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Everything you wanted to know about DUST but were afraid to ask!

Why Dust Control?

Process and fugitive dust emissions are regulated pollutants. Standards adopted by federal and state agencies are enforced to protect worker health and limit the amount of particulate entering the environment.

The National Ambient Air Quality Standards (NAAQS) have targeted PM10 (-10 micron particulate) because these very fine particles represent the most serious health hazard.

Why water-spray systems?

Dry collection systems are very efficient. However, this technology is capital intensive, high maintenance, and applicable only to sources that can be enclosed. Filter fabrics have limitations with stacking materials in a pile and the disposal of filters \ fabrics often produce secondary emissions.

Water spray systems remain the most efficient and cost effective means of dust control for both process and fugitive dust emissions. Reason; the dust remains with the product of origin, while it is being disturbed. [For further information, see *"Water-spray systems: the dust-control workhorse", by Mark Kestner, Ph.D., Pit & Quarry, March 1991.*]

Why **Arch Fogger Systems**?

Fogger systems were developed to overcome the deficiencies of conventional spray systems as they are **designed to suppress airborne dust without wetting the product**. To achieve proper atomization and suppression of fine or porous fugitive dust, water spray pressures should exceed 90 psi.

Arch Fogger technology was designed for the aggregate, crushing and mining industries. It has a proven track record; is simple and easy to maintain; and requires minimal capital investment in comparison to other forms of dust suppression.

How can **Arch Fogger Systems** be enhanced?

Screen materials provide an environment for fogger systems to effectively bond water to dust. To build durable and effective wind fences for all applications a woven, industrial grade polyester fabric is effective at wind velocity reduction. Fences are applicable to airborne particulate collection i.e., sand, dust, wood fiber, etc.

Surfactants or other forms of bonding agents further enhance the bonding characteristics of dust particles. These agents are available to match the chemistries of the particulate matter being addressed.

Points of Interest

- Fugitive dust is a problem common to many industries, i.e., crushing, mining, and recycling.
- **ARCH Fogger Systems** reduce secondary operating problems.
- **Arch Environmental** atomized fog produces like-sized water particles for efficient dust control.
- No chemical additives are required.
- Wets the dust, not the product.
- Low initial capital cost, no ventilation ducts, and low maintenance costs.

DUST SUPPRESSION TECHNOLOGY

AN OVERVIEW

The control of fugitive dust from surface materials handling systems (dumping, conveying, screening, crushing, and storing) is a topic of interest to designers and operators in many industries including:

- Mining & Minerals Processing
- Wood Products
- Chemical
- Power Generation

In these industries, the creation of dust is an unavoidable result of operations. In most areas, the control of dust is a requirement of federal, state, and/or local regulations. Enforcement is becoming more rigid and the penalties imposed for operating without proper dust controls are too great a risk. Considering the cost of a regulatory fine and enhanced work environment that may be created, dust control becomes an investment in safe operations. There are a number of technologies available to control dust each with its own set of implications for permitting, capital cost, production, operating cost, and maintenance. Choosing the strategy that best suits a given plant site need is often confusing.

1. Wet Chemical Systems:

These systems utilize a wetting agent combined with water. This process attempts to thoroughly wet the material handled so that dust is bound to the surface of larger material and is not released to the atmosphere. Although these systems are effective on certain kinds of materials and applications, they may not be applicable when the chemicals effect production. Open dump areas, or where materials that cannot be wetted, or freezing, limit the application of wet chemical systems. There are however, a number of suitable surfactant chemicals (anti-freezing agents) available in the marketplace.

2. Ventilation Systems:

When control of respirable dust is required or the material handled cannot tolerate the addition of moisture, a well-designed ventilation system may be in order. These systems extract the dust as it is created and filters it through conventional collectors such as fabric filters or scrubbers. Ventilation systems are effective for certain types of materials and applications.

They are generally more expensive and power consumptive than the alternatives though they often may be the only alternative because of their rated efficiency.

3. Garden Hose Technology:

By far the most common instruments used in the control of fugitive dust are the garden hose \ hardware store nozzle variety. They're cheap, available anywhere, and will do the job if the source material can be thoroughly wetted without causing a problem. If, in handling the material, dry surfaces are created (such as by crushing) then dust will be released. If freezing conditions exist, the material will freeze. If the wet material is sticky, the abundance of water may cause clinging to conveyors or tires creating housekeeping and maintenance problems. Various unpublished studies have found that wear parts are significantly affected by the abundance of water. The idea of “more is better” is a mistake when considering the high cost of wear parts compared to the investment of an efficient fogger system for dust control.

4. Agglomerative Dust Control, the **ARCH Fogger System:**

Agglomerative dust suppression is a cross between a ventilation / filtration system and the garden hose technology. It works on the principal that small particles of water will "come together” with small particles of solid matter (dust), forming larger and heavier particles that will settle by gravity. Like a garden hose spray because it uses water and no chemicals; similar to the ventilation system because it doesn't saturate the material; and it separates dust by the filtration process created from the fog.

5. Wind Fences:

When the effect of wind is the cause of (or a contributing factor to) a fugitive dust emission problem, the only solution may be to isolate the dust source from the wind. Conventional design practice would utilize a building for this purpose.

Using a woven polyester fabric mounted on support posts, the fence is extremely effective in reducing downwind velocity. This process reduces the amount of dust picked up and transported by the wind. EPA and other independent studies have used designed fence systems in conjunction with other fugitive emission technologies.

BACKGROUND to Agglomerative Dust Control

Agglomerative dust suppression technology was developed in the early 1970's with the commercial availability of atomizing nozzles that could produce liquid particles within 10 to 30 microns. The Royal Institute of Stockholm did most of the early work in Scandinavia. This was a direct result of the stringent dust control laws of Sweden. In the mid to late 1970's, the technology found its way to the U.S. but early attempts for application in U.S. mining were not successful due to the initial capital investment required. In the early 1980's, South Africa's mining industry began to utilize the technology, followed by Australian mining facilities in the mid 80's.

PRINCIPAL OF OPERATION

The performance of the agglomerative dust control is based upon the principal of agglomeration. Dust particles released from the material being handled (i.e., conveyer points,

screens, above and below crushers, and dump areas) are exposed to an environment that contains massive quantities of very fine water particles. This environment is similar in nature to a very wet fog often experienced on a cool summer morning. The dust particles agglomerate with the water particles, increasing in weight, then falling back to their source of origin. The percentage of water added to the material is extremely low because only the fugitive dust is effected. The control efficiency of the system can be in excess of 95% depending on the application.

ENCLOSURES

For maximum efficiency of agglomerative dust control, the dust source should be enclosed to provide protection from ambient conditions, especially wind. In an exposed windy area, the fog and dust particles are dispersed preventing maximum agglomeration and settlement of fugitive dust. These enclosures will vary from project to project but can be generally defined as follows:

1. Transfer points. At transfer points, enclosures should include;

    A) a head box with inlet strip curtain;
    B) a seal of some type on the underside of the feeder belt;
    C) a tight chute with a rock box (if the vertical drop is substantial);
    D) a cover over the receiving belt extending at least three belt widths downstream from the chute discharge and having a height at least equal to the belt width; and
    E) a cover extending back on the receiving belt behind the chute approximately one belt width.

In addition, tight skirt boards are necessary for the entire length of the belt cover. Special skirt board designs are available and should be utilized if the material handled is extremely dusty. This is especially true if the vertical fall is great, or if the belt speeds are high. Strip curtains should be fitted at the front and back discharges of the cover.

2. Screens. Screens may either be totally enclosed or open above the deck. If the screen is open, the feeder belt(s) should be enclosed with a head box that extends out over the deck and distribution plate to provide a protected area for agglomeration. The area between the deck and the hopper should be sealed with rubber. Over chutes can generally be open but their receiving belts must also be treated as a transfer point.

3. Crushers. Depending on the type of crusher and the material being crushed, the enclosure size will vary. In general, a rock box or vault under the crusher with substantial empty volume is desirable. If no vault is provided, the receiving belt must be tightly skirted. The belt covers at least twice the size of a typical transfer point, and special skirting is preferred in the impact zone enclosing the belt. The mouth of the crusher should be protected in some way from wind so the belt, chute, or feeder supplying the crusher is "enclosed" with the crusher. A wind screen is generally sufficient.

4. Dump pockets and hoppers. Depending on the type of vehicles feeding a dump pocket or hopper; the mass flow through them; the nature of the material; operating procedures; and ambient conditions; enclosures for this application require custom designs. In some cases, walls on three sides extending six feet or more above the maximum level of the material is all that is required. In other cases, a building with large dimensions and flexible or removable walls may be necessary. Each case will require individual design and fabrication.

Many times the top of a hopper is much larger than necessary and can be covered with a solid sheet of material or tarp fabric similar to that used for dump trucks. Surround the point with wind fence material as much as possible to reduce the influence of ambient winds on the fog filter. Try to control the flow direction of the displaced air that carries the dust so that is stays within the enclosure. This requires some creativity but the principal is simple. Baffles or turning veins are often helpful.

CONCLUSION

Agglomerative dust control systems like **ARCH Fogger Systems** are an effective solution to most fugitive emission problems. They are installed in numerous mining and bulk material handling applications in the U.S. and the technology is widely used in other areas of the world. They are considered "BACT" (best available control technology) in many regions and are well liked by both users and regulatory agencies. Care should be taken to design the systems for severe climates and use requirements.

Considering the benefits; with no ongoing costs related to chemical use; and minimum effect on downstream processes associated with the product; the **ARCH Fogger System** is the system of choice. Agglomerative dust systems require a minimum of maintenance \ housekeeping and power requirements are low in comparison to other "BACT" technologies. When combined with other fugitive dust control technologies such as road stabilization and windscreens, agglomerative dust systems becomes an integral and important part of a total dust control strategy.

How to Identify Agglomerative Dust Suppression Applications

MINING - All stages of crushing and screening, truck dumps, storage bins, reclaim feeders, and rail car loading and unloading.

CEMENT - All stages of crushing and screening, truck dumps, storage bins, reclaim feeders, stacking, limestone and additive storage silos and sheds, and open handling of cold clinker.

CRUSHED STONE - All stages of crushing and screening, truck dumps, reclaim feeders, stacking and reclaiming.

SMELTING - Ore and cold slag handling.

POWER - Solid fuel receiving, conveying, stacking , reclaiming, and processing.

CHEMICAL - Bulk solid material handling including truck and rail car loading; unloading, conveying, storing, reclaiming, and processing.

WOOD PRODUCTS - Conveying and processing bark, saw dust systems, truck loading and unloading, and fly ash handling.

RECYCLING - Paper unfailing, tromels, and conveying; wood waste handling and processing; and scrap metal processing.

SOLID WASTE - Garbage handling at transfer stations, land fills, incinerators and fly ash conditioning.

GUIDELINES TO QUALIFY AGGLOMERATIVE DUST CONTROL APPLICATIONS:

1. Is the source of dust a hot material? Agglomerate dust control uses moisture to agglomerate and settle dust. In a hot environment, the fog evaporates to steam, generally not a good application for agglomerative dust technology.

2. Is the dust extremely hygroscopic or soluble in water? For example, Agglomerative dust control may not be appropriate for cement batch plants because the agglomerated dust sticks to the walls forming cement. Dust generated from handling salts and other soluble materials have not been effectively resolved using agglomerative dust technology.

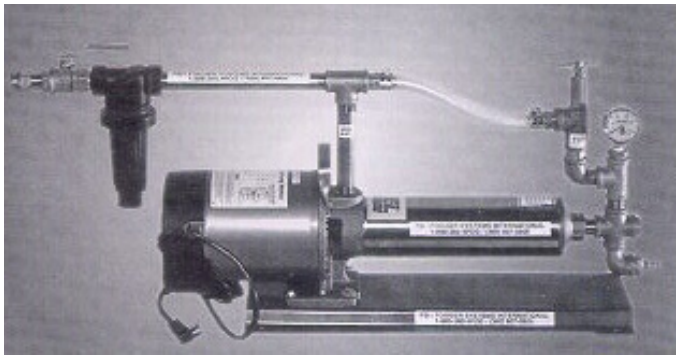
3. Is visibility a major concern? In certain applications, the fogging process will reduce visibility while agglomerating dust particles. This may require intermittent fogging, where the fog suppresses the dust and then shuts off to provide maximum visibility.

4. Is the dust source is highly corrosive? Agglomerative dust technology is not the answer.

5. Is the dust source sensitive to the addition of small amounts of water? In some cases the addition of even a small amount of water may cause the accelerated growth of bacteria, an increased chance for spontaneous combustion, or a deterioration of product quality during extended storage. Pharmaceuticals and certain chemical processes; and selected food industry processes are not good applications for agglomerative dust technology.

6. Can the dust source be isolated from ambient conditions? In order for agglomerative dust control to work efficiently, a fog filter completely encompassing the dust source must be created and maintained. The more open the system, the more fog is needed and the less effective the fogging system. It is common practice to enclose screens, transfer points, and easy to enclose the mouth of a cone or roll crusher. Truck dumps and the mouths of big crushers are more difficult. The general rules to follow in designing these types of partial enclosures is simple, make the opening as small as possible.

Arch Fogger Products



Industry / Primary ARCH Fogger System Applications

Aggregate products

- Dust suppression for crushing, transfer stations, screening, and material handling.

Mining

- Dust suppression, evaporative cooling
- Continuous underground mining
- Long-wall mining, material handling
- Mine cooling / timber wetting
- Tunnel Boring (TBM) operations
- Scrubber enhancement
- Evaporation of leachates

Recycling & Demolition

- Concrete – asphalt
- Wood recycling and demolition rubble
- Garbage disposal \ material handling, odor control

Wood products, Pulp and Paper

- Dust suppression for wood chips, milling and sawdust control
- Cooling and lubrication of saw blades
- Cooling towers \ scrubber enhancement

Cement, Batch Plant Operations

- Pre-conditioning to bag house operations
- Lime kiln, evaporative cooling
- Atomization of materials, fuels

Manufacturing, power plants

- Dust suppression and cooling

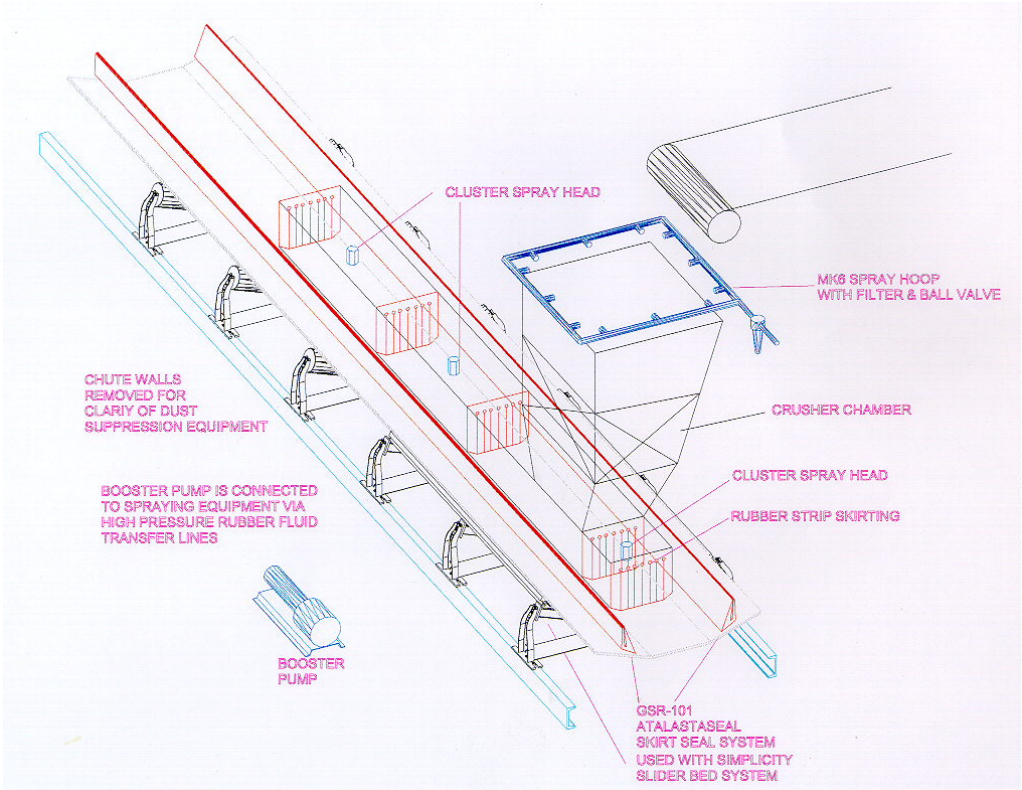
Agriculture

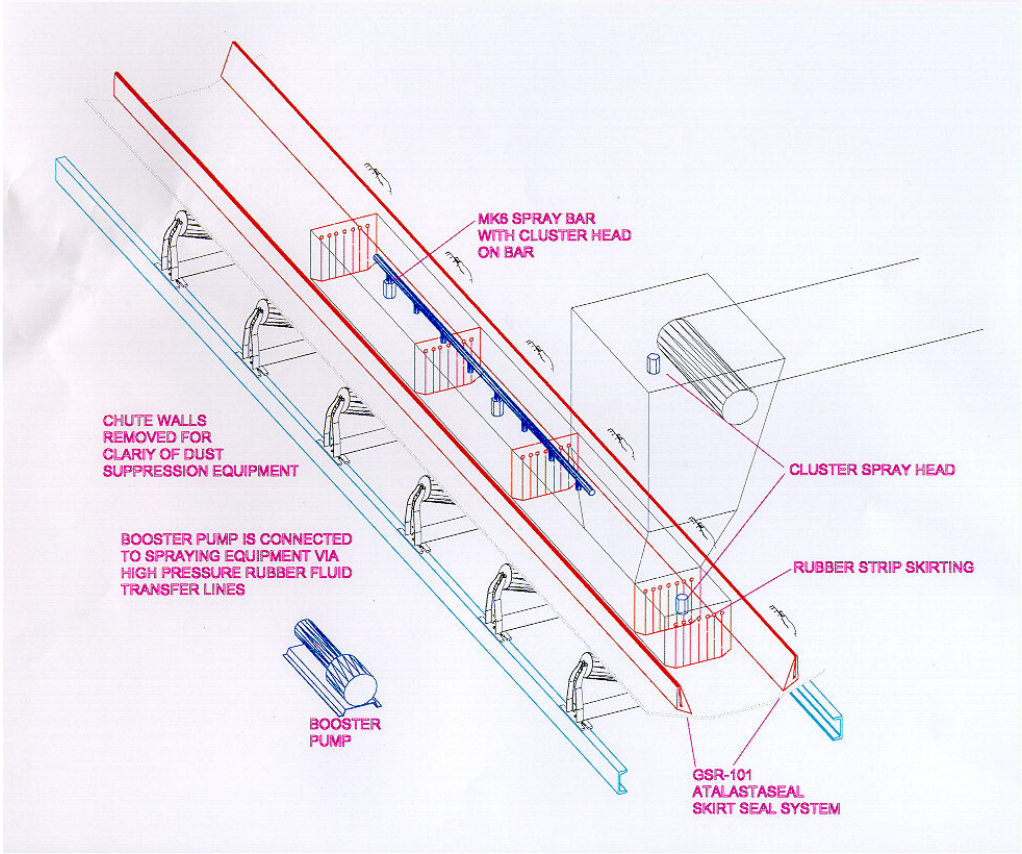
- Dust suppression and humidifying of stockyard, dairies, horse arenas
- Cooling and odor control, poultry and hog farms

Transportation

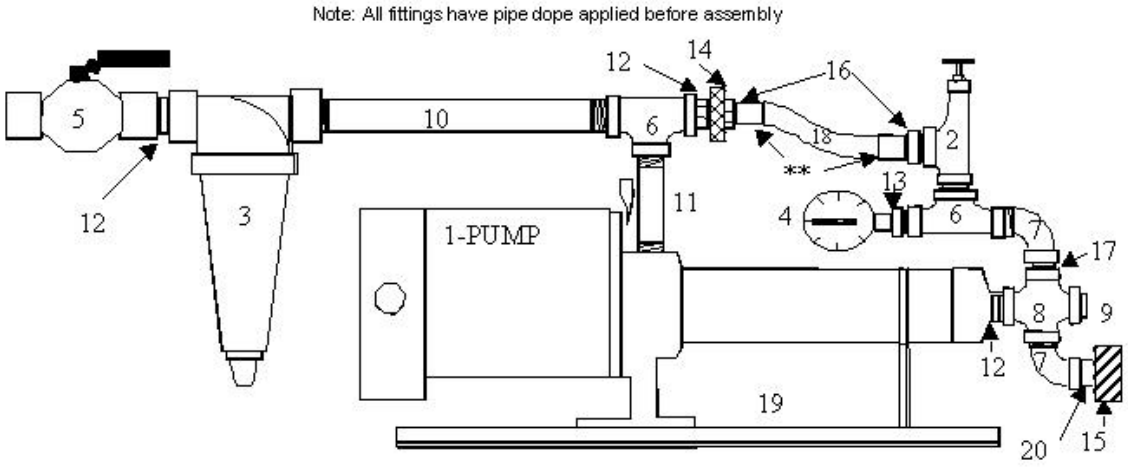
- Street sweepers
- Asphalt grinding \ mobile equipment
- Rail car operations

Typical System Diagrams





Arch Environmental Equipment Pump Assembly Diagram



			Pump & Plumbing Assembly List		
item	arch #		description		qty
1	varies		Booster Pump Assembly		1
2	PRV		pressure relief valve		1
3	BTS-3/4B		3/4" t strainer with 100 mesh		1
4	G-200PSI		200 psi gauge with 2" diameter face		1
5	3/4BV-B		3/4" brass ball valve		1
6			3/4" brass tee		2
7			3/4" brass street elbow		2
8			3/4" cross		1
9			3/4" plug		1
10			3/4 x 10 pipe nipple		1
11			3/4 x 4 nipple		1
12			3/4" close nipple		3
13			3/4 x 1/4 reducer bushing		1
14			3/4" union		1
15			3/8" mnpt x 1/4" quick coupler socket female		1
16			3/4" npt x 5/8" hose barb with ferrell		2
17			3/4 x 2 nipple		1
18			5/8" clear hose for pump		1
19	P-STD		pump base		1
20			3/4 x 3/8 brass reducer bushing		1

Pump Specifications

Pump Size		***@100psi***	***@150PSI***
¾ HP (max 160psi)		510gph	270gph
	Spray head		quantity
	Mark 2	15	6
	Mark3	8	3
	Mark 4	12	5
	Single Nozzle	112	47

1 HP (max 185psi)		750gph	480gph
	Spray head		quantity
	Mark 2	22	12
	Mark3	12	6
	Mark 4	17	9
	Single Nozzle	159	84

2 HP (max 150psi)		1200gph	900gph
	Spray head		quantity
	Mark 2	36	22
	Mark3	19	12
	Mark 4	28	16
	Single Nozzle	255	157

3 HP (max 185psi)		1614gph	1155gph
	Spray head		quantity
	Mark 2	48	35
	Mark3	26	18
	Mark 4	37	27
	Single Nozzle	339	205

Arch Fogger Systems Water Consumption

WATER USAGE, GALLONS PER MINUTE (GPM)

Model	@ 100psi	@ 150psi	@ 200psi
Single nozzle	0.078	0.095	0.112
Mark 2 (7)	0.546	0.665	0.784
Mark 3 (13)	1.014	1.235	1.456
Mark 4 (9)	0.702	0.855	1.008

WATER USAGE, GALLONS PER HOUR (GPH)

Model	@ 100psi	@ 150psi	@ 200psi
Single nozzle	4.7	5.7	6.7
Mark 2 (7)	32.9	39.9	46.9
Mark 3 (13)	61.1	74.1	87.1
Mark 4 (9)	42.3	51.3	60.3

Mark 6 bar, range from 1 nozzle to cluster Mark 3 (13) per insert.

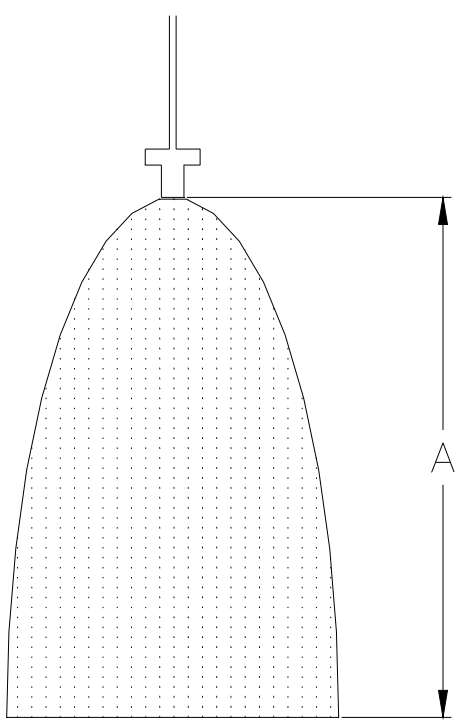
The above GPH volumes are based on using a #3 spray nozzle.

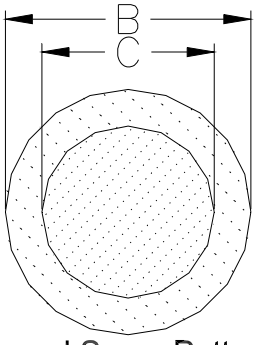
CAPACITY (GPM) for Mk 2, (7 nozzle) cluster spray

This chart shows the comparison between nozzle sizes.

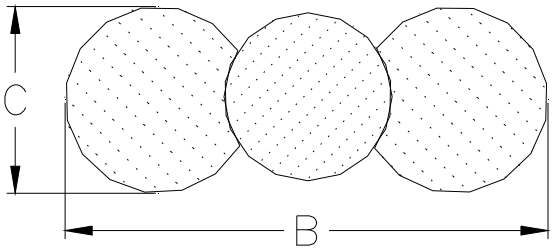
nozzle#	100	125	150 (PSI)
0.6	.11	.12	.13
1	.18	.20	.22
1.5	.28	.31	.34
3	.55	.61	.66
6	1.1	1.2	1.3
12	2.2	2.5	2.7
18	3.4	3.7	4.0
26	4.8	5.3	5.8

Spray Patterns





Round Spray Pattern



Rectangular Spray Pattern

Round Spray Pattern (using #3 nozzles)

Head	Dimensions (Ft)		
	A	B	C
Mark 2	3	5.5	2.5
Mark 3	4	6.5	4.5

Rectangular Spray Pattern (using #3 nozzles)

Head	Dimensions (Ft)		
	A	B	C
Mark 4	4	3.5	2.5

Spray patterns affected by outside elements