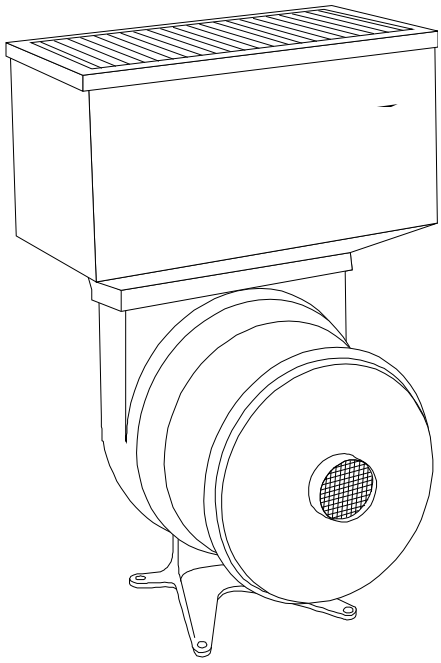
Centrifugal Mist Collectors

Product Overview



The Centrifugal Mist Collectors (Models E and EA) are compact, high efficiency, four-stage, centrifugal mist collection systems designed to collect, filter and, in most cases, reclaim liquid mists generated from machine tool or process applications. The first Centrifugal Mist Collector development began in the 1950s by the founders of Aercology while working for the Air Systems Group for General Dynamics. The original application was for lube oil reservoirs on naval submarines for control of mist generated by the gearboxes. The group continued to develop and utilize the collector to industrial applications, eventually redesigning the collector and founding Aercology in 1973.

The Centrifugal Mist Collectors are well suited to the "chip" generating markets such as screw and bar machines, CNC turning and milling machines as well as applications involving straight oil coolants. Their compact size allows for direct machine mounting integrating the collection system directly to the mist generating machine or process. They provide in-plant air pollution control by collecting water-soluble or oil mist. Additional add-on afterfilters (HEPA and carbon) provide for the removal of smokes produced by high speed machining operations as well as gas/vapors and odors from solvent-based coolants.

Operation Explanation

The E and EA series Centrifugal Mist Collectors utilize a four-stage filter system. During operation, mist laden air enters the mist collector through a flexible hose. As air passes through a first stage throw-away filter liner consisting of spun-bonded polyester media and into the second stage primary filter consisting of needled polyester media. Sub-micronic mist particles are trapped and retained until the mist droplets coalesce and grow to droplet size. The first two filter stages are housed in a unique, rapidly spinning, perforated drum with integral radial fan blades for air movement.

The droplets are then thrown free of the perforated drum to the inner wall of the Mist Collector housing by centrifugal force. High velocity air drives the liquefied oil along the housing walls and through a circumferential slot into a collection chamber where the liquid is drained from the collector. A third stage, secondary filter consisting of polyester spray bonded and needled batting catches any liquid that bypasses the circumferential slot and is drained via the secondary drain. Clean air is exhausted through the fourth stage, exhaust grill filter consisting of polyester spray bonded and needled batting. While the clean air is returned to the plant environment, the recycled oil drains from the unit for reuse or disposal.

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Additional prefilter and afterfilter stages are available. Prefilter traps, Canister or In-Cover, are used to remove chips or solid particles prior to entering the rotating drum. Impingers are used to remove heavy sprays of raw fluids that may contain solid particles. The prefilters remove solids and result in reduced filter replacement and unit maintenance. Optional HEPA filters (standard and high capacity sizes, 99.97% efficient at 0.3 micron particles) are available for smoke removal. Carbon modules are available for gas/vapor and odor removal.

Application Summary

Mist is defined as small droplets of materials that are ordinarily liquid at normal temperature and pressure and are suspended in the air. For use with a mist collector, this is further defined as metalworking fluids used in machine tool operations. Typical metalworking fluids include straight oil, oil- and water-soluble, semi-synthetic and synthetic coolants. Mist particles are created by two basic means: mechanical action and thermal effects. Mechanical action refers to the mist generated from the oil or coolant nozzle; mechanical action creates a mist typically greater than one micron in size. Thermal effects occur when localized heat vaporizes the coolant, and then the vapor cools, condensing into a mist. Thermal effects create mist from 0.01 to 1 micron in size. Other contaminants, such as dust coming off the part or the tool and smoke from the combustion of the oil or coolant, are also generated in the use of metalworking fluids in machine tool operations.

Metal working fluids are used for a number of reasons. Primarily for heat removal (cooling) and lubrication. Secondary functions of metal working fluids are corrosion protection, removal of chips and swarf, lubrication of the machine tool, and for control of rancidity. Different types of metal working fluids are selected based on the need of the customer's machining operation. See the Wet Machining application paper online at DTIC (Donaldson Torit Information Center) for more information about metal working fluids.

Mist collection is done for numerous reasons, including: visual clarity of part being machined and containment of mist/contaminants. Secondary benefits of mist collection are reduced heath effects such as sore throats, respiratory problems, and even cancer; reduced maintenance problems like slippery floors and dirty lights and walls; and increased worker productivity with a cleaner, healthier work environment.

The Centrifugal Mist Collectors (Models E and EA) are primarily designed to control liquid mists generated in machining operations or other process applications. In many cases collectors are applied to turning, screw, bar machines or general machining applications where water soluble or oil based coolants are used. They are also used to collect mist in spraying and automatic cleaning systems. Consult Applications Engineering for design guidance on steam or high temperature applications. They have been applied extensively in the process markets as well as on large, lube oil reservoirs for large turbine, power generation, desalination and process systems for control of vent oil mist and smoke from lube sumps. A variety of custom inlet and outlet fittings are available for these specialized markets.

In a typical application, the Centrifugal Mist Collector is mounted directly on the machine requiring collection. If a suitable mounting surface is not available or machine mounting is not desired, optional floor mounted pedestal stands (6' 6" high is standard) are available. A flex hose is run from the collector to a source capture collection hood or, collar mounted on the

machine enclosure for capture of generated contaminants. The collector is typically mounted above the inlet hood or collar to allow solids collected in the flex hose to drain back into the machine rather than into the mist collectors filters. Drain lines from the Mist Collector are typically routed back into the machine cavity or lube sump for reuse of collected fluids.

Centrifugal Mist Collectors are designed to handle cleaner mists such as straight oil mist generated from turning and "chip" generating operations. Collector maintenance is dependent upon the amount of solids drawn into the system, if there are no solid particles present in the air or collected fluid there will be no maintenance! Applications that produce large amounts of fine solid particulates that stay suspended in the coolants, such as heavy grinding applications, will require more frequent unit maintenance and may be handled better with a mechanical filter system such as the MediaFilter or Dryflo system.

Centrifugal Mist Collectors are not suitable for applications where the collected mist will solidify such as spray painting. They can, however, be used in applications involving low temperature wax or animal fats, but may require supplemental strip heaters to keep the liquids from cooling and solidifying. They can also be used in water soluble coolant applications where the coolants used tend to gel (due to evaporation of water). In these applications the collector's ability to handle heavy amounts of liquids allow the unit to be "power flushed" which reliquifies gelled coolants and flush cleans the filters to minimize unit maintenance (optional spray wash nozzles available).

When properly applied to machining operations with cleaner coolants, Centrifugal Mist Collectors are infrequently and easily maintained. Typical, routine maintenance requires a simple replacement of the inexpensive, first stage, throwaway liner taking about 5 minutes. In average screw machine applications with semi-clean oil coolants, throwaway liner replacement is required every 4 to 6 months per shift of operation. An application with dirty coolant, such as cast iron, brass or bronze turning or wet grinding operations may require filter replacement every 1 to 2 weeks. Optional Prefilter Traps and Impingers are available to reduce maintenance and improve performance if chips or solids and heavy sprays are present. Optional HEPA and Carbon modules are available for control of secondary smoke and/or gas/vapors and odors.

Coolant Gelling or Crystallization

In the past, coolant gelling or crystallization in Mist Collectors rarely occurred; however, this problem is now appearing with greater frequency. The cause of the problem is the result of changes made to the base coolant itself. The EPA and OSHA forced the removal or reduction of phenols, nitrates, nitrites, and other additives from the coolants that gave them stability. By removing these materials from the coolant, evaporation of some of the water (which increases the base coolant concentration) will result in gelling and/or crystallization in areas with water containing a high mineral content. It is important to note that the gelling problem is usually more severe in applications with lighter concentrations of mist rather than those with heavy mist. In heavy mist applications, filters are continuously flushed with coolant in concentrations that exceed the evaporation rate of the water so the coolant concentration cannot be increased enough to gel or crystallize.

Coolant gelling or crystallization can result in a drastic decrease in Mist Collector efficiency, typically resulting in heavy amounts of mist being exhausted through the collector and increased unit vibration levels. In HEPA equipped units, complete filter blockage and loss of airflow will

occur, requiring frequent filter changes to keep the collector on-line. In most cases, standard maintenance procedures (replacement of prefilter and throwaway liner) will not resolve the problem or improve collector efficiency.

When faced with coolant gelling or crystallization problems, the first suggestion is to discuss the problem with the coolant supplier. In many cases, additives can be added to the coolant to improve stability. On some applications, investigation by the coolant vendor indicated the problem was inappropriate coolants were used (reaction with material being machined) or additives, bactericides, and concentrations were not properly maintained. If after corrective measures to the coolant itself have been attempted, but gelling or crystallization problems continue it is suggested that the following periodic maintenance be performed to the collector.

Mist Collector Flush Cleaning

The main problem with coolant gelling or crystallization results from the fact that the coolant blocks the primary filter in the rotating drum assembly in the unit. During unit operation, mist is drawn into the rotating drum assembly of the collector and is captured in the throwaway liner (first filter) and primary felt filter (under the throwaway liner). Evaporation results as high volumes of air pass through the wetted filters, resulting in gelling or crystallization that can completely block both filters.

As stated in the Mist Collector maintenance manual (section 5-3), replacement of the primary filter may affect the balance of the collector; therefore, it is suggested that you attempt to flush the filter out rather than replace the primary filter. Due to the Mist Collector's ability to handle extremely heavy concentrations of liquids, if the collected material can be reliquified (such as water-soluble coolants); the primary filter can be flushed out. In numerous applications, a heavy coolant flush of the primary filter will not only eliminate the need for filter replacement, but may also remove some of the solids within the filter, resulting in reduced unit vibration. The flush procedure is as follows:

> Remove the throwaway liner (if loaded with solids and requires replacement) and disconnect flex hose to cover of unit. If unit is equipped with an in-cover prefilter trap, remove the trap and block off the drain line. Install cover to collector, turn on the power and let unit reach full operating rpm. It is suggested that the drain lines be moved to drain into a separate container, if a liquid other than the coolant being collected is used to flush the unit to prevent coolant cross contamination. Pour or spray flushing liquid into the inlet of the collector, start slowly at first; eventually, as filters are flushed, you will be able to pour or spray a few gallons at a time through the collector. After flushing, allow unit to run for a few minutes to purge remaining liquid from the drum. During the flush operation you should note a heavy liquid (usually dirty) flow out of the main 1.5-inch drain line (do not obstruct or submerge main drain line, any back pressure on line will reduce drain system efficiency).

Because primary filter blockage cannot be determined by visual inspection, it is suggested that you perform the following test to check the permeability of the primary filter and the effectiveness of the filter flush:

> Turn off unit power and allow drum to stop rotating. Remove the cover of the collector and pour one cup of the coolant that you are collecting into the drum assembly of the collector, so that it must drain through the primary filter. Examine how quickly the coolant

drains through the filter. If the coolant puddles or takes a considerable amount of time to drain, then the filter is still blocked off and a second flush may be required. If the coolant drains through the filter rapidly, the flush was sufficient to clean the filter out. Simply replace the throwaway liner, prefilter (if applicable), cover and intake hose.

It is suggested that you manually flush the unit with clean coolant and use the above permeability test to help you determine the actual throwaway liner replacement and primary filter flush cycles. Please record this data for future reference and also note that throwaway liners should be replaced before they accumulate too many solids to prevent these solids from being flushed into the primary filter.

Should you find that frequent flushing is required to maintain unit efficiency, the unit can be equipped with a spray wash nozzle that can be connected to your clean coolant feed line allowing you to flush the filters in place. The spray wash nozzle attachment will simplify the flush procedure and reduce the time required to flush each unit.

It is hoped that the above items will help to explain and resolve any gelling or crystallization problems you may encounter, assist you in reducing unnecessary filter replacement and help determine actual filter maintenance cycles on your Centrifugal Mist Collector installations.

Sizing and Selecting Criteria

There are three different methods for calculating the required airflow from an enclosed machining center. Each of these methods should be evaluated based on the specific needs of the customer, design of the machine enclosure, and available locations for the inlet hood. See the Wet Machining application paper online at DTIC (Donaldson Torit Information Center) for more information about calculating the required airflow.

Once the required airflow has been calculated, refer to the Centrifugal Mist Collector datasheet for performance curves. Use these curves to choose the size collector needed.

Prefilters
Although the Centrifugal Mist Collector is best applied on cleaner mist applications, prefilters are available to reduce particulate loading, prolong filter life, and minimize maintenance.

- **In-line prefilter traps** can be used when a lot of particulate is created in the process. These are traps with no drain and are best used for chip collection. Maintenance will be required for removal and cleaning of the in-line prefilter traps.
- **In-cover prefilters** are used for incidental or light dust along with the machining fluid mist. They also assist in coalescing atomized mist by using double or triple media stacked in the in-cover prefilter.

Features and Benefits

Features	Benefits
Heavy, industrial grade construction	• Durable, long life unit
Custom design, industrial grade, externally mounted, permanently lubricated TEFC motor	• No maintenance, long life motor • External mounting prevents damage to motor should a machine tool fire occur
High speed rotating Drum and advanced forced drainage system	• Can efficiently handle extremely high concentrations of mist
Continuous duty	• No machine downtime required for filter drainage
Machine-mountable configuration	• Direct machine mount for easy and inexpensive installation and changes to plant layout • Eliminates concern of fire spread throughout plant should a machine tool fire occur • No cross contamination of coolants
First Stage Throwaway Filter Liner	• Easy to replace, low cost replacement filter
Second Stage Primary Filter	• High efficiency coalescing filter provides optimum performance for collection of fine mists
Prefilter stages • Canister or In-Line Prefilter Traps • In-Cover Impingers	• For removal of chips, solid particles and raw coolant sprays before entering the rotating drum • Reduces unit maintenance and can be added in the field
Afterfilters • HEPA Filter • Activated Carbon	• Allows the system to handle Smoke and Gas/Vapor (individual or combined) • Can be added in the field if processes change
Modular Design and numerous add-on options	• Adaptable to changing contaminants and conditions • Systems can be tailored to specific application requirements and needs

Donaldson vs. Generic Media

It has been learned that most of the recent increased operational problems with the Centrifugal Mist Collectors can be attributed to the use of "generic" replacement filter media.

Evaluation of the generic throwaway liner indicated it was two full grades lower than the Donaldson media. The throwaway liner is designed to prevent most of the particulate from entering the primary filter. The lower grade media allows more particulate to pass into the primary filter resulting in increased replacement frequency. It is not desirable to change the primary filter frequently because it increases the chances that rebalancing of the drum will be required. Increased system maintenance and costs result from using low-grade throwaway media. Throwaway media specs are as follows:

Media	Nominal Basis Wt. oz/yd^2	Mullen Burst psi	Thickness mils
Donaldson	2.1	48	12
"Generic"	1.0	17	8

The generic primary felt filter was a lower efficiency, more porous felt with much larger fibers. A major problem with this filter was that it was cut to a shorter length than our standard filters. When installed, a 1-inch gap is present between the ends of the primary media, this gap opens to 1.5 inches after the unit has been in operation because centrifugal force compresses the filter into the drum assembly. The gap between the filter ends is a bypass point for mist (lowers efficiency), resulting in dirt loading on the secondary and exhaust grill filters and creating balance problems in the unit (no media weight at gap). Additional problems result from the large fibers with larger air voids throughout the media. The large fibers have lower efficiency on the smaller particles and the larger voids plus more porous structure provides air passages for small particles to pass through the filter. Media density varies widely on the generic filter and results in inconsistent weight at various points on the filter. Inconsistent weight in the filter increases chances of imbalance during primary filter replacement.

The generic media was also much easier to compress. Early studies of filters for the Centrifugal Mist Collector proved that media that compresses easily collapsed the pore structure of the filter causing a rapid increase in filter resistance. The increased resistance resulted in a bypass of contaminants in the gap between the drum and cover of the unit leading to a loss in system efficiency. The same problem occurred in early tests run on tighter, higher efficiency media. Over 350 different types of felt were tested for short and long-term performance before the felt used in the current systems was selected. The primary filter is critical for proper system operation and small variations in this media can have drastic results in overall system performance. Comparison on weight between the media (when the Donaldson filter was cut to same size) resulted in a 145.5-gram weight for the generic filter verses a 173.6-gram weight for the Donaldson filter.