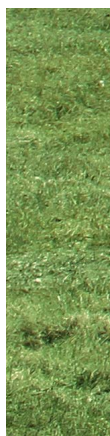
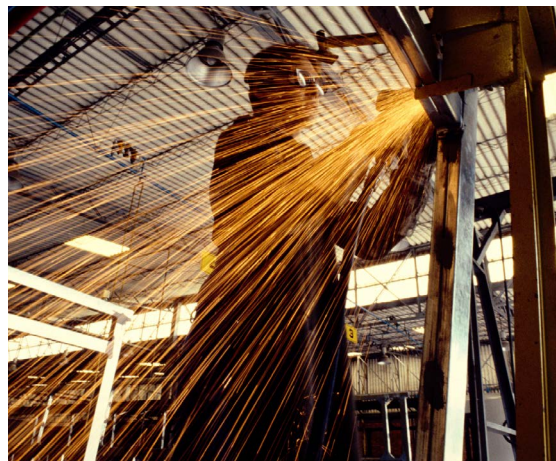
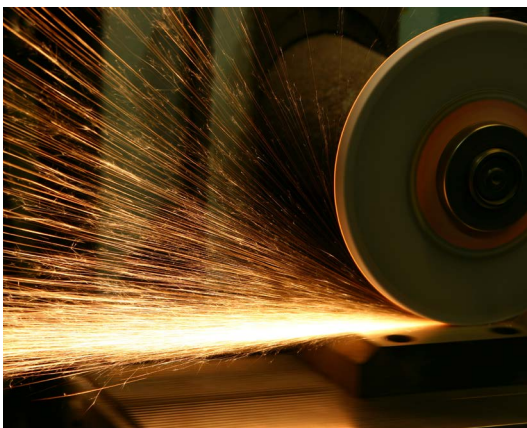




# UNDERSTANDING NFPA 484 AND BEST PRACTICES FOR SAFE COLLECTION OF COMBUSTIBLE METALS 2019 Edition



**AUGUST 2019**



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## **Section 1 - Executive Summary**

Every company involved in the production, processing, finishing, handling, recycling, storage and use of combustible metals and alloys needs to understand the changing regulatory environment in the wake of several high-profile and catastrophic workplace explosions. This white paper outlines new guidelines set out by the National Fire Protection Association (NFPA), summarizes established standards in relation to dust collection equipment and details emerging source capture products and technology.

The 2019 edition of NFPA 484 includes several important code changes. One of the most important changes is that self-contained, air material separators (AMS), downdraft benches and environmental control booths are now permitted for the collection of aluminum and other combustible dusts under certain conditions.

Fortunately, equipment manufacturers such as Diversitech are well-versed in the changing NFPA regulations. Our specialized wet filtration downdraft tables and dust collectors are fully NFPA compliant ahead of the changing regulatory environment.



## Section 2 - Introduction to Combustible Dust Hazards

### The Combustible Dust Pentagon

While a fire needs only (1) oxygen, (2) fuel to burn, and (3) a source of ignition, a dust explosion also needs (4) dispersion of dust particulates, and (5) confinement. This is referenced by Occupational Safety and Health Administration (OSHA) as the “dust pentagon”, illustrated below:

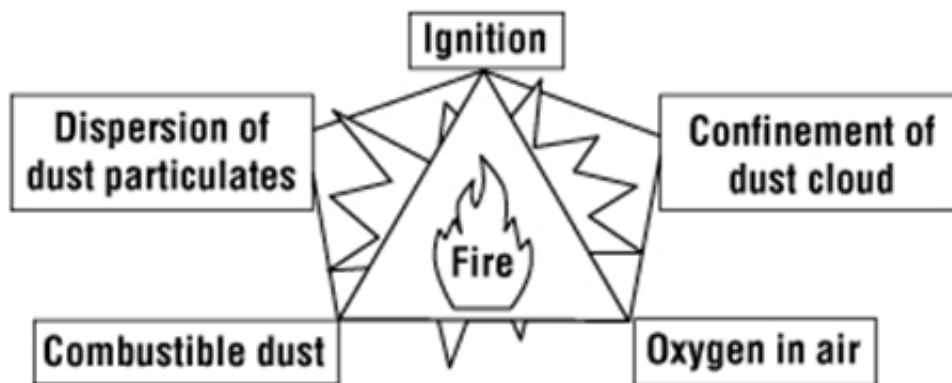


Figure 1: OSHA Dust Pentagon

- |    |                         |  |
|----|-------------------------|--|
| 1) | <b>Yes</b><br><b>No</b> | Do you process any material identified as a potential “Combustible Dust”?  |
|    |                         | See (Appendix) for a complete list.  |
|    |                         | If YES, proceed to question 2.   |
| 2) | <b>Yes</b><br><b>No</b> | Does any of your processes, such as cutting, grinding, deburring, polishing, sieving, budding, or blasting, create dust?                 |
|    |                         | If YES, proceed to question 3.   |
| 3) | <b>Yes</b><br><b>No</b> | Is there any possible ignition source present (e.g. grinding sparks, weld arcs, stoves, kilns, employee smoking, electrical enclosures)? |
|    |                         | If YES, you have a Combustible Dust Hazard   |



## Section 3 -

# Most Common Combustible Metals Dusts from Industrial Applications

## Aluminum

Aluminum dusts from typical fabricating operations, can produce particles as small as 400 microns. Only the smallest particles are a risk of ignition, but once started, even particles larger than 500 microns can contribute to an explosion.

The mix of coarser and finer material can change with alterations in alloy, machine speed, abrasive material, or lubricant. Production of finer dusts can increase the Combustible Dust hazard.

## Magnesium

Magnesium dust from grinding and finishing processes is highly combustible and an airborne dust cloud can be ignited almost instantly. Shavings and chips of magnesium can also ignite but less readily than a dispersed dust cloud. Magnesium dust submerged in water generates a significant amount of flammable hydrogen gas which must be exhausted outside of a building.

## Titanium

Titanium dust from deburring and sanding presents a serious fire and explosion risk, especially inside confined dust collector housings. Shavings and chips of titanium must be disposed of carefully to avoid dangerous reactions with other materials. Titanium dust off-gases hydrogen which should be ducted outside to prevent gas concentration from building up.

## OSHA Combustible Dust Chart

<b>Agricultural Products</b> Egg white Milk, powdered Milk, nonfat, dry Soy flour Starch, corn Starch, rice Starch, wheat Sugar Sugar, milk Sugar, beet Tapioca Whey Wood flour	Cottonseed Garlic powder Gluten Grass dust Green coffee Hops (maltd) Lemon peel dust Lemon pulp Linseed Locust bean gum Malt Oat flour Oat grain dust Olive pellets Onion powder Parsley (dehydrated) Peach Peanut meal and skins Peat Potato Potato flour Potato starch Raw yucca seed dust Rice dust Rice flour Rice starch Rye flour Semolina	Soybean dust Spice dust Spice powder Sugar (10x) Sunflower Sunflower seed dust Tea Tobacco blend Tomato Walnut dust Wheat flour Wheat grain dust Wheat starch Xanthan gum	<b>Chemical Dusts</b> Adipic acid Anthraquinone Ascorbic acid Calcium acetate Calcium stearate Carboxy-methylcellulose Dextrin Lactose Lead stearate Methyl-cellulose Paraformaldehyde Sodium ascorbate Sodium stearate Sulfur	Epoxy resin Melamine resin Melamine, molded (phenol-cellulose) Melamine, molded (wood flour and mineral filled phenol- formaldehyde) (poly) Methyl acrylate (poly) Methyl acrylate, emulsion polymer Phenolic resin (poly) Propylene Terpene-phenol resin Urea-formaldehyde/ cellulose, molded (poly) Vinyl acetate/ ethylene copolymer (poly) Vinyl alcohol (poly) Vinyl butyral (poly) Vinyl chloride/ ethylene/vinyl acetylene suspension copolymer (poly) Vinyl chloride/ vinyl acetylene emulsion copolymer
<b>Agricultural Dusts</b> Alfalfa Apple Beet root Carrageen Carrot Cocoa bean dust Cocoa powder Coconut shell dust Coffee dust Corn meal Cornstarch Cotton		<b>Carbonaceous Dusts</b> Charcoal, activated Charcoal, wood Coal, bituminous Coke, petroleum Lampblack Lignite Peat, 22% $H_2O$ Soot, pine Cellulose Cellulose pulp Cork Corn	<b>Metal Dusts</b> Aluminum Bronze Iron carbonyl Magnesium Zinc	
			<b>Plastic Dusts</b> (poly) Acrylamide (poly) Acrylonitrile (poly) Ethylene (low-pressure process)	



## Section 4 - Industry Implications

### Aerospace

Because of their light weight, high strength and corrosion resistance, the aerospace industry has continually increased its use of metal alloys such as aluminum, titanium and magnesium in the manufacture of aircraft parts. While these materials provide the industry a number of benefits, they also create highly combustible metal dusts that are challenging to contain.

After being machined, most aerospace parts must be deburred and sanded to complete the parts within fine tolerances. The safest option to contain the airborne dust generated from these activities is the use of wet dust collection equipment. Because the aerospace manufacturing industry is constantly adapting to product and process changes, having a flexible and mobile solution like the Monsoon Wet Downdraft Table means that line changes and relocations become less time consuming and less expensive.

### Metal Working

The metalworking industry needs to constantly adapt to customer demand and the production of parts and components using exotic metal alloys. To remain safe in the workplace and comply with OSHA guidelines, companies need to understand the dangers of different types of combustible metal dusts and the necessary procedures to safely capture and collect them.

One of the most common sources of combustible dust in a metal fabrication shop is dust generated from a wide belt sander. These sanders produce a large volume of fine dust and the frequent material changes create a dust fire and explosion hazard. The use of a wet dust collector to safely capture and remove particles when sanding aluminum, titanium or magnesium sheets prevents the endangerment of workers and facility. Wet dust collectors can be easily maintained with the use of a sludge removal vacuum or a basket straining system to automate the cleanup.







## Section 5 - NFPA 484: Standard for Combustible Metals

### New Highlights for 2019 Edition

To limit the dangers posed by combustible metal dusts, the NFPA has guidelines in place for their safe capture. NFPA 484 addresses combustible metals specifically.

The latest version of NFPA 484, 2019 edition is more in alignment with NFPA 652 Standard on the Fundamentals of Combustible Dust. Chapter 7, for example, on Dust Hazard Analysis (DHA) conforms with the DHA requirement in NFPA 652.

NFPA 484, 2019 also addresses new and emerging technologies. Chapter 12 focuses on the handling of nanometals, very fine metallic particles smaller than 500 nanometers. Chapter 13 deals with additive manufacturing. Industries involved with these particular applications can find the guidelines they need for their unique situation.

Other highlights of NFPA 484, 2019 include:

- The rewriting of Chapter 11 to clarify dust collection and centralized vacuum systems.  
New requirements include:
  - ◊ Dry collection systems are no longer permitted for applications that produce heat or sparks (grinding, sanding, etc.). A wet-type scrubber is now required.
  - ◊ A time-delay on startup and shutdown of dust collection systems to ensure proper function is also advised.
- Downdraft benches and environmental control booths with an integral filter media in wall are now permitted provided that:
  - ◊ A DHA has been performed
  - ◊ Less than 0.22 kg (0.5lbs) of dust less than 500 microns is collected and emptied each day





- All components of dust collection systems must be bonded and grounded, independently of the electrical grounding system to minimize accumulation of static electrical charge.
- Portable dust collection systems also have additional requirements and restrictions including:
  - ◇ Portable indoor, dry-type air-material separators (AMS) can only be used for grinding, sanding and buffing operations.
  - ◇ Portable indoor, dry-type dust collectors shall not be connected to a permanent piping system.
  - ◇ Housekeeping must be maintained to keep dust below levels where a secondary dust explosion could occur.
- Additional requirements for ductwork on both wet and dry collectors state:
  - ◇ Operations generating hot metal particles such as grinding and plasma spray shall have a spark arrester system upstream of the AMS.
- A dry filter media (Ex. HEPA) is permitted downstream of a wet dust collector if the filter contains:
  - ◇ Signs posted in the area warning of the hazards associated with the use of dry filter media
  - ◇ Differential Pressure Alarm
  - ◇ Static Dissipative or conductive Filter Media
  - ◇ A means to limit hydrogen to 10% of the LFL (Vent fan)
  - ◇ A high-temperature alarm at the filter media limit

*For free access to the 2019 Edition of NFPA 484, please follow this link on the NFPA website:*

<https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=484>







## **Section 6 - Downdraft Tables: Dry vs. Wet**

### **Dry Downdraft Tables**

#### **Pros**

- Now permitted for the collection of Combustible Dusts provided that a DHA has been performed and less than 0.22 kg (0.5 lbs) of dust less than 500 microns is collected and emptied each day.

#### **Cons**

- Not suitable for the capture of higher volumes of combustible dusts.

### **Wet Downdraft Tables**

#### **Pros**

- Versatile ventilated work surfaces that achieve excellent particle containment, right at source of processing
- Air velocity at table surface remains constant over time (no filter-load degradation)
- Lower consumable costs, no replacement filter cartridges
- Combustible dust is submerged in water to prevent dust from igniting or catching fire
- Complies with regulatory guidelines

#### **Cons**

- Requires frequent preventative maintenance to remove accumulated materials.





## **Section 7 - Dust Collectors: Dry vs. Wet**

### **Dry Dust Collectors**

#### **Pros**

- Straight forward maintenance procedures

#### **Cons**

- Requires expensive accessories for the collector (e.g. explosion vents, fire suppression system, sprinkler vents)

### **Wet Dust Collectors**

#### **Pros**

- Safe collection of flammable and explosive dust
- Lower consumable costs, no replacement filter cartridges

#### **Cons**

- Requires frequent preventative maintenance to remove accumulated materials



## Section 8 - Diversitech Products

Diversitech first introduced wet filtration dust collection equipment in 2010. Since then the product offering has evolved with feedback from a growing install base, and changing OSHA/NFPA regulations. Today, our offering can be broadly categorized as:

1. [Monsoon Series Wet Downdraft Tables](#)
2. [Typhoon WX Series Wet Dust Collectors](#)
3. [Typhoon Central Wet Dust Collectors](#)
4. [Custom Engineered Systems](#)

### Monsoon Series Wet Downdraft Tables

The Monsoon™ Series of Wet Downdraft Tables are self-contained units, requiring no additional equipment for the safe capture of hazardous and combustible dusts. Integrating the dust collection basin and water baffles under the downdraft table surface allows for an extremely small equipment footprint. All Monsoon tables include swivel castors, offering added versatility to metal processing applications.

#### Standard Specifications

- Stainless Steel Construction
- High Capture Face Velocity
- Heavy-duty Steel Bar Grating
- Protective Rubber Surface Mat
- Mist Eliminator After Filter
- NEMA 12 Control Panel with Overload Protection
- Low Water Auto-shutdown

#### Options

- HEPA After-filters
- Auto Water-level Control System
- Auto Wash-down Spray Kit
- Dust Tight Light Kit
- Back and Side Walls
- Sludge Vacuum for Easy Maintenance





## Typhoon WX Series Wet Dust Collectors

The Typhoon WX Series of Wet Dust Collectors meet and exceed all OSHA/NFPA requirements for safe capture of hazardous/combustible dusts, at a fraction of the cost for comparable NFPA 484 compliant dry dust collection systems.

The Typhoon WX series features 100% duty cycle with ultrasonic intelligent water level control system operates both online and offline.

All collectors can be connected to either existing dust collection or a Diversitech ducted downdraft table. Up to 4" of static pressure is available on most models and airflow may be adjusted with an optional baffle kit.

### Standard Specifications

- Interlocked offline vent-fan
- Mist-Eliminator after filter
- Safety overflow drain
- Low water auto-shutdown

### Control Specifications

- NEMA 4X control panel
- LCD display with alarms
- Mainline interlock switch
- High-temp input for optional HEPA after filter

### Options

- HEPA after-filters
- Sludge Vacuum for easy maintenance
- Automatic basket strainer self-cleaning system



## Typhoon Central Wet Dust Collectors

The Typhoon Central Wet Dust Collectors feature powerful performance and high efficiency filtration for large scale dust collection applications.

The Typhoon uses an ultrasonic water level control system to maintain correct water level when in operation. The machine is capable of 8000 to 12,000 CFM and can achieve up to 12" of external static pressure.

The Typhoon series can withstand industries' toughest applications, from rubber grinding to chemical dust, foundry applications and abrasive blasting. For high dust loading applications, an optional hopper or compact flat bottom configuration is available.

### Standard Specifications

- Stainless Steel Construction
- Interlocked Offline Vent Fan
- Safety Overflow Drain
- Low Water Auto Shutdown

### Options

- HEPA Afterfilters
- Sludge Vacuum for Easy Maintenance
- Hopper Configuration



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## **Section 9 - Conclusion**

Combustible dust in the workplace is an insidious hazard that can cause loss of life along with major property damage. Air quality regulators including the NFPA and OSHA are continually updating regulations when it comes to the safe capture and collection of combustible materials.

Industries with combustible dust exposure can mitigate fire and explosion risks by following the NFPA's recommended guidelines. Some legacy dry downdraft tables being used to collect aluminum dust will need to be either double checked to see if they are up to code or upgraded to wet downdraft tables. Dry dust collectors collecting combustible materials will also need to be upgraded or replaced with wet type dust collectors.

If your operation requires a custom engineered dust collection system, please contact one of our application experts to get a complete assessment of your specific process.





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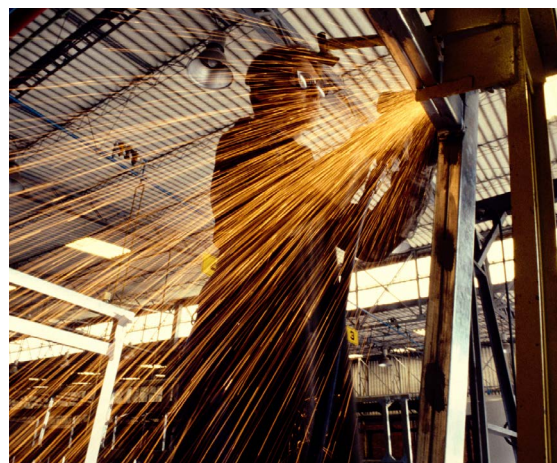
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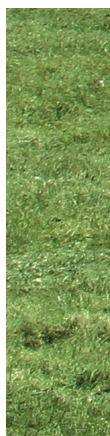
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