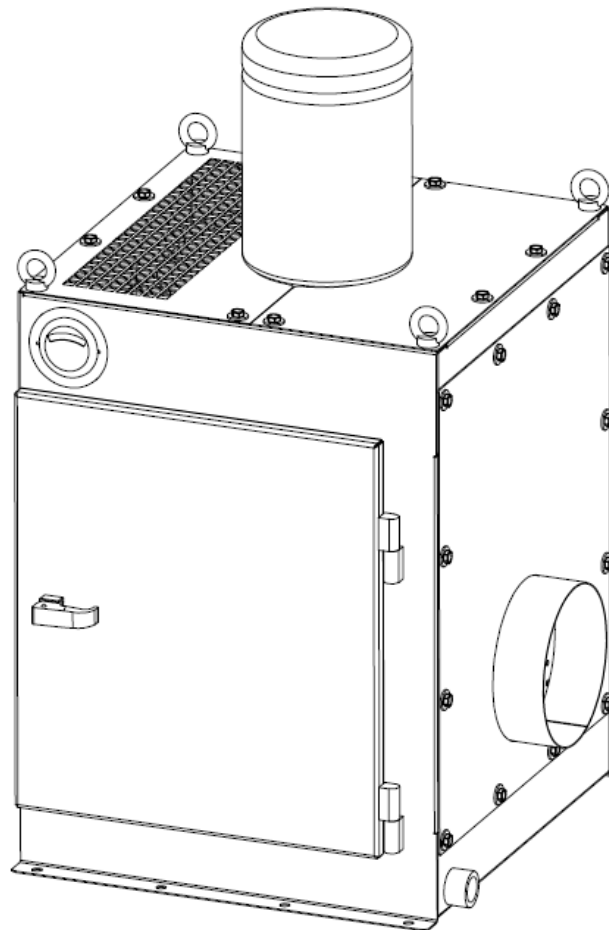




## WSO MV Mist Collector Machine Mountable

### Installation and Operation Manual

Installation, Operation, and Service Information



This manual is property of the owner. Leave with the unit when set-up and start-up are complete. Donaldson Company reserves the right to change design and specifications without prior notice.

Illustrations are for reference only as actual product may vary.



**This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.**

**WARNING**

Process owners/operators have important responsibilities relating to combustible hazards. Process owners/operators must determine whether their process creates combustible dust, fume, or mist. If combustible dust, fume, or mist is generated, process owners/operators should at a minimum:

- Comply with all applicable codes and standards. Among other considerations, current NFPA standards require owners/operators whose processes involve potentially combustible materials to have a current Hazard Analysis, which can serve as the foundation for their process hazard mitigation strategies.
- Prevent all ignition sources from entering any dust collection equipment.
- Design, select, and implement fire and explosion mitigation, suppression, and isolation strategies that are appropriate for the risks associated with their application.
- Develop and implement maintenance work practices to maintain a safe operating environment, ensuring that combustible dust, fume, or mist does not accumulate within the plant.

Donaldson recommends process owners/operators consult with experts to insure each of these responsibilities are met.

As a manufacturer and supplier of Industrial Filtration Products, Donaldson can assist process owners/operators in the selection of filtration technologies. However, process owners/operators retain all responsibility for the suitability of fire and explosion hazard mitigation, suppression, and isolation strategies. Donaldson assumes no responsibility or liability for the suitability of any fire and/or explosion mitigation strategy, or any items incorporated into a collector as part of an owner/operators hazard mitigation strategy.

Improper operation of a dust control system may contribute to conditions in the work area or facility that could result in severe personal injury and product or property damage. Check that all collection equipment is properly selected and sized for the intended use.

DO NOT operate this equipment until you have read and understand the instruction warnings in the Installation and Operations Manual. For a replacement manual, contact Donaldson Torit.

This manual contains specific precautionary statements relative to worker safety. Read thoroughly and comply as directed. Discuss the use and application of this equipment with a Donaldson Torit representative. Instruct all personnel on safe use and maintenance procedures.

**Data Sheet**

Model Number _____	Serial Number _____
Ship Date _____	Installation Date _____
Customer Name _____	
Address _____ _____	
Filter Type _____	
Accessories _____	
Other _____	

**Contents**

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**DANGER** indicates a hazardous situation which, if not avoided, will result in death or serious injury.



**WARNING** indicates a hazardous situation which, if not avoided, could result in death or serious injury.



**CAUTION**, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



**NOTICE** is used to address practices not related to personal injury that may result in damage to equipment.

## Description

Designed for versatility, the **WSO MV** (Water, Smoke, and Oil) mist collector is specifically engineered for water-soluble, smoke, and oil-based mist applications. **WSO MV** mist collector, Machine-Mountable Model collects airborne mist such as oil, water-soluble, semi-synthetic and synthetic coolant from machining operations. prefilter and primary filter, plus an optional HEPA or 95% DOP filter, provide a cleaner, healthier work environment as well as a more cost effective means of mist collection. With clean filter airflow capacities of 520 cmh (306 cfm) @ 50 Hz and 660 cmh (388 cfm) @ 60 Hz, the **WSO MV** is a strategic component to meeting industrial and government air-quality standards. The high efficiency filter cartridges allow air and coolants to be recycled.

Designed to increase the versatility of the unit, a variety of filter media specifically designed for mist collection is a standard offering on the product line. The primary filter is designed for either water-based coolants, straight oils, or thermally-generated smoky applications. Standard options include drain collection containers, adjustable floor mounting stands, and afterfilters.

The **WSO MV** machine-mountable unit is powered by a blower and motor mounted in the filter cabinet.

## Purpose and Intended Use



### WARNING

Misuse or modification of this equipment may result in personal injury.

Do not misuse or modify.

Airborne mist is small droplets of metalworking fluids suspended in the air. Metalworking fluids include straight oils, water-soluble coolants, semi-synthetic synthetic coolants. These fluids perform a variety of functions such as lubricating or cooling the part or the tool, flushing chips away from the part, and suppressing dust and smoke.

Mist is created in two ways: mechanical action or thermal effects. Mechanical action involves coolant used for light lubrication and generally creates mist greater than one micron in size. Thermal effects occur when heat vaporizes the coolant, the vapor cools and recondenses into a mist. Thermal effects create mist from 0.01 to 1 micron in size. Other contaminants, such as dust from the part or the tool or smoke from the vaporization of the oil or coolant are also generated when using metalworking fluids.

The **WSO MV** mist collector is not designed to handle water mist alone. There should be some type of oil content to allow coalescing since water vapor will simply pass through the filters. The extremes of very heavy oil and light, thin oil should be avoided. Very heavy oil, similar to tar consistency, will not drain while very light, thin oil, similar to paint thinner consistency, may evaporate.



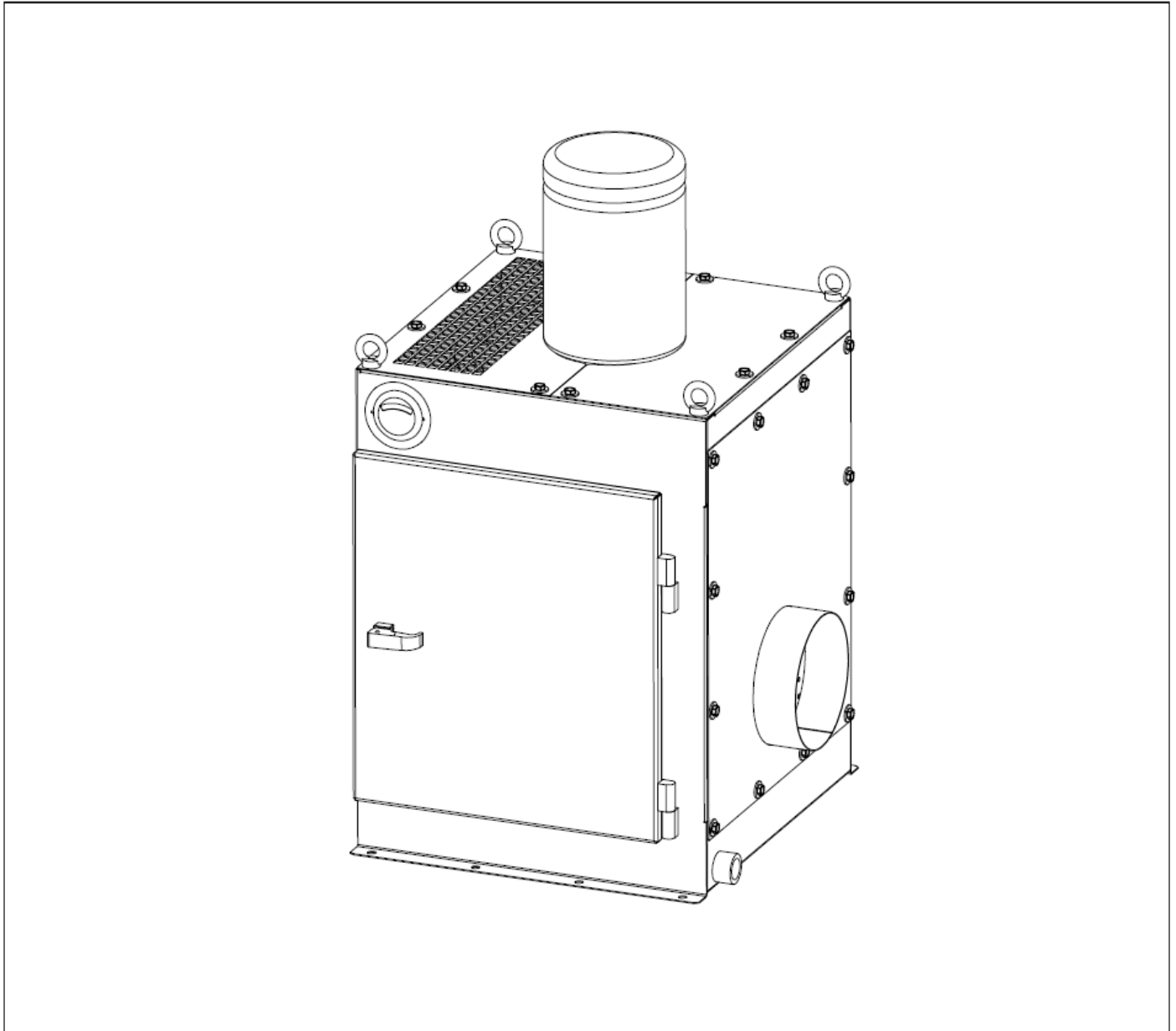
### WARNING

Combustible materials such as buffing lint, paper, wood, metal dusts, weld fume, or flammable coolants or solvents represent potential fire and/or explosion hazards. Use special care when selecting, installing, and operating all dust, fume, or mist collection equipment when such combustible materials may be present in order to protect workers and property from serious injury or damage due to a fire and/or explosion.

Consult and comply with all National and Local Codes related to fire and/or explosion properties of combustible materials when determining the location and operation of all dust, fume, or mist collection equipment.

Standard Donaldson Torit equipment is not equipped with fire extinguishing or explosion protection systems.

## Rating and Specification Information



All Units (as per IBC 2009 Specifications):

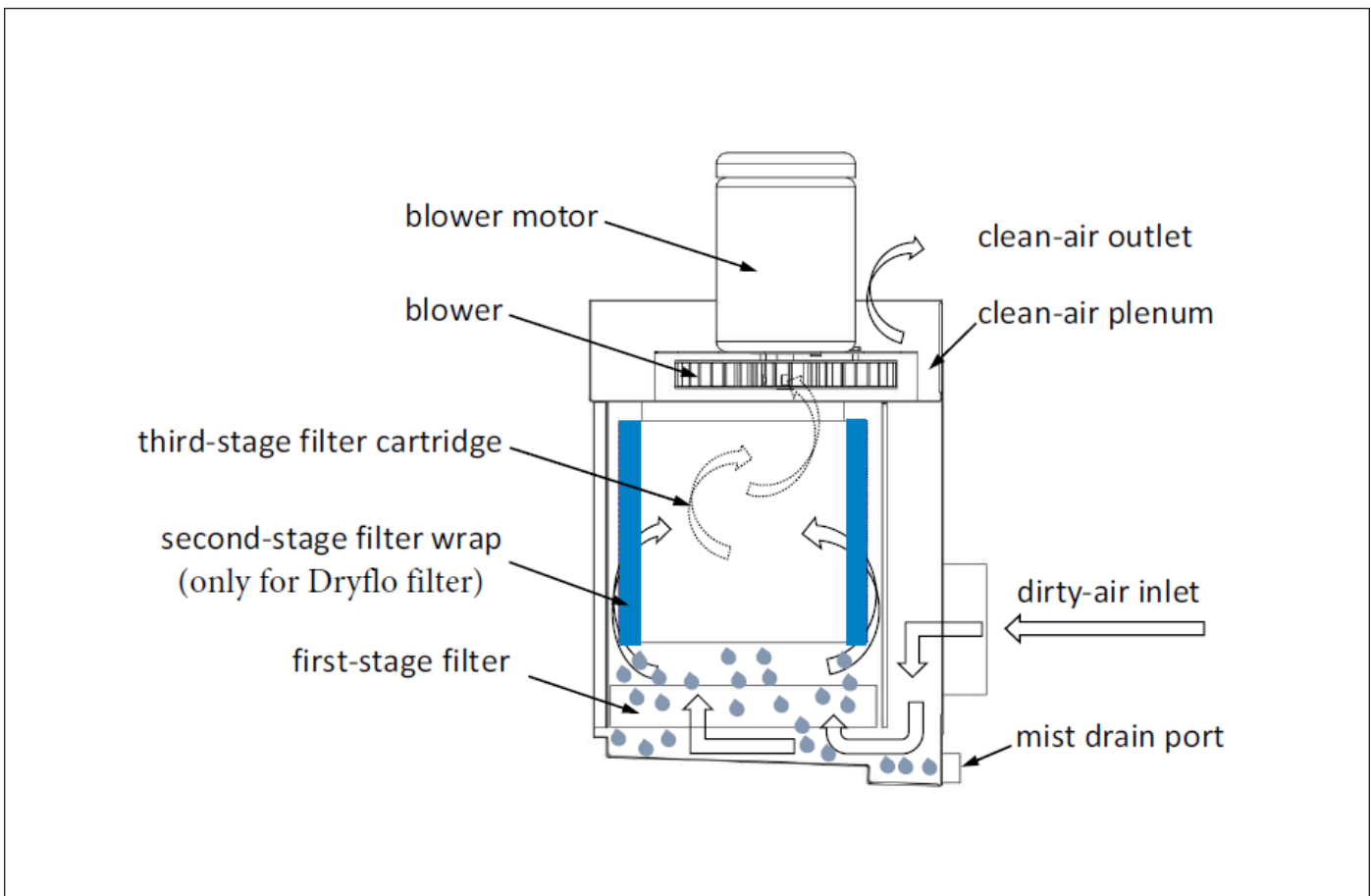
Housing rating, inches water gauge .....	- 10
Control power .....	200-Volt, 50/60 Hz
	220-Volt, 50/60 Hz
	380-Volt, 50/60 Hz

\*If unit was supplied with a Record Drawing, the specifications on the drawing will supersede the standard specifications above.

## Operation

During normal operation, contaminated air enters the unit through the dirty-air inlet on the bottom of the unit. The incoming air slows, causing large mist droplets and particles to fall out of the air stream. The air passes through a reusable first-stage filter designed to collect and coalesce large droplets and particles.

The primary stage of filtration is the pleated filter cartridge specifically designed to collect, coalesce, and drain fine mist. As the mist coalesces, the droplets are big enough to run down the cartridge and drain back into the collector. The droplets will drain on both the inside and outside of the cartridge. Liquid that collects on the inside of the cartridge drains through the bottom portion of the porous media and into the hopper. Clean, mist-free air exits the cartridge and discharges through the top of the collector.



Unit Operation

## Inspection on Arrival

1. Inspect unit on delivery.
2. Report any damage to the delivery carrier.
3. Request a written inspection report from the Claims Inspector to substantiate any damage claim.
4. File claims with the delivery carrier.
5. Compare unit received with description of product ordered.
6. Report incomplete shipments to the delivery carrier and your Donaldson Torit representative.
7. Remove crates and shipping straps. Remove loose components and accessory packages before lifting unit from truck.
8. Check for hardware that may have loosened during shipping.
9. Use caution removing temporary covers.

## Installation Codes and Procedures



Codes may regulate recirculating filtered air in your facility.

Consult with the appropriate authorities having jurisdiction to ensure compliance with all national and local codes regarding recirculating filtered air.

Safe and efficient operation of the unit depends on proper installation.

Authorities with jurisdiction should be consulted before installing to verify local codes and installation procedures. In the absence of such codes, install unit according to the National Electric Code, NFPA No. 70-latest edition and NFPA 91 (NFPA 654 if combustible dust is present).

A qualified installation and service agent must complete installation and service of this equipment.

All shipping materials, including shipping covers, must be removed from the unit prior to, or during unit installation.

### NOTICE

Failure to remove shipping materials from the unit will compromise unit performance.

Inspect unit to ensure all hardware is properly installed and tight prior to operating collector.

## Installation



Use proper equipment and adopt all safety precautions needed for servicing equipment.

Electrical service or maintenance work must be performed by a qualified electrician and comply with all applicable national and local codes.

Turn power off and lock out electrical power sources before performing service or maintenance work.

Do not install in classified hazardous atmospheres without an enclosure rated for the application.



Site selection must account for wind, seismic zone, and other load conditions when selecting the location for all units.

Codes may regulate acceptable locations for installing dust collectors. Consult with the appropriate authorities having jurisdiction to ensure compliance with all national and local codes regarding dust collector installation.

Collectors must be anchored in a manner consistent with local code requirements and anchors must be sufficient to support dead, live, seismic, and other anticipated loads. Consult a qualified engineer for final selection of anchorage.

## Unit Location

### **WARNING**

Donaldson Torit equipment is not designed to support site installed ducts, interconnecting piping, or electrical services. All ducts, piping, or electrical services supplied by others must be adequately supported to prevent severe personal injury and/or property damage.

When hazardous conditions or materials are present, consult with local authorities for the proper location of the collector.

### **CAUTION**

If combustible materials will be processed through this collector, local codes may require the collector be located either outside or adjacent to an exterior wall to accommodate devices related to a fire or explosion mitigation strategy. Consult local codes prior to installation.

## Site Selection

This unit can be located on a foundation or structural framing.

Provide clearance from heat sources and avoid any interference with utilities when selecting the location.

## Foundations or Support Framing

Prepare the foundation or support framing in the selected location. Foundation or support framing must comply with local code requirements and may require engineering.

Foundation and support framing must be capable of supporting dead, live, wind, seismic and other applicable loads. Consult a qualified engineer for final selection of foundation or support framing.

## Rigging Instructions

### Suggested Tools & Equipment

Clevis Pins and Clamps	Lifting Slings
Crane or Forklift	Pipe Sealant
Drift Pins	Pipe Wrenches
Drill and Drill Bits	Screwdrivers
End Wrenches	Socket Wrenches
Adjustable Wrench	Spreader Bar

## Hoisting Information

### **WARNING**

Failure to lift the collector correctly can result in severe personal injury or property damage.

Use appropriate lifting equipment and adopt all safety precautions needed for moving and handling the equipment.

A crane or forklift is recommended for unloading, assembly, and installation of the collector.

Location must be clear of all obstructions, such as utility lines or roof overhang.

Use all lifting points provided.

Use clevis connectors, not hooks, on lifting slings.

Check the Specification Control drawing for weight and dimensions of the unit and components to ensure adequate crane capacity.

Allow only qualified crane operators to lift the equipment.

Refer to local codes when using cranes, forklifts, and other lifting equipment.

Lift unit and accessories separately and assemble after unit is in place.

Use drift pins to align holes in section flanges during assembly.



## Electrical Wiring

### **WARNING**

Electrical installation, service, or maintenance work must

be performed by a qualified electrician and comply with all applicable national and local codes.

Turn power off and lock out electrical power sources before performing service or maintenance work.

Do not install in classified hazardous atmospheres without an enclosure rated for the application.

All electrical wiring and connections, including electrical grounding, should be made in accordance with the local codes.

Check local ordinances for additional requirements that apply.

The appropriate wiring schematic and electrical rating must be used. See unit's rating plate for required voltage.

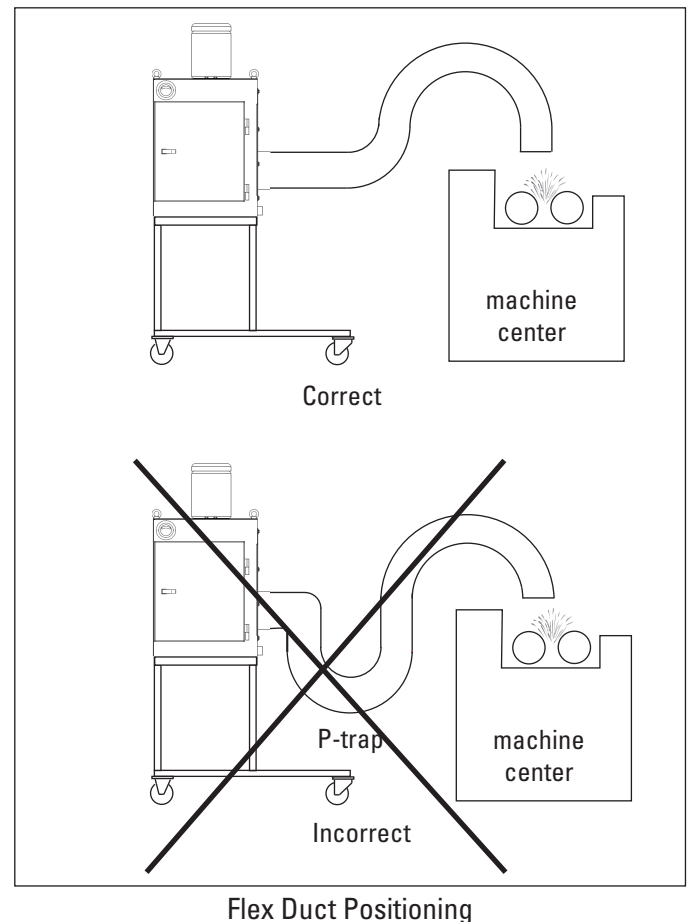
An electric disconnect switch having adequate amp capacity shall be installed in accordance with local codes. Check unit's rating plate for voltage and amperage ratings.

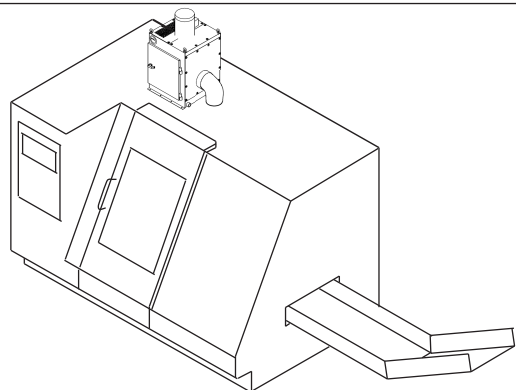
Refer to the wiring diagram for the number of wires required for main power wiring and remote wiring.

The only component requiring electrical power is the blower motor.

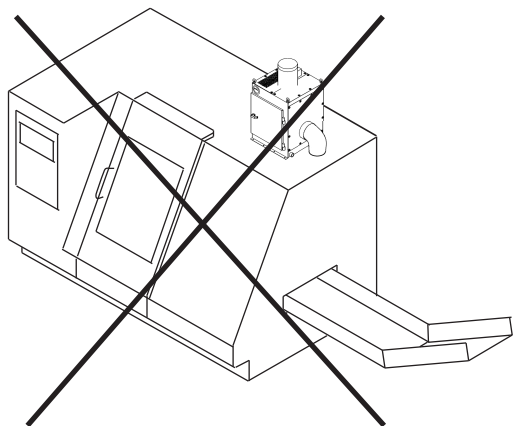
## General Installation

1. Apply a generous amount of sealant when installing attachments.
2. Do not allow a P-Trap to form when using flexible duct. See Flex-Duct Positioning.
3. On enclosed-machine installations, mount the unit as far from the chip conveyor opening as possible. Installing too close allows the negative pressure created by the unit to draw clean shop air, not mist, into the collector. See Enclosed-Machine Installation.
4. On open-machine installations, position the unit's pick-up hood a minimum of 305 mm (12-inches) from the mist source. Avoid mounting the pick-up hood too close to the mist source of an open machine such as a wet surface grinder. Installing too close can shorten filter life as the unit will collect large droplets and particulate instead of mist. See Open Machine Installation.



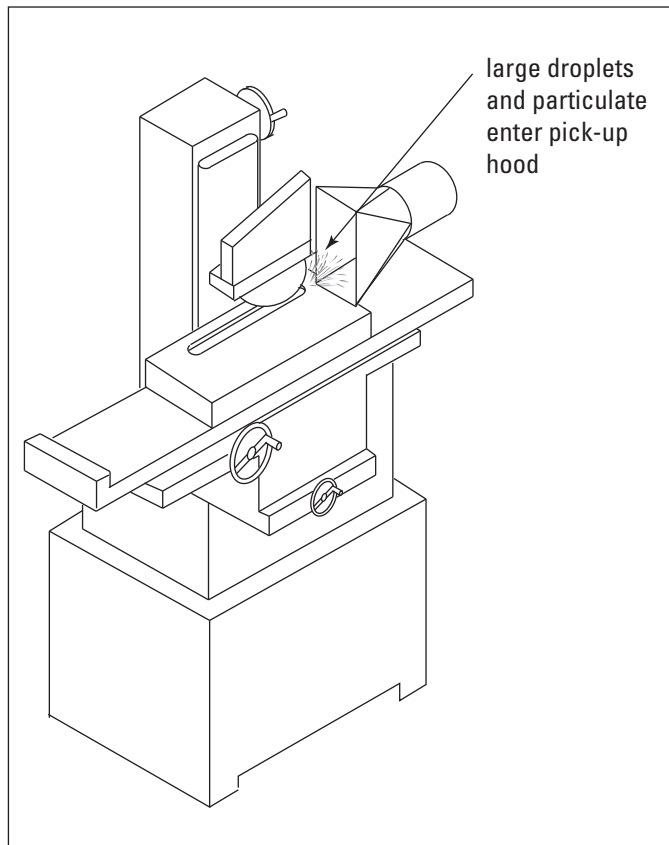


Correct Location



Incorrect Location

Enclosed Machine Installation



large droplets  
and particulate  
enter pick-up  
hood

Open Machine Installation

## Standard Equipment Installation

The WSO MV can be mounted directly on the roof of a machining center.

1. Open the unit's access door and remove the primary and first stage filters.
2. Remove the filter retention system.
3. Carefully lift unit into position over the machine center and lower into position.
4. Trace bolt pattern onto the machine center or match drill pattern.
5. Cut opening into machine center and drill mounting holes.
6. Move the unit aside and apply generous amounts of sealant to the outside perimeter of the bolt pattern on the machine center.
7. Carefully position unit over the bolt pattern and lower into position.
8. Install and tighten fasteners into every hole.
9. Install filter retention system and filters.

## Factory-Installed HEPA or 95% DOP Final Filter

HEPA filters provide 99.97% efficiency on 0.3 micron particles. 95% DOP filters are less efficient than HEPA's but generally provide longer final filter life.

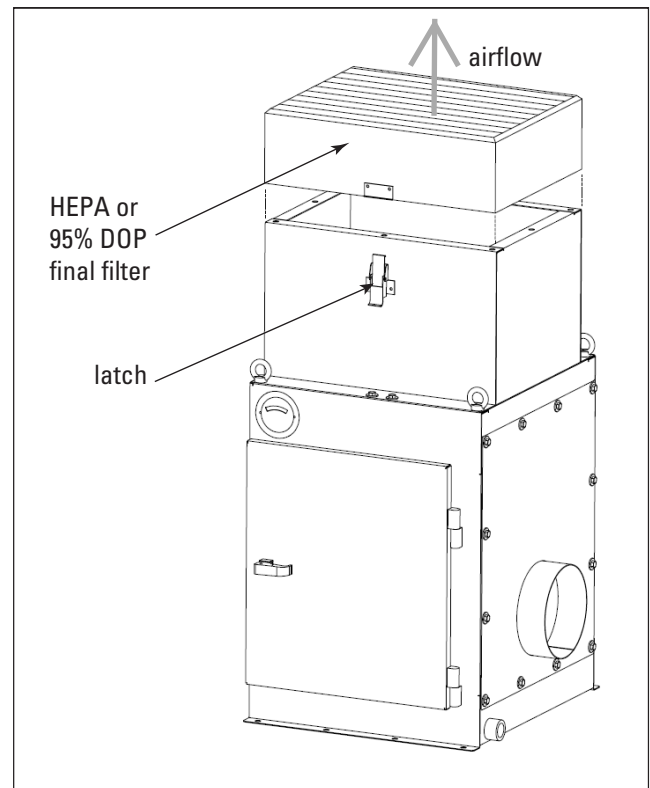
The HEPA or 95% DOP final filter is attached to the side of the WSO MV unit using side-mounted latches.

## Final Filter Removal and Installation

1. Release the latches on both sides of the HEPA/95% DOP filter frame. Dispose of used filter properly. Do not wash.
2. Install new HEPA/95% DOP filter with the gasket facing the frame and the airflow arrow pointing away from the unit.

## Retrofit Kit Field Installation

An afterfilter installation retrofit kit is available for customers who decide to add a HEPA or 95% DOP filter to an existing field-operating WSO MV machine-mountable unit originally configured with a standard exhaust. The field kit includes: afterfilter, adaptor with latches and hardware.



HEPA or 95% DOP Final Filter Replacement

## Electrical Connection

### **⚠ WARNING**

Electrical installation, service, or maintenance work must be performed by a qualified electrician and comply with all applicable national and local codes.

Turn power off and lock out electrical power sources before performing service or maintenance work.

Do not install in classified hazardous atmospheres without an enclosure rated for the application.

WSO MV mist collectors must be equipped with a customer-supplied safety disconnect with short circuit protection, contactors, and overload protection. Complete the wiring as shown in 3 Phase Motor Starter Wiring.

### Unwired Units

1. Remove the exhaust pack. Remove all bolts and lift starting at one corner.

### **NOTICE**

The gasket material is fragile and must be handled with care. If the gasket is disrupted, reposition evenly around the inner and outer flanges when replacing the exhaust panel.

2. Make the wiring connections to the fan motor according to the wiring diagram located inside the control box and the instructions on the motor decal.

### **NOTICE**

All electrical components must be sized for the supply voltage and motor horsepower. See Motor Starter Wiring.

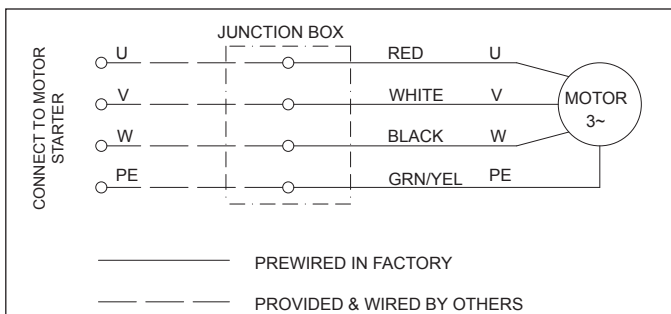
3. Turn the fan-motor ON then OFF and check for proper rotation by removing the inspection cover on the top of the WSO MV and viewing the wheel rotation.

To reverse rotation, single-phase power supply: Follow manufacturer's instructions on the motor's nameplate.

To reverse rotation, three-phase power supply: Turn electrical power OFF at source and switch any two leads on the motor junction box.

### **⚠ WARNING**

Do not interchange a power lead with the ground wire. Severe damage or personal injury may result.



3 Phase Motor Starter Wiring

## Preliminary Start-Up Check

Instruct all personnel on safe use and maintenance procedures.

### **WARNING**

Electrical work during installation, service or maintenance must be performed by a qualified electrician and comply with all applicable national and local codes.

Turn power off and lock out electrical power sources before performing service or maintenance work.

Check that the collector is clear and free of all debris before starting.

Do not install in classified hazardous atmospheres without an enclosure rated for the application.

1. Check all electrical connections for tightness and contact.
2. Check for proper rotation as noted on the fan housing.

To reverse rotation, single-phase power supply:  
Follow manufacturer's instructions on the motor's nameplate.

To reverse rotation, three-phase power supply:  
Switch any two leads on the motor junction box.

### **WARNING**

Do not interchange a power lead with the ground wire. Severe damage or personal injury may result.

3. All access panels should be sealed and secure.
4. Check that the door is properly sealed and clamped.

5. Check and remove all loose items in or near the inlet and outlet of the unit.
6. Check that all remote controls are properly wired and all service switches are in the OFF position.
7. Check that all optional accessories are installed properly and secured.
8. Check that hopper discharge is open
9. Close faucet valve on drain collection container if used.
10. Turn power ON at source.
11. Turn blower fan motor ON.

### **WARNING**

Stand clear of exhaust to avoid personal injury.

## Maintenance Information

Instruct all personnel on safe use and maintenance procedures.

### **WARNING**

Use proper equipment and adopt all safety precautions needed for servicing equipment.

Electrical service or maintenance work must be performed by a qualified electrician and comply with all applicable national and local codes.

Turn power off and lock out electrical power sources before performing service or maintenance work.

Do not install in classified hazardous atmospheres without an enclosure rated for the application.

## Operational Checklist

1. Monitor the physical condition of the collector and repair or replace any damaged components.

Routine inspections will minimize downtime and maintain optimum system performance. This is particularly important on continuous-duty applications.

2. Monitor pressure drop across filters using the differential pressure gauge.

Abnormal changes in pressure drop may indicate a change in operating conditions and possibly a fault to be corrected.

4. Monitor exhaust.
5. Monitor hopper drainage. If slow or has stopped, check hopper for obstructions and clean as necessary.

6. For a typical installation, Donaldson recommends filter installation when the gauge indicator needle is half way into the red zone. See First Stage Filter Cleaning and Installation.

### **CAUTION**

Do not attempt to clean or wash the primary filter. Replace only.

Do not operate the unit without the first stage or primary filter in place. Significant reduction in final filter life can result.

## Filter Removal and Installation

### **WARNING**

Use proper safety and protective equipment when removing contaminants and filters.

Dirty filters may be heavier than they appear.

Use care when removing filters to avoid personal injury.

Turn power off and lock out electrical power sources before performing service or maintenance work.

## First Stage Filter Cleaning and Installation

Remove the first stage filter through the lower access door. Clean the first-stage screen by tapping it gently over an appropriate waste container. If further cleaning is required, wash in an appropriate wash tank. To clean the first-stage filter, soak in an appropriate wash tank, rinse, dry, and re-install.

### **CAUTION**

Do not operate the WSO MV mist collector without the first-stage filter in place. Significant reduction in primary filter life can result.

High temperature, steam-cleaning methods should not be used with the polypropylene filters due to the temperature limitations.

## Primary Filter

**Note:** With the unit's airflow off, allow mist-laden, wet filter to drain into the inlet plenum for at least 15 minutes prior to removal.

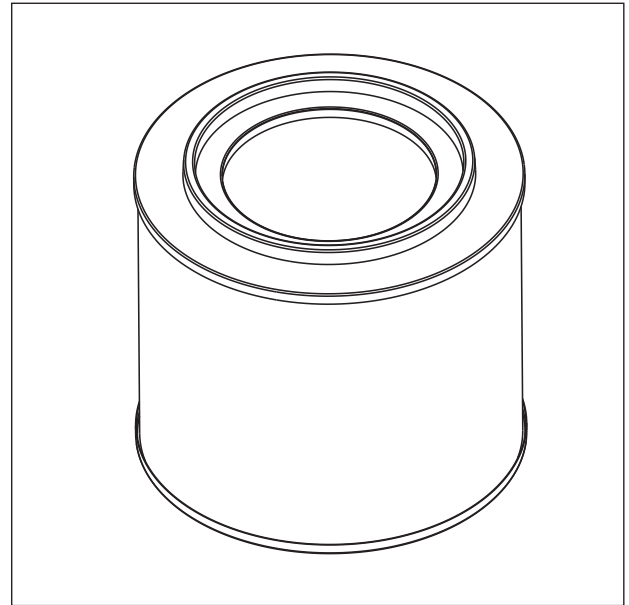
1. Remove the filter by pulling the filter retention lever down to a horizontal position. Remove filter from unit and dispose of properly for the materials collected.

**Note:** A large plastic garbage bag placed over the top of the used filter allows cleaner filter change out. The filter can be tipped forward and out of the unit while the bag is pulled up over the bottom of the cartridge.

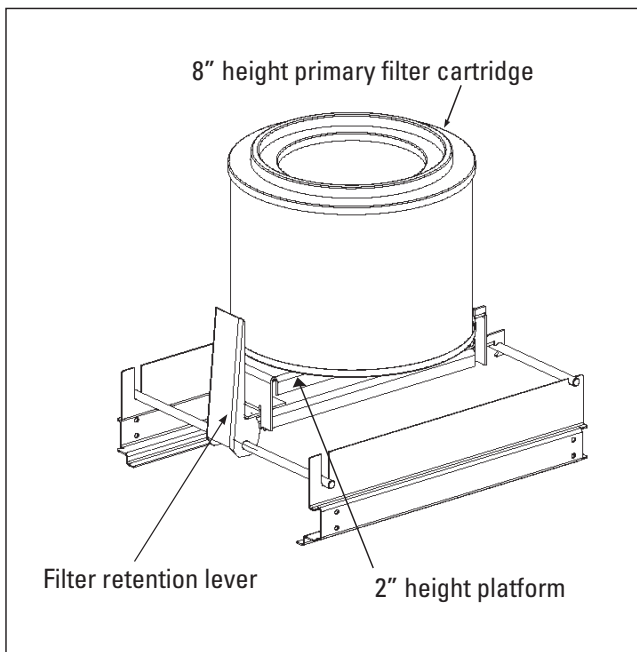
2. Place new filter on the filter retention platform, gasket side up. Slide filter back as far as it will go.

**Note:** The primary filter must be replaced. Do not wash.

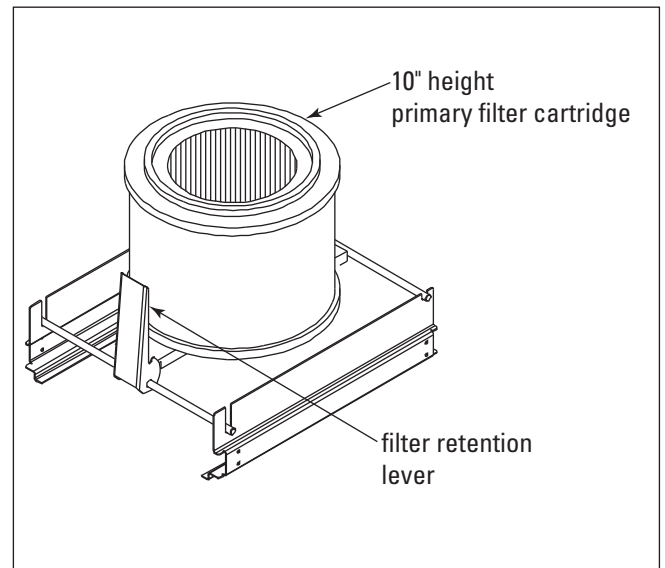
3. Lift the filter retention lever up and close access door.



Primary Filter



8" height Primary Filter Replacement



10" height Primary Filter Replacement

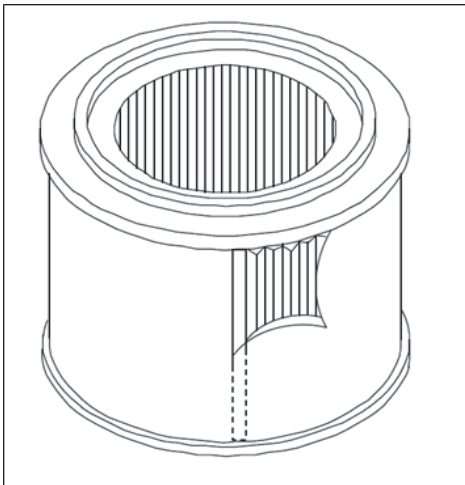
## Filter Element Wrap

Note: Only round Dryflo (8" height primary filter) comes with wrap.

- To determine if the second stage filter element wrap needs replacement, install a clean filter element wrap, restart the mist collector and check the dp value on the controller. If the gage is in the green zone, the third stage filter element will not require replacement and can continue operation with the clean filter element wrap. If the gage still reads in the red zone with the clean filter element wrap, the filter element will need to be replaced.
- For easiest maintenance, the second stage filter element wrap and third stage filter element can be changed at the same time. Access the filter element wrap through the access door. The second stage filter element wrap can now be replaced using the hook and loop seam to open the wrap.

### NOTICE

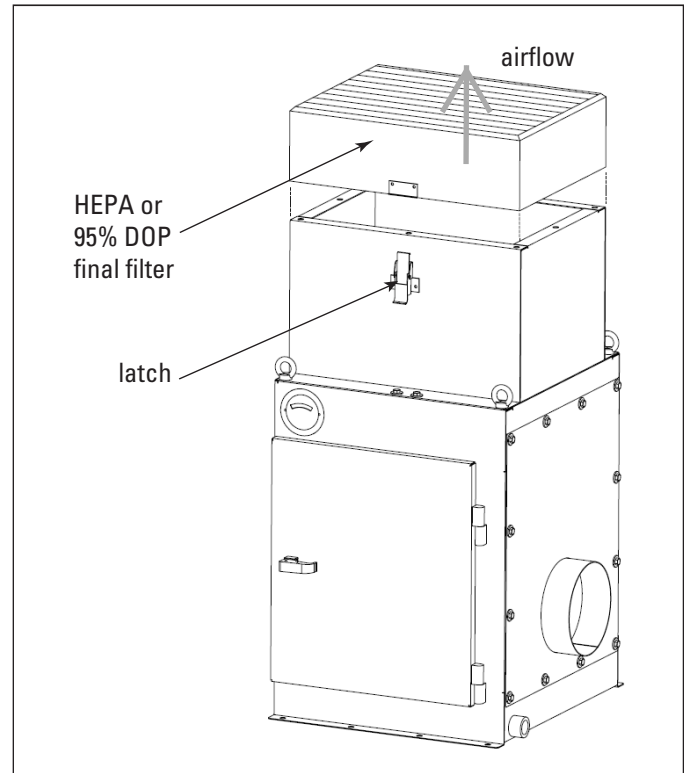
1. Do not operate the mist collector without the second stage filter element wrap installed. Significant reduction in third stage filter element life may result.
2. Wear gloves when handling filter element and filter element wrap.
3. Due to accessibility, it may sometimes be easier to replace the filter element wrap by removing the complete filter element assembly from the unit.



Dryflo (8" height primary filter)

## Final Filter

1. Release the latches on both sides of the HEPA or 95% DOP filter frame. Dispose of used filter properly.
2. Install new HEPA or 95% DOP filter with the gasket facing the frame and the airflow arrow pointing away from the unit.



Final Filter



## Troubleshooting

Problem	Probable Cause	Remedy
<b>Fan blower and motor do not start</b>	Improper motor wire size	Rewire using the correct wire gauge as specified by national and local codes.
	Not wired correctly	Check and correct motor wiring for supply voltage. See motor manufacturer's wiring diagram. Follow wiring diagram and the National Electric Code.
	Unit not wired for available voltage	Correct wiring for proper supply voltage.
	Input circuit down	Check power supply to motor circuit on all leads.
	Electrical supply circuit down	Check power supply circuit for proper voltage. Check for fuse or circuit breaker fault. Replace as necessary.
	Overload relay tripped	Reset. Check amp draw on motor leads.
	Defective overload heater or overload assembly	Replace as necessary.
<b>Fan blower and motor start, but do not stay running</b>	Incorrect motor starter heater elements installed	Check for proper heater elements and replace if necessary.
	Access doors are open or not closed tight	Close and tighten access doors.
	Electrical circuit overload	Check that the power supply circuit has sufficient power to run all equipment.
<b>Clean-air outlet discharging oil mist</b>	Filters not installed correctly	See Filter Removal and Installation.
	Filter damage, dents in the end caps, gasket damage, or holes in media	Replace filters as necessary. Use only genuine Donaldson replacement parts. See Filter Removal and Installation.
	Access cover(s) loose	Tighten access doors securely. See Filter Installation.
<b>Insufficient airflow</b>	Fan rotation backwards	Proper fan rotation is clockwise from the top of the unit. The fan can be viewed through the back of the motor. See Preliminary Start-Up Check.
	Access doors open or not closed tight	Check that all access doors are in place and secured. Check that the hopper discharge opening is sealed and that dust container is installed correctly.
	Fan exhaust area restricted	Check fan exhaust area for obstructions. Remove material or debris.
	First Stage filter plugged	Remove and clean or replace.
	Second-stage filter wrap plugged	Remove and replace. Use only genuine Donaldson replacement parts. See Second-stage filter wrap Replacement.

## Troubleshooting

Problem	Probable Cause	Remedy
<b>Insufficient airflow</b>	Primary filter needs replacement	Remove and replace. Use only genuine Donaldson replacement parts. See Primary Filter.
	Plugged HEPA or 95% DOP final filter	Remove and replace.
<b>Insufficient hopper discharge</b>	Plugged hopper screen	Remove and clean hopper screen.
<b>Liquid leaking from collector door</b>	Access door not closed tight	Check that access door is in place and secured.
	Missing gasket on access door	Install new door gasket.





## The Donaldson Torit Warranty

Donaldson does not warrant against damages due to corrosion, abrasion, normal wear and tear, product modification, or product misapplication. Donaldson also makes no warranty whatsoever as to any goods manufactured or supplied by others including electric motors, fans and control components. After Donaldson has been given adequate opportunity to remedy any defects in material or workmanship, Donaldson retains the sole option to accept return of the goods, with freight paid by the purchaser, and to refund the purchase price for the goods after confirming the goods are returned undamaged and in usable condition. Such a refund will be in the full extent of Donaldson's liability. Donaldson shall not be liable for any other costs, expenses or damages whether direct, indirect, special, incidental, consequential or otherwise. The terms of this warranty may be modified only by a special warranty document signed by a Director, General Manager or Vice President of Donaldson. Failure to use genuine Donaldson replacement parts may void this warranty. THERE EXIST NO OTHER REPRESENTATIONS, WARRANTIES OR GUARANTEES EXCEPT AS STATED IN THIS PARAGRAPH AND ALL OTHER WARRANTIES INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHETHER EXPRESS OR IMPLIED ARE HEREBY EXPRESSLY EXCLUDED AND DISCLAIMED.



**Donaldson**  
FILTRATION SOLUTIONS

### Parts and Service

For genuine Donaldson replacement filters and parts, call the Parts Express Line. For faster service, have unit's model and serial number, quantity, part number, and description available.

Donaldson Company, Inc.  
Minneapolis, MN  
donaldson.com • shop.donaldson.com

China  
Email: info.cn@donaldson.com  
Phone: +86-400-820-1038

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Donaldson Company, Inc. is the leading designer and manufacturer of dust, mist, and fume collection equipment used to control industrial-air pollutants. Our equipment is designed to help reduce occupational hazards, lengthen machine life, reduce in-plant maintenance requirements, and improve product quality.

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