How to Design a Dust Collection System

SLY INC

Dust collection systems are essential in many industrial facilities for adhering to clean air standards. The basics of dust collection system design can be broken down into three areas:

Containing or capturing the dust

Conveying it to the collector

Collecting the dust

Containment or Capture: Starting at the Source

Identify Collection Points:

- Identify and map areas and processes that are generating dust, including equipment.
- Include any future problem areas, especially if the dust is combustible.
- Verify all material values and standards for industrial hygiene and safety requirements.

Determine Hood or Enclosure Design Requirements:

- Determine if the dust at each point should be controlled with a collection hood or contained within an enclosure.
- Ensure that your system can generate sufficient velocities to either contain or capture and move the dust, including overcoming any surrounding air currents.

Calculate Air Volume:

- Calculate the system's air volume. The basic formula for calculating air volume is **Q= V x A**.

Q	=	V	x	A
Volume of Air *(cubic feet per minute)*		Desired Velocity at the hood *(feet per minute)*		Open Area of the Hood *(square feet)*

- Refer to this document, *Industrial Ventilation: A Manual of Recommended Practice for Design*, by the ACGIH.
- Check if your design is centered more on dust collection than on dust control; if so, consult with a qualified system provider.

Conveying: Keeping it Moving

Design Ductwork:

- Next, design the dust ductwork. Map the locations of each collection point relative to the collector location, designed to scale.
- When planning location, consider size, the material being collected, how collected dust will be handled, and accessibility.
- Find the bulk density and loading (amount of material to be collected) of the dust being conveyed in the ducts. Conveying air velocity should increase with an increase in the bulk density.
- Keep ductwork lengths as short and straight as possible. Minimize turbulence and friction in elbows and transitions.
- Blast gates should be used to adjust the airflow at each pick-up point. Go with round ducts over square or rectangular ones.

Calculate Ductwork Losses:

- Limit friction (system static pressure) to save on fan horsepower and minimize power requirements.
- Correctly calculate system static pressure by adding the combined resistance of the worst case of an inlet duct, including elbows and transitions, plus pressure drop across the dust collector, the fan outlet duct and stack, or any ductwork or accessories such as HEPA Filters that are used to return air to the facility if a stack is not used. Consult loss tables if need be.
- Define the required air volume (CFM) and system static pressure (inches of water column) for the system.

Collection: Choosing a Well-Balanced, Efficient System

Select the Collection Device:

- Select the right dust collector for the specific application and utilities available. Pulse-Jet collector baghouses and cartridge filters are the most common.
- Factor in the type of dust, particle size (microns), inlet dust loading (pounds/hour), temperature, chemical composition of the gas or air, and the desired outlet emission rate (grains/standard cubic foot or pounds/hour.)
- Ensure that the collector operates at or near the design pressure drop.
- Consider the correct type of filter media, sufficient filter area (expressed as air-to-cloth ratio), consideration of interstitial velocity, and an efficient cleaning system.

There should be consistent air volumes at the pick-up points, predictable compressed air usage, stable pressure drop, and long bag or cartridge life with no unplanned outages.

Select the Exhaust Fan:

- Select the exhaust fan used to move the air from the collection points through the ductwork and dust collector.

Selecting the correct exhaust fan and motor will ensure the system will deliver the design air volume.

- Typically, the fan wheel style is either radial blade or backwardly inclined. The latter is more efficient and can save on cost.
- Consider the location of the fan in either a positive (inlet side) or negative orientation (after the collector) in relation to the dust collector.

Most systems use negative orientations, but you may want a positive orientation, especially in high-temperature applications with non-abrasive substances or if limited space is an issue.

Additional Considerations:

- Consider additional factors including air quality permits, fire and safety precautions for combustible dust, explosion protection, etc.
- Consider equipment to manage the collected dust from the dust collector.
- Your system may also require positive make-up air of equal magnitude to limit excessive negative pressure in the building.
- Your system should be robust and operate within its design specifications.
- Include other company departments in the design process: operations, maintenance, and those reporting on the system.

Do You Know the Essentials for Designing a Dust Collection System?

Get the Guide

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