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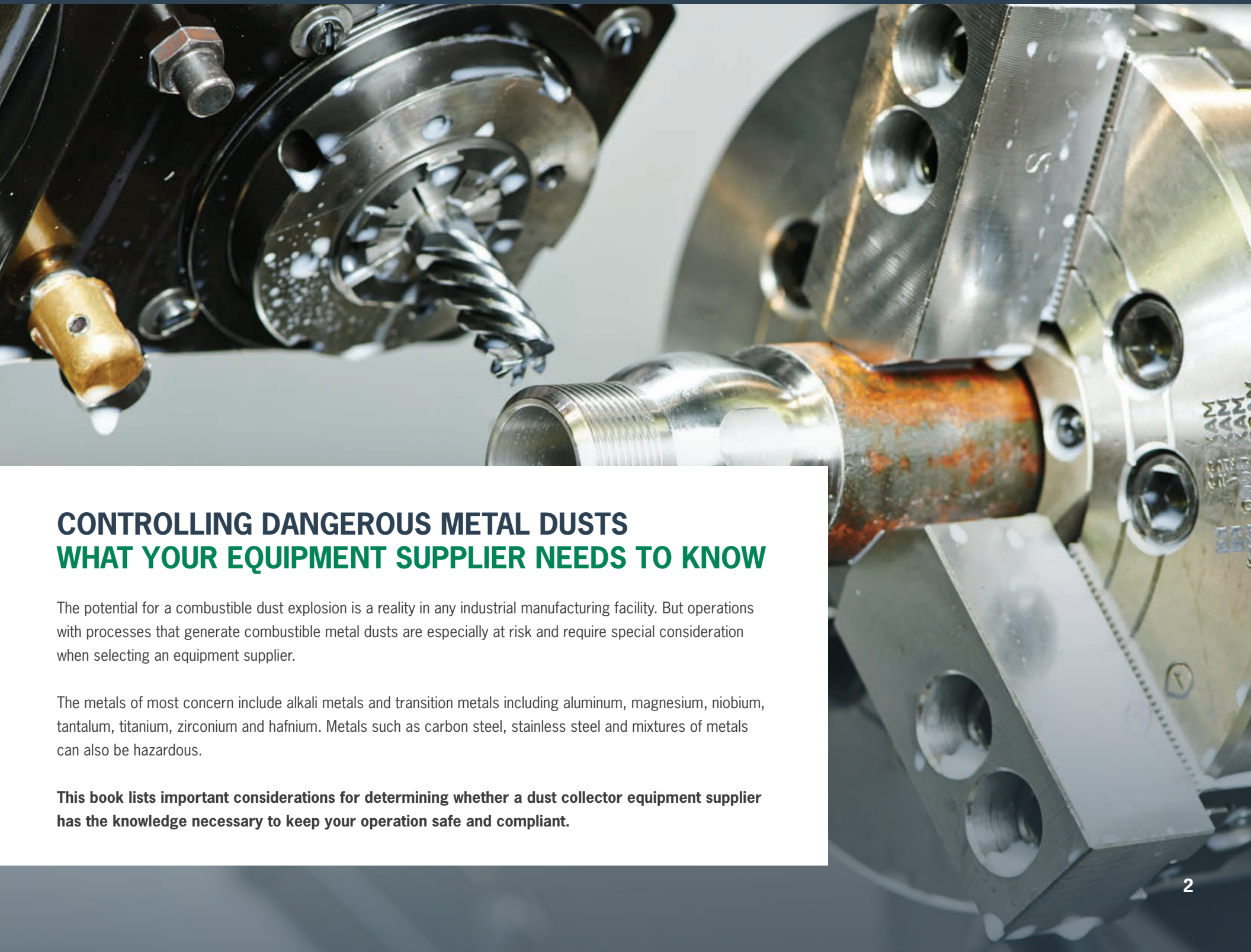
CLEAN AIR SOLUTIONS

SAFE HANDLING OF COMBUSTIBLE METAL DUST

7 key considerations when selecting the right equipment supplier



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 neutralised 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 wet scrubber and necessary accessories to ensure you are getting the right collector to protect your employees and workplace.

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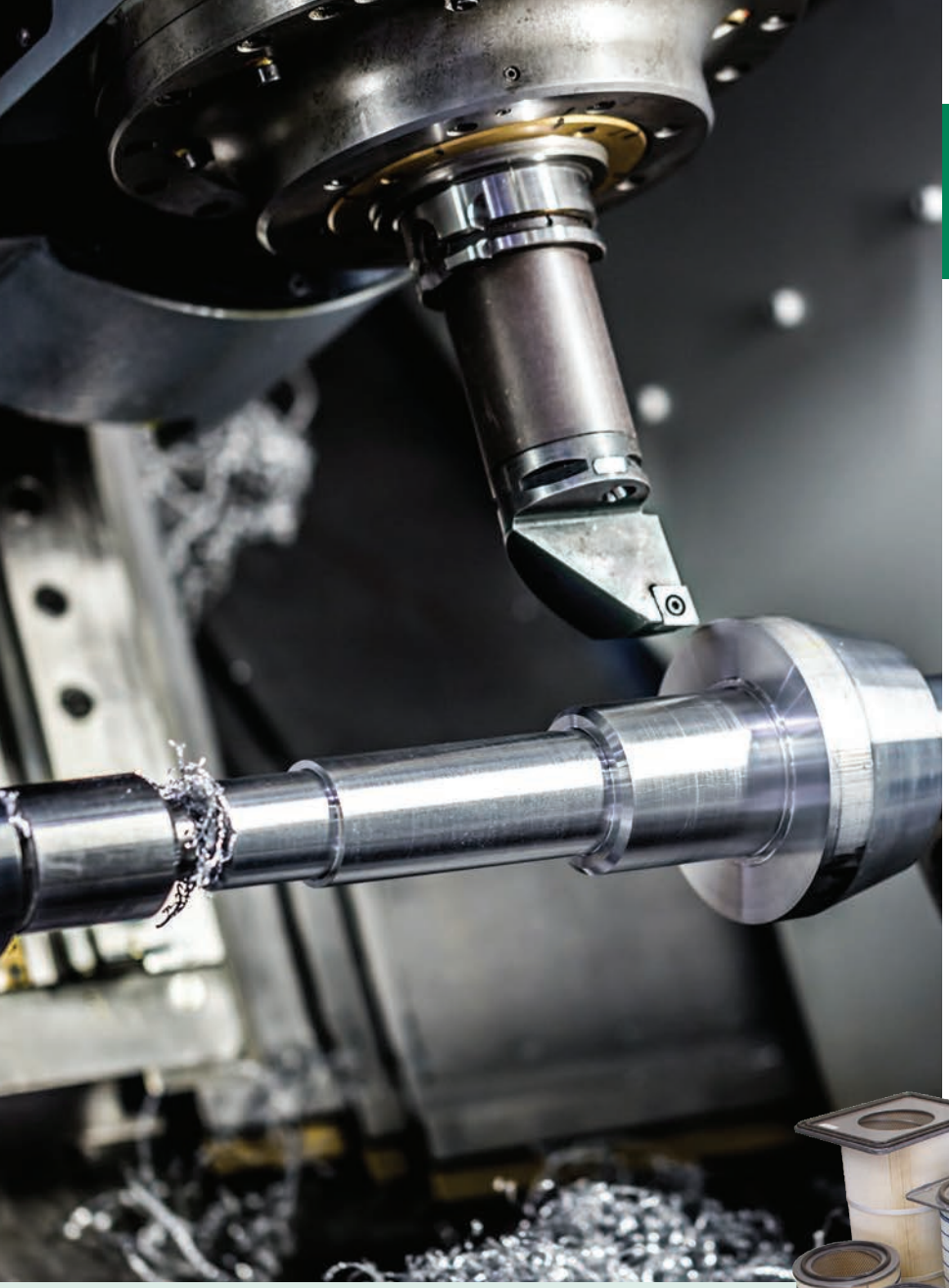
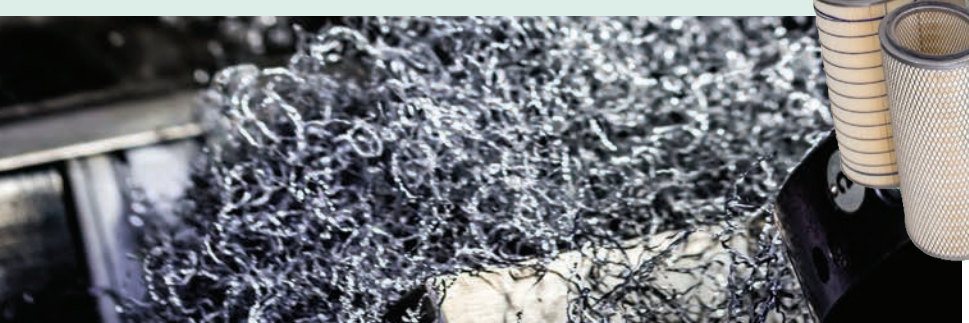




2 Will the supplier provide a written guarantee of filtration efficiency?

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 a specific grade of filter media.

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, environmental regulations might require that emissions will not exceed 1 milligram per cubic meter at the discharge of the dust collector. Sometimes there are additional requirements for special metals such as chromium or nickel.

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 local environmental emissions requirements.

Verify that the supplier will provide a written guarantee of performance or other applicable emissions requirements.

3 How does the supplier approach ATEX 1992/92 and 2014/34 compliance?

When dealing with combustible dust, it's imperative that the dust collection supplier has knowledge and experience in working with explosive dusts. Explosive metals requires a high skill level due to the big variation in properties and risks.

The final responsibility rests on the plant owner to select safe equipment that will reduce the risk of explosions and fire and safely manage the consequences should an accident happen. The ATEX regulations does not differentiate between metal dust and other explosive dusts, its the plant owners responsibility to test the dust and identify any risks. High risk applications are typically sawing, grinding , buffing and polishing. Most of these are capable of producing a fine unoxidized powder. This often requires expert knowledge and a plant owner needs to be able to rely on his equipment supplier.

A part that contains multiple metals or alloys is subject to the requirements of the metal that its combustion characteristics most closely match. As an example the explosibility properties of some metals are listed in the accompanying table. However, the actual values can vary a lot depending on the process and it is necessary to verify the value by testing.

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 Ex-regulations. Make sure the collector manufacturer has tested its equipment for Ex-compliance and has experience in configuring and installing dust collection systems that meet all applicable requirements. Wet collectors working with light metals are still a fire risk and must be well designed and installed to be safe. The collected waste needs to be stored safely as the risk of fire remains for a while.

Explosibility properties of common metals

Material	Median Diameter (µm)	Kst (bar-m/s)	Pmax (Bar)
Aluminum	<10	515	11.2
Bronze	18	31	4.1
Iron	12	50	5.2
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	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: *The data in this chart shall only bee seen as examples as actual parameters varies widely.*

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.

Explosibility Testing

For most common types of dust there is publicly available information about their explosive properties. 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 standardised 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 Ignition Temperature (MIT) and the Minimum Ignition Energy (MIE).

Explosibility testing is essential to help analyse 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 to select the correct certified and tested equipment?

Designing a system that is intended to operate with explosive metal dust involves many challenges. All components must be tested and evaluated to be safe for use.

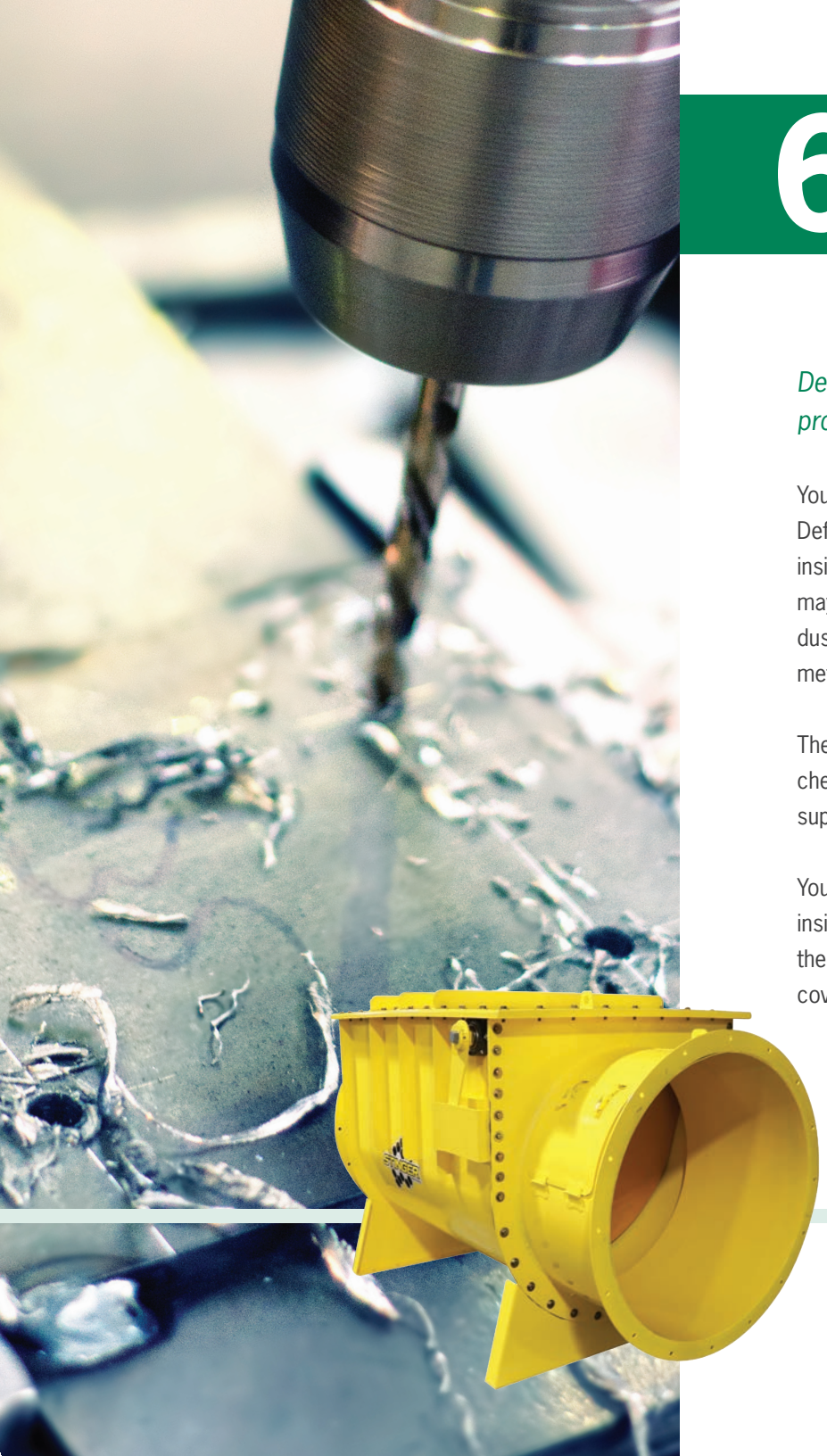
Supplying an explosion vent is not sufficient. The supplier must also test the filter unit and its parts to be able to withstand the explosion pressure and not leak flames that might ignite surrounding powder. A simulation can never predict the full behavior of an exploding dust collector. Testing components under real conditions is strongly advised.

Many components need to be selected in such a way that they are able to function even in case of a dangerous situation. Things like using a flexible hose that will burn through for a unit with high fire risk is an example for bad practice.

Another example is that passive and active isolation valves must be certified as protective systems also for metal dusts. This includes dust discharge components such as rotary valves and double valve systems.

A commonly overlooked component is a manual valve used to protect the operator when changing the dust bin.

A safe system is always based on tested and evaluated components.



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. But they have usage limitations with light metal dusts that needs to be taken into account.

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 certified and that the certification also covers light metals.

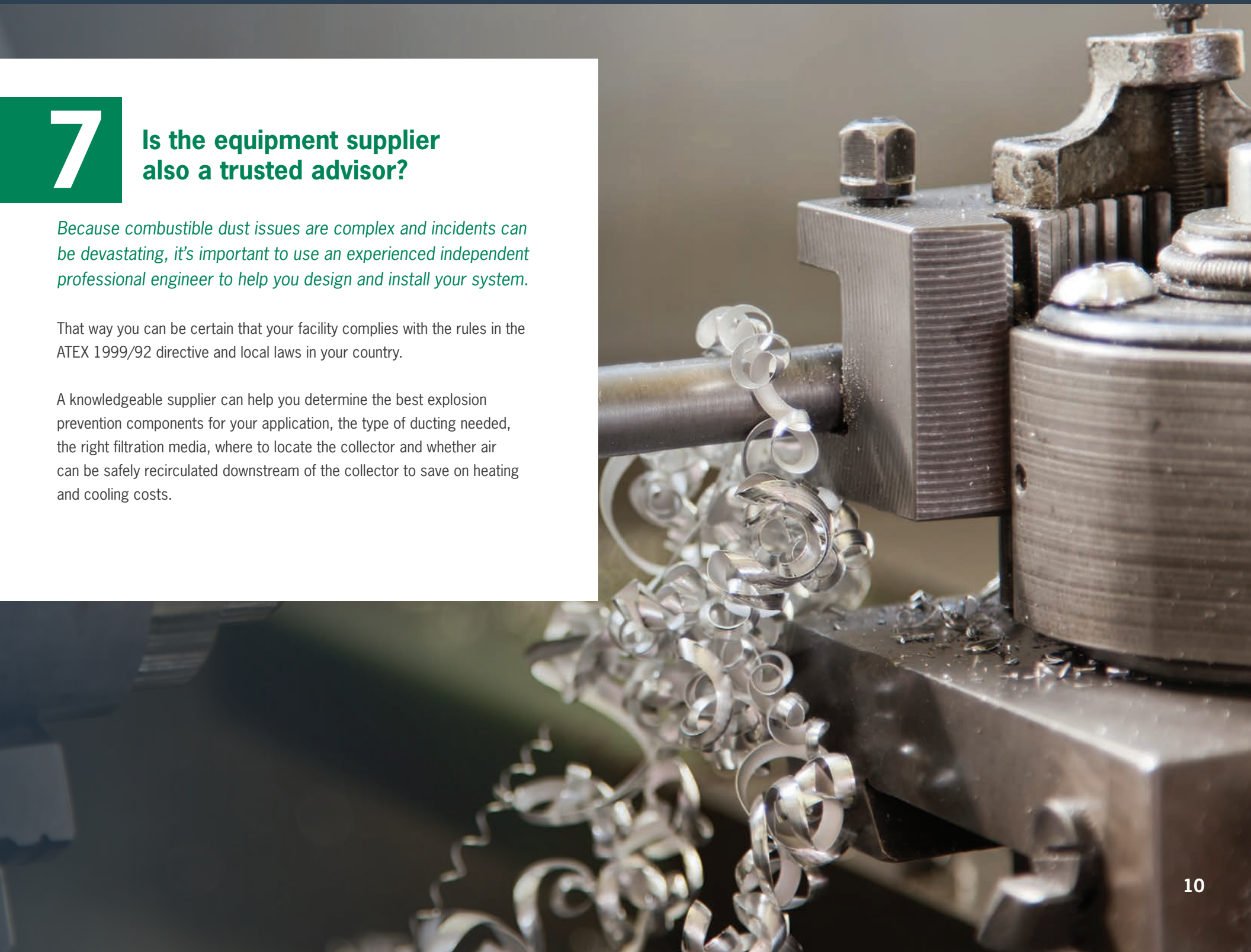
The equipment supplier should have experience with explosion protection solutions.

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 the rules in the ATEX 1999/92 directive and local laws in your country.

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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