

Optimizing Industrial Sustainability Through Smart Dust Collection Management

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Industries today face many challenges:



Energy Efficiency
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- Competition
- Lack of skilled labor
- Economical
- Regulatory
- Environmental

Air quality is a common concern for many industries, including:

- Wood processing
- Aerospace
- Machining mist
- Welding
- Laser and plasma
- Agricultural
- Food and ingredients
- Fiberglass
- Pharmaceutical
- Many more



Poor air quality affects:

Health of everyone in the facility

Employee retention

Equipment and overall facility
cleanliness

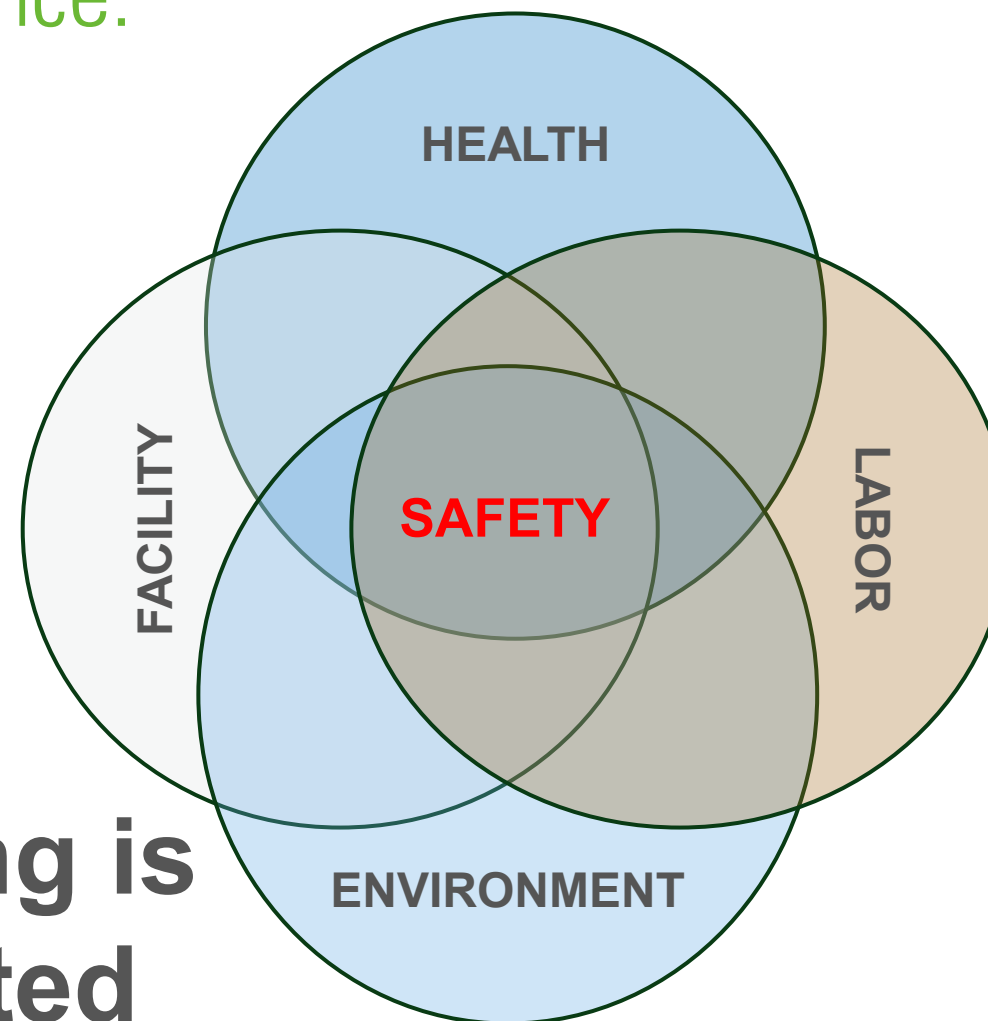
Environment



BEFORE

Efficient dust collection is critical for industrial facilities aiming to enhance:

- Workplace health
- Employee retention
- Operational efficiency and general maintenance
- Reduce environmental impact
- **Overall safety**



**Everything is
Connected**

Potential Solutions



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Option 1:

Continually add new pieces of dust collection equipment each time a new issue is discovered.

Issues:

- Short-term thinking
- Lacks continuity
- Difficult to maintain
- Expensive

Option 2 :

Install a large central static system.

Issues:

- May not be expandable
- Always operates at 100% capacity
- Not energy-efficient
- Subject to human involvement to adjust - often to the detriment of the system

Option 3:

Integrate an intelligent system.

This can be installed with a new collector or in many cases can be added to an existing system, with modifications, to improve the efficiencies and capacity of an existing system.

Real-World Example



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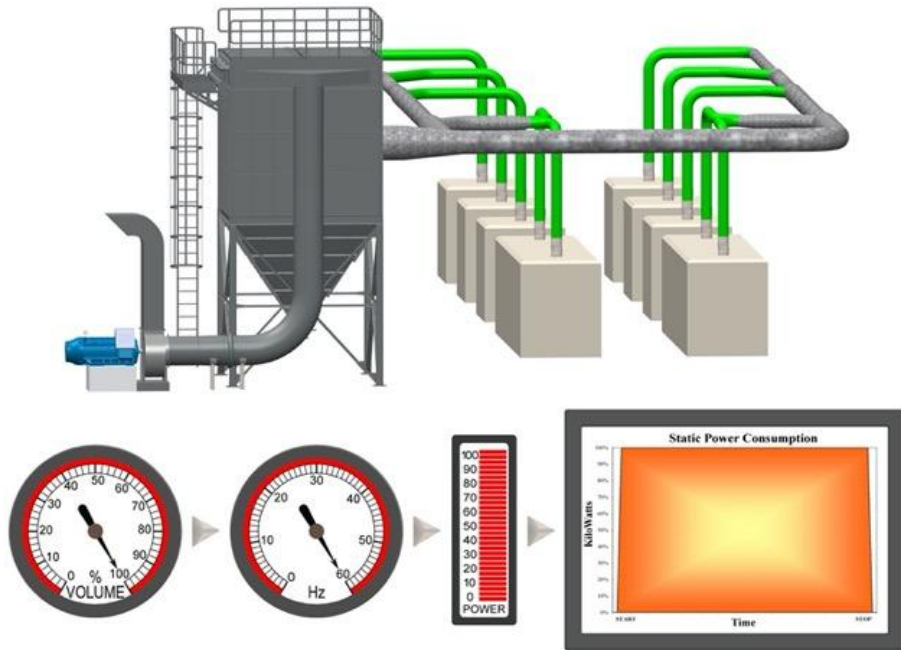


BEFORE



AFTER

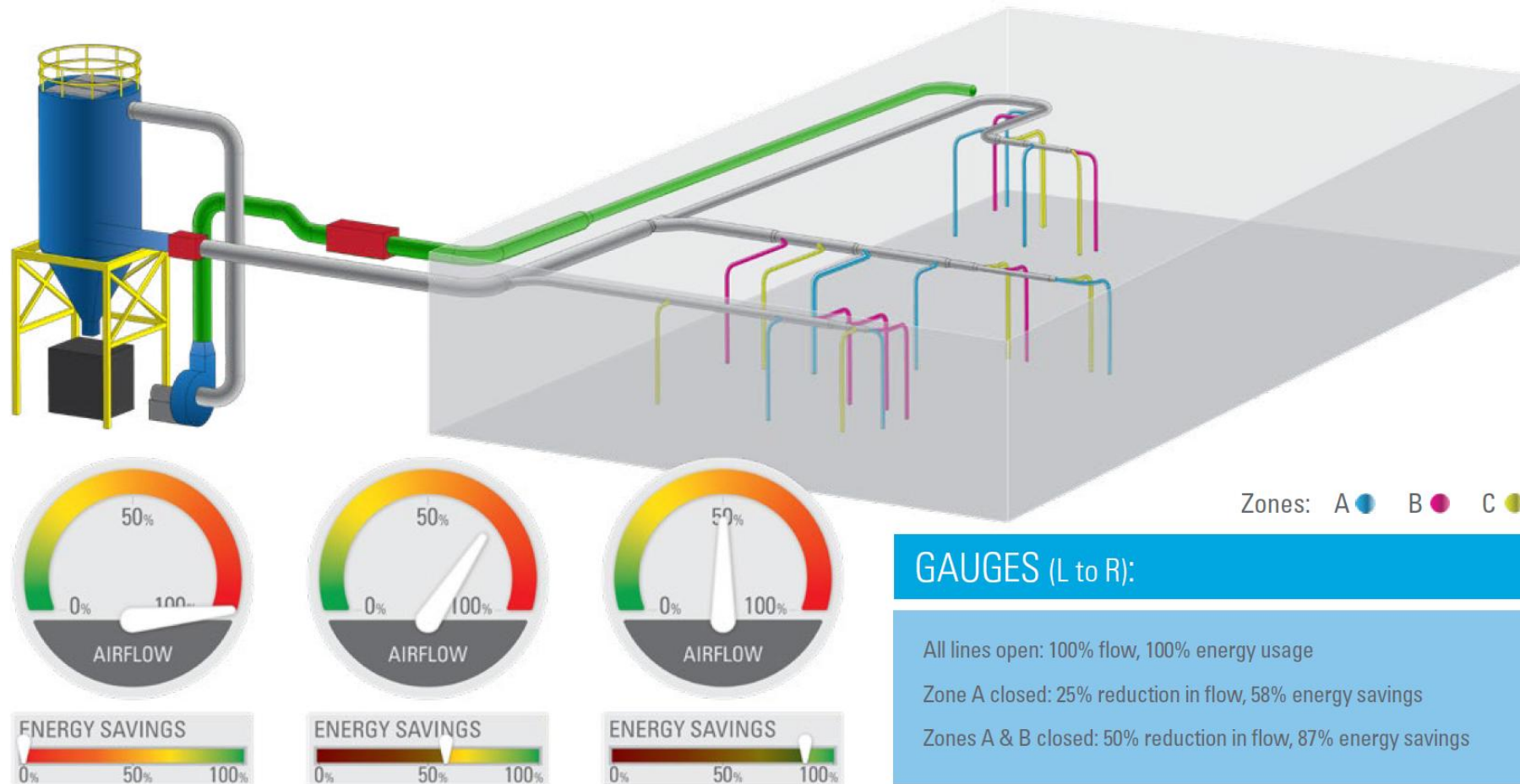
Most systems on the market and in the field are static systems.



STATIC SYSTEM

- Designed to operate at full power.
- Ducts are oversized to exhaust all workstations.
 - Rarely do facilities operate at over 70%.
- Filters, fans and motors are also oversized resulting in inefficiencies in the overall system.
- Exhaust dampers are used to modulate the speed and maintain the “desired” velocity.

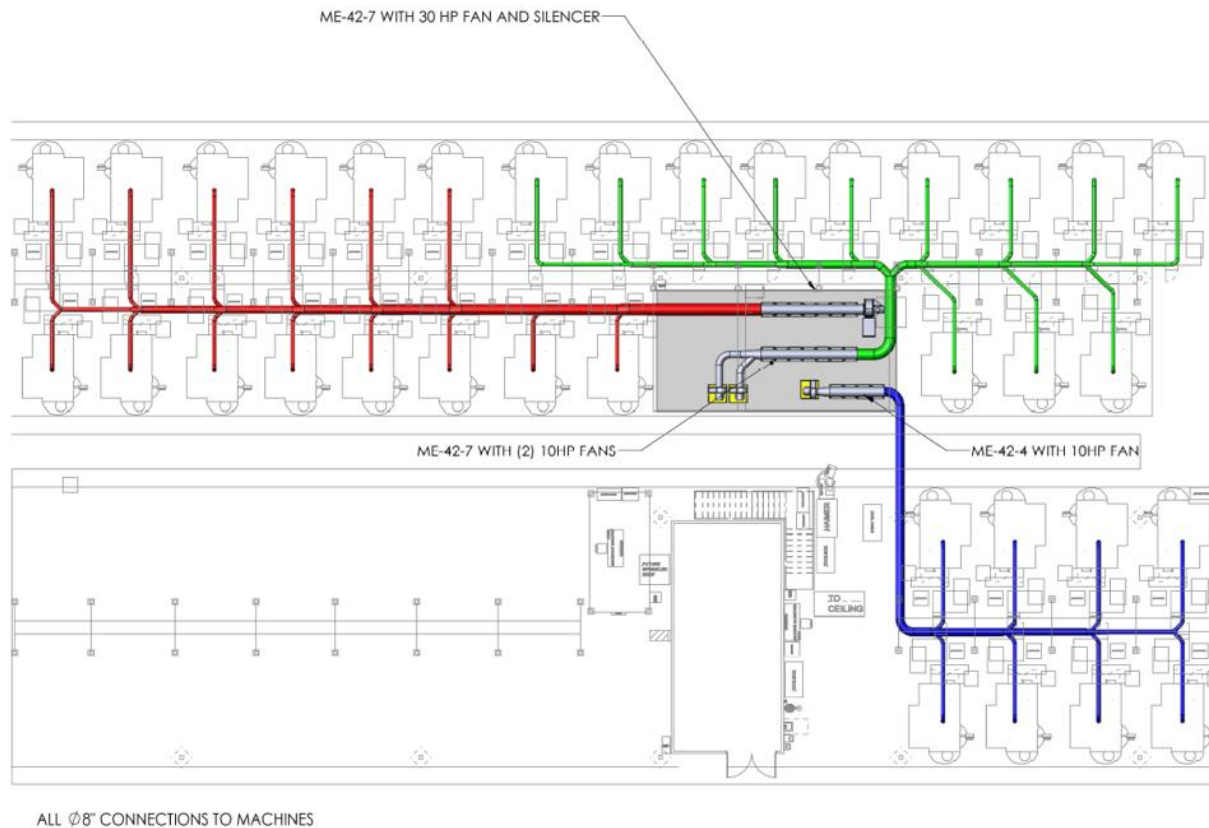
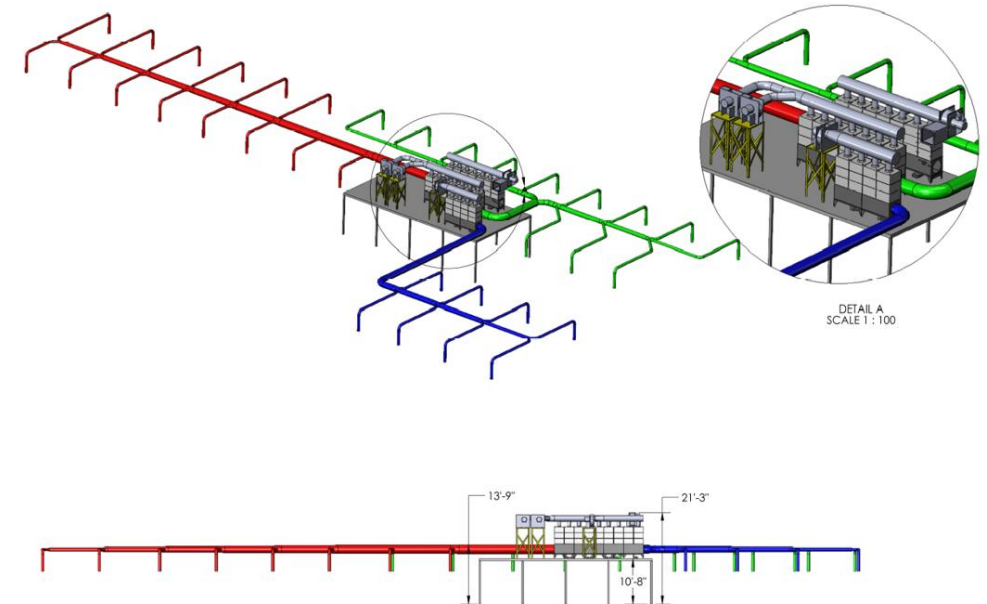
Difference Between a Static System and an Intelligent System



Intelligent System

Example of an Intelligent Control System

An intelligent system can be integrated into single or multiple large central systems or into multiple ambient systems.



Intelligent Control Systems



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- Provide energy savings
- Improve filter life
- Increase filtration capacity
- Reduce carbon emissions
- Reduce fan noise
- Provide single point monitoring of the system
- Log data
- Eligible for energy efficiency incentives



More Than a Basic Control and a VFD



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Data Captured on an Intelligent Control System include:

- Fan speed
- Duct velocity
- Duct pressure
- Filter pressure
- Broken bag warning/fault
- Energy saved
- Compressed air usage
- Dollars saved
- Open gates
- Sweep function
- System up time
- Bin full warning
- Explosion vent fault
- Spark detection warning
- And much more

Alerts on an Intelligent Control System

- Filter pressure remaining high time to change filters
- Error code if gates don't open
- Error code if duct velocity is not maintained
- Error code if segments go offline
- Filter full
- Low pressure

**Data is recorded in real time and can be view on a computer or smart device.
It can also provide historical data and reports.
It can interface with a company's BAS system.**

Example of an Intelligent Control System



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An automated collector with smart controls can optimize an existing air filtration system. This approach leverages intelligent motor control panels, motion sensors and system interlocks to dynamically adjust airflow based on demand, significantly reducing energy consumption while maintaining high air quality standards.

A smart control is made up of:

- Central command box
- VFD (Variable Frequency Drive) to manage the fan*
- Velocity sensors and drives
- Over Pressure kits to monitor duct pressure
- Pressure sensors and drives
- Optional control panels**
- Cleaning controls – sweep function
- Remote control panel
- Servo-driven gates with control panel
- Desktop dashboard with reporting and alert functions



* Not all VFDs are capable of smart controls.

** Manages additional accessories – ie. sensors, air locks, augers, etc.

Intelligent Control Systems Save Money



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- Reduces energy consumption.
- Reduces or eliminates need for make-up air.
- May qualify for rebates, incentives from local energy company or federal DOE/ITAC grants, building-related tax incentives (deductions and credits).
- Increases the life of filter media.
- Increases capacity of current equipment by up to 50%, reducing the need and cost for additional equipment.
- Improves maintenance efficiency.



Intelligent Dust Collection Management

What makes dust collection *intelligent*?

1. It knows when the dust needs to be collected.
2. It knows where dust needs to be collected.
3. It knows how fast the dust needs to be collected.
4. It can adjust fan speed dependent on demand.
5. It can monitor velocities and adjust accordingly.
6. It alerts to service needs.
7. It alerts to errors in the system.
8. It can track and report:
 - Energy usage
 - Filter pressure
 - Fan speed
 - Compressed air
 - Dollars saved



How does it know when and where to collect?

An Intelligent collector will know when a particular piece of equipment is in use and can open a servo-driven gate to allow the collector to collect at that point and ramp up the fan to meet the new demand.

This can be accomplished in a variety of ways.



Pneumatic
Flow



Mat



Motion



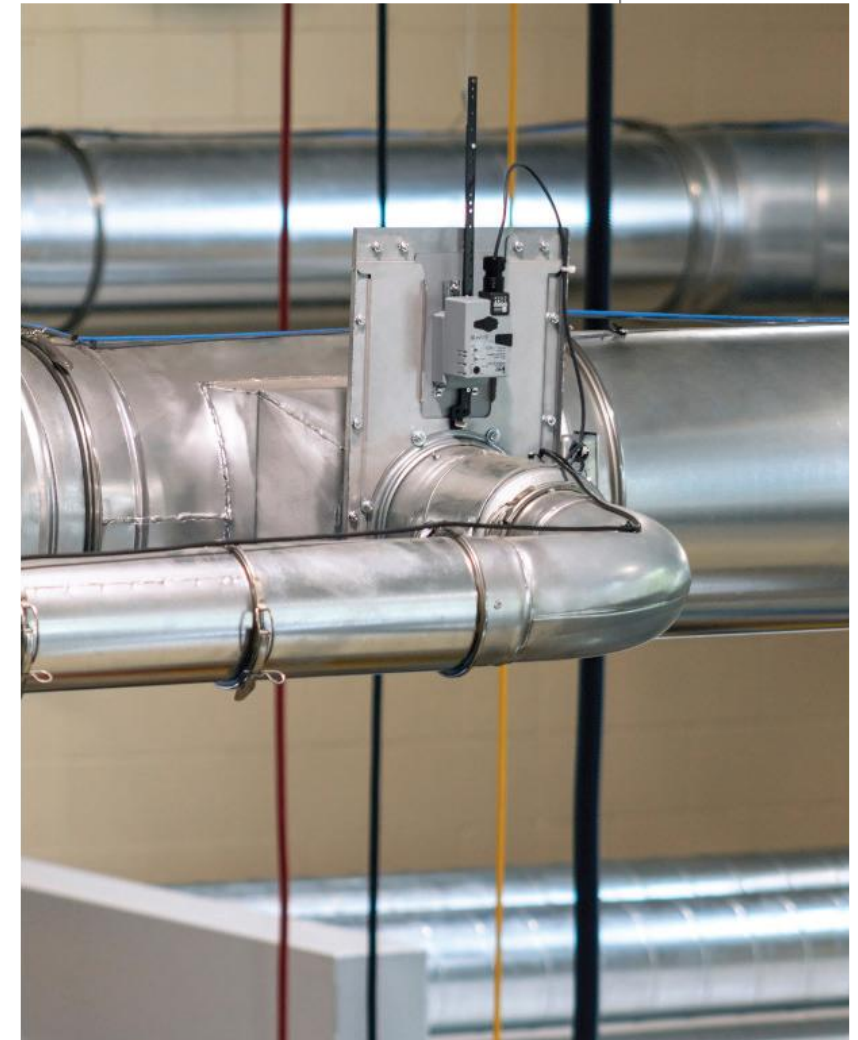
Wireless Current
Sensor



Timer



Proximity



Timers can be added to delay
the close.

Multiple Stations

Intelligent control opens gates only at active stations.



Proximity sensor

- When the sensor is activated, the gate opens and the fan speeds up to provide air to the equipment.
- When the sensor is de-activated, the gate closes and the fan slows down to save energy.



Only Where Needed



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Here is an intelligent control in action:

- Machining centers have a practical uptime of about 60%.
- The other 40% is spent on load/unload and setup.
- Depending on the time required between cycles, a gate can be kept open with a delayed timer or it can close to save energy.
- A 25% reduction in flow (3 of 12 machines offline) results in 58% energy savings.

How does it know how much dust needs to be collected or how fast?

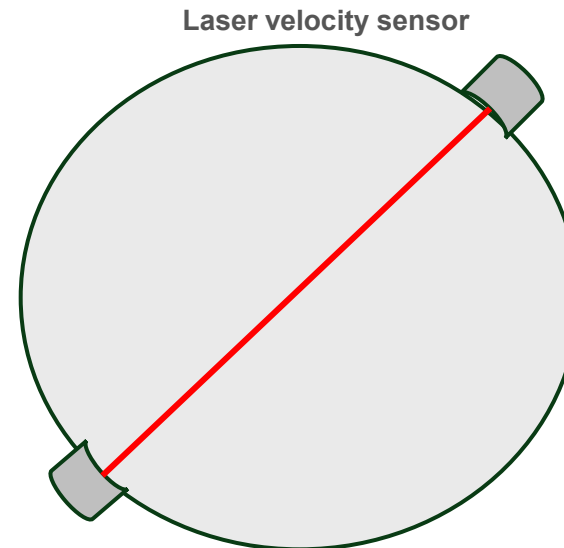
A dust or mist collector is designed around specific criteria.

- Fan
- Ductwork
- Collector
- Material to be collected

Different materials have different conveying velocities. Therefore, it is imperative that the velocity in the ducting should be monitored with a velocity sensor.

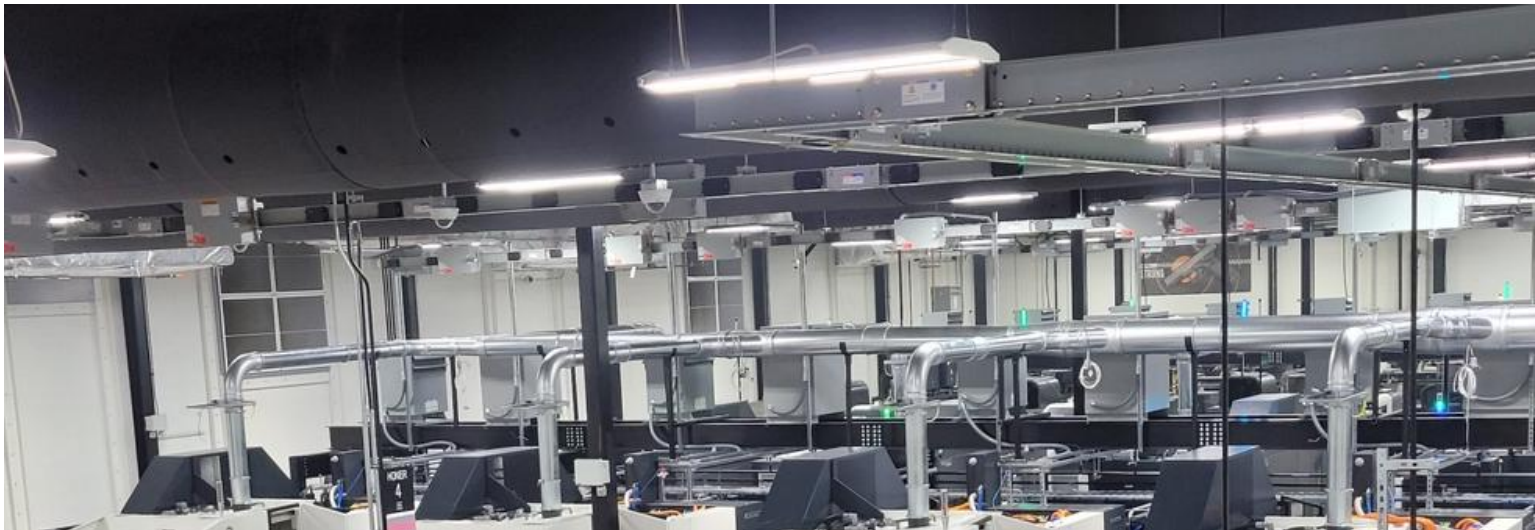
- If the speed drops below a set speed, the fan can ramp up to increase the velocity to meet the demand.
- If demand is low, the fan can be ramped down to reduce energy consumption and open assist gates to maintain velocity if necessary.

Adjustments to duct size can be made to maximize energy consumption and increase overall collector capacity, resulting in additional savings.



Ensuring Duct Velocities

Monitoring duct velocities ensures collected material (dust or coolant) does not fall out in the duct and ensures there is sufficient suction at the point it is needed.



This is critically important when dealing with explosive or flammable dust.



Incentives for Intelligent Controls



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Energy companies across the country offer incentives for adding energy-efficient equipment. These incentives range from \$0.08 - \$0.45 per kWh saved annually.

Some of these energy companies include:



Some of the incentives companies have received by installing intelligent systems:

- | | |
|---------------------|---------------|
| 1. General Dynamics | \$4.1 Million |
| 2. McNeilus Truck | \$569,000 |
| 3. Komatsu Mining | \$550,000 |
| 4. Caterpillar | \$420,000 |
| 5. Mercury Marine | \$340,000 |
| 6. Oshkosh Corp | \$200,000 |
| 7. Fender Guitar | \$161,000 |
| 8. Tyco | \$115,000 |

Save Money and Energy on Make Up Air



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Exhaust fans are widely used to simply exhaust dust, smoke and mist from facilities but are not the best option:

- Exhaust fans are not the most effective method to deal with airborne contaminants.
- Exhaust fans are not energy-efficient.

Recirculating filtered air is significantly more efficient and cost-effective.



Recirculation Energy Savings: Cooling | Heating

Exhaust CFM:	<input type="text" value="150000"/>
Hours of Operation per Week:	<input type="text" value="80"/>
Degree Days:	<input type="text" value="Ohio, Cleveland"/>
Fuel:	Electric (Cost per KWH) ☐ <input type="text" value=""/> Dollars
	Gas (Cost per Mcf) ☒ <input type="text" value="6.00"/> Dollars
	Oil (Cost per Gallon) ☐ <input type="text" value=""/> Dollars
<input type="button" value="Calculate"/>	
Savings per Year: \$88188.	
<input type="button" value="Close Window"/>	

The ICAN Recirculation Energy Savings Calculators provide approximations of the cost of replacing tempered air, based on major factors including recorded geographical temperature patterns and customary energy efficiency standards. © 2003 ICAN

<https://www.dustspot.com/files/heating.htm>

Energy Saved – Reduce CO₂ Emissions



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Every 100,000 kWh saved is the equivalent of:

- 67 metric tons of CO₂ or burning 74,630 pounds of coal.
- It would require one year of over 67 acres of forest to offset it.



<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Case Study – Musical Instrument Manufacturer



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Situation:

- Company had 4 dust collectors totaling 700 hp.
- Dust being collected is wood dust.
- Dust was escaping their current collector at the dust source.
- People were being employed just to sweep the floors.
- Explosive dust was settling on top of ducts and settling inside of the ducts.
- In excess of 270 workstations with only 180 operational at the same time on average with a max of 230.



Objective:

- Eliminate explosive dust from settling
- Improve performance of dust collection
- Not add additional collectors
- Reduce energy costs
- Reduce carbon emissions
- Perform engineering study
- Projected annual energy savings of 1,075,000 kWh
- Secure energy grant of \$133,000



Result:

- Installed intelligent controls
- Installed Servo-driven gates
- Added workstation sensors
- Added velocity sensors in main duct
- Implemented a sweep function to overcome any intermittent fallout
- Improved performance at source
- Eliminated need for regular floor sweeping
- Significantly reduced collector noise
- Energy savings in excess of 1,400,000 kWh – 40% higher than forecasted
- Grant increased to \$161,000
- Annual energy usage decreased by \$235,200
- Increased capacity of existing collectors
- Improved work environment
- Eliminated approximately 1,750 tons of CO₂
- ROI: 15 months



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QUESTIONS? THANK YOU

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