium	80	238	6.3
Niobium	70	326	7.1
Silicon	<10	126	10.2
Silicon (from dust collector)	16	100	9.4
Tantalum	100	149	6.0
Tantalum	80	97	3.7
Tantalum	50	108	5.5
Tantalum	65	129	5.8
Tantalum	~25	--	4.7
Tantalum	10	--	4.8
Zinc (from collector)	<10	125	6.7
Zinc (from collector)	10	176	7.3
Zinc (from Zn collector)	19	85	6

Note: This chart lists only some of the properties of common metals. Refer to NFPA 484 for a comprehensive chart of all affected metals.

4 Does the supplier provide in-house dust testing to help determine the best system for your application?

Sometimes the choice between a wet and dry dust collection system will not be clear cut. Dust testing is an essential first step in the decision-making process.

THERE ARE TWO TYPES OF DUST TESTING:

1. **Lab testing**, which pinpoints physical properties of the dust that affect filter efficiency and performance.
2. **Explosibility testing**, which determines combustible and explosive properties of the dust.

LAB TESTING

Lab tests on dust samples and simulation of specific challenges help you understand the characteristics of the material you are dealing with, so that you can make informed decisions on equipment, filter cartridges and engineered controls to mitigate dust hazards. Dust collectors that are designed based on facts rather than guesswork perform as required with lower energy and operating expenses.

Important dust testing for determining the right collector for your application includes:

- **Particle size analysis** – These tests determine the filtration efficiency required to meet emissions standards.
- **Video microscope** – Knowing dust shape and characteristics is vital to selecting proper equipment.
- **Pycnometer** – Knowing the dust's true specific gravity helps determine the efficiency of cyclonic-type dust collectors.
- **Moisture analysis** – Identifying moisture-absorbent dust is essential to selecting effective filters.
- **Abrasion testing** – Knowing the dust's relative abrasiveness helps determine the optimal design of dust-handling components like valves, inlets and ductwork.
- **Terminal velocity testing** – Knowing the air velocity required to lift the dust helps determine the correct filter housing size.

Certain manufacturers can also provide testing for ANSI/ASHRAE Standards. This testing requires selected dust types to be fed into a collector at a specified rate and to a specified differential pressure. The dust samples then proceed through pulse cleaning, several cycles of dust loading and a simulated upset condition to generate performance data.

This information provides real-world information on emissions, pressure drop, compressed air usage, energy consumption and emission readings based on your dust and the manufacturer's dust collectors. That way, you can see what it really costs to operate the collector over time and make accurate system comparisons.

EXPLOSIBILITY TESTING

To determine whether a dust is combustible, it should undergo separate explosibility testing as stated in NFPA 68: Standard on Explosion Protection by Deflagration Venting. This standard recommends testing per either ASTM E1226-12a or ISO 6184/1. If a dust sample is not available, it is permissible to use an equivalent dust (i.e., same particle size, etc.) in an equivalent application to determine combustibility properties. But once the dust becomes available, it is still recommended that you go back and test the dust using standardized test methods.

Using your dust sample, the lab will start with a screening test to determine whether the dust is combustible. If the dust is not combustible, testing will stop there. If it is combustible, the lab will conduct further testing on dust cloud parameters to pinpoint the Kst value and Pmax (the maximum pressure in a contained explosion). Depending on your application, you may also need to determine the minimum explosion concentration (MEC) and the minimum ignition energy (MIE).

Explosibility testing is essential to help analyze the best type of collection system (wet or dry) for an application as well as the explosion protection or prevention equipment that may be needed on the dust collector and related components.

5 Does the supplier have the experience, engineering and testing capabilities to use the performance-based design option of NFPA 484?

Chapter 10 of NFPA 484 describes a performance-based design option, which specifies that if another method for protecting your dust collector from explosions is acceptable to the authority having jurisdiction, you can use that method instead of one specified in the standard.

This performance-based design option may give you greater latitude in equipment selection. Find out if the supplier can provide the real-world testing and documentation needed for performance-based options. You must document and maintain this optional design method and its data sources over the collector's service life.

An example of a performance-based design option is a manufacturer conducting actual explosion tests of their dust collector to show that it will stand up to certain pressure conditions. Some dust collector suppliers can provide this testing using a combination of field tests and full-scale dust collector laboratory tests. This approach can sometimes yield more accurate real-world performance data than the calculations provided in NFPA 484.

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6 Does the supplier have access to, and familiarity with, alternative protection technologies, such as flameless venting and explosion suppression?

Deflagration venting and explosion isolation valves are two commonly-used explosion protection methods.

You'll have to work with the manufacturer of your device to determine the correct safety zone. Deflagration vents work for many applications. They open when predetermined pressures are reached inside the dust collector, allowing pressure and flame fronts to exit to a safe area. Flameless devices may be a viable option to ducted explosion vents, but they are not recommended for toxic dusts because dust can be released into the room where the dust is vented. They install over a standard deflagration vent to extinguish the flame front as it exits.

The equipment supplier should also have experience with active explosion suppression solutions like chemical isolation, which is designed to react within milliseconds of an explosion. There's also chemical suppression, which releases a chemical agent to extinguish the flame before an explosion can occur.

You'll also want to ask about explosion isolation valves, which can help contain a deflagration that occurs inside a dust collector. This flow-activated valve helps prevent flame and pressure from traveling through the inlet ducting and into the workspace. Make sure the valve is explosion tested and designed to meet NFPA standards for a range of applications and dust types. Other NFPA-approved explosion protection methods include oxidant concentration reduction, deflagration pressure containment and dillution. For a full list, consult NFPA 484, Section 9.4.13.13.1.

The equipment supplier should have experience with alternative explosion protection solutions.

7 Is the equipment supplier also a trusted advisor?

Because combustible dust issues are complex and incidents can be devastating, it's important to use an experienced independent professional engineer to help you design and install your system.

That way you can be certain that your facility complies with NFPA requirements and those of your local fire marshal and insurance carriers.

A knowledgeable supplier can help you determine the best explosion prevention components for your application, the type of ducting needed, the right filtration media, where to locate the collector and whether air can be safely recirculated downstream of the collector to save on heating and cooling costs.

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3505 South Airport Rd. Jonesboro, AR 72401 • (800) 479-6801 • filterman@camfil.com • **camfilapc.com**