



P.O. Box 7016 / Issaquah, WA 98027  
ph: 425.313.2600 / lakesideindustries.com

July 20, 2023

Mr. Mark Goodin  
Olympic Region Clean Air Agency  
2940 Limited Lane NW  
Olympia, WA 98502

**RE: NOC Application for Lakeside Olympia Airport Facility**

Dear Mark:

Enclosed is a Notice of Construction (NOC) application for Lakeside Industries' Portable Asphalt Pellet Manufacturing Facility located at 8840 Old Highway 99 SE, Tumwater, WA.

Lakeside is submitting the enclosed NOC which includes information requested by ORCAA as follows:

1. Form 1 – *Form 1 Notice of Construction enclosed.*
2. Copy of the most recent SEPA determination for the facility made by the local lead agency – *SEPA Determination enclosed.*
3. SDS for the lime and organic binder used – *See Asphalt Pellet Plant Process Flow Diagram Notes sheet, Attachment A.*
4. Description of the RAS material that characterizes its origin, percent fines, potential for asbestos fibers - *See Asphalt Pellet Plant Process Flow Diagram Notes sheet and note sheet Attachment A.*
5. Requested material use rates in terms of mass per day and per year - *See Asphalt Pellet Plant Process Flow Diagram Notes sheet.*
6. Process flow diagram and description of the process with detail on how dust will be controlled at potential fugitive dust points such as hoppers, shakers, screens, transfer points, silo vent, and mixers – *Asphalt Pellet Plant Process Flow Diagram enclosed. See Notes sheet and referenced attachments for description of process.*
7. Specifications on the Silo and description of how the silo will be filled including dust control measures - *See Asphalt Pellet Plant Process Flow Diagram, Notes sheet, and Attachment B.*
8. Documentation that the silo filter will provide adequate filtration for the consistency of the lime used – *See Asphalt Pellet Plant Process Flow Diagram, Notes sheet, and Attachment B.*

9. Site map of facility (to scale) and showing outline of all structures, location of equipment, and property boundaries – *Site Map enclosed.*
10. NOC Filing fee of \$2,261 – *Check Number 95777057 enclosed.*

Asphalt pellet manufacturing has the potential for fugitive emissions from material transfer equipment. Controls are installed for localized control of fugitive dust. The pelleting process operates at ambient temperatures and is electrically powered by line power.

Please contact me if you have any questions or if you need additional information to process the NOC application for the Portable Asphalt Pellet Manufacturing Facility.

Sincerely,



Karen Deal  
Director of Environmental & Land Use



# OLYMPIC REGION CLEAN AIR AGENCY

2940 Limited Lane NW - Olympia, Washington 98502 - 360-539-7610 – Fax 360-491-6308

## FORM 1- NOTICE OF CONSTRUCTION

TO CONSTRUCT - INSTALL - ESTABLISH OR MODIFY AN AIR CONTAMINANT SOURCE

**Form 1 Instructions:**

1. If the application contains any confidential business information, please complete a Request of Confidentiality of Records ([www.orcaa.org/forms](http://www.orcaa.org/forms)).
2. Duty to Correction Application: An applicant has the duty to supplement or correct an application. Any applicant who fails to submit any relevant facts or who has submitted incorrect information in a permit application must, upon becoming aware of such failure or incorrect submittal, promptly submit supplementary factors or corrected information.

<b>Business Name:</b> Lakeside Industries, Inc.	<b>For ORCAA use only</b>
<b>Mailing Address:</b> PO Box 7016, Suite 200 Issaquah, WA 98027	File No: 801 County No: 67 Source No: 991 Application No: JSNOC1607
<b>Physical Address of Project or New Source:</b> 8840 Old Highway 99 SE Tumwater, WA 98501	Date Received: <span style="color: red; font-size: 1.2em;">Received</span> <span style="color: red; font-size: 1.2em;">JUL 24 2023</span>  <span style="color: red; font-size: 1.2em;">ORCAA</span>
<b>Billing Address:</b> PO Box 7016, Suite 200 Issaquah, WA 98027	
<b>Project or Equipment to be installed/established:</b> Asphalt Pellet Manufacturing Facility Equipment and operations include raw material transfer, raw material mixers, and final product transfer, storage, loadout and fugitive dust control.	
Anticipated startup date: <u>07</u> / <u>  </u> / <u>23</u> Is facility currently registered with ORCAA? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
This project must meet the requirements of the State Environmental Policy Act (SEPA) before ORCAA can issue final approval. Indicate the SEPA compliance option: <input checked="" type="checkbox"/> SEPA was satisfied by <u>Thurston County</u> (government agency) on <u>8 / 17 / 90</u> (date) - Include a copy of the SEPA determination <input type="checkbox"/> SEPA threshold determination by _____ (government agency) is pending - Include a copy of the environmental checklist <input type="checkbox"/> ORCAA is the only government agency requiring a permit - Include ORCAA Environmental Checklist <input type="checkbox"/> This project is exempt from SEPA per _____ (WAC citation).	
<b>Name of Owner of Business:</b>	<b>Agency Use Only</b>
Title: Lakeside Industries, Inc., Attn: Karen Deal	
Email: karen.deal@lakesideindustries.com      Phone: (425) 313-2600	
<b>Authorized Representative for Application</b> (if different than owner): Karen Deal	
Title: Director of Environmental & Land Use	
Email: karen.deal@lakesideindustries.com      Phone: (425) 313-2600	
I hereby certify that the information contained in this application is, to the best of my knowledge, complete and correct.	
<b>Signature of Owner or Authorized Representative: (sign in Blue Ink)</b>	
	Date: <u>7/20/2023</u>
<b>IMPORTANT:</b> Do not send via email or other electronic means. ORCAA must receive Original, hardcopy, signed application and payment prior to processing application.	

DETERMINATION OF NONSIGNIFICANCE

Proponent: Olympia Oil and Wood Products, Inc.  
PO Box 27  
Olympia, WA 98507

Description of Proposal: Building Permit to construct a 60' by 60' repair shop building with an associated well and septic system within the Light Industrial Zoning District. The proposed shop building will be part of the existing Sjoboen Gravel Pit located adjacent to portable crushing units and asphalt batch plant.

Location of Proposal: 8900 Old Highway 99 SE

Section/Township/Range: 13/17/2W Tax Parcel No.: 12703140100

Threshold Determination: The lead agency for this proposal has determined that it does not have a probable significant adverse impact upon the environment. An Environmental Impact Statement is not required under RCW 43.21C.030(2)(C). This decision was made after review by the Lead Agency of a completed Environmental Checklist and other information on file with the Lead Agency. This information is available to the public on request.

**Conditions/Mitigating Measures:**

1. SEE ATTACHMENT

Jurisdiction: Thurston County  
Lead Agency: Planning Department  
Responsible Official: Harold Robertson, AICP, Planning Director

Date of Issue: August 17, 1990  
Comment Deadline: August 31, 1990

Paula Ehlers / em  
Paula Ehlers, Environmental Review Officer

This Determination of Nonsignificance (DNS) is issued under 197-11-340(2); the lead agency will not act on this proposal for 15 days from the date of issue. No permits may be issued, and the applicant shall not begin work until after the comment deadline has expired and any other necessary permits are issued. If conditions are added, deleted, or modified during the 15 day review period, a modified DNS will be issued. Otherwise, this DNS will become final after the expiration of the comment deadline.

**NOTE:** Pursuant to RCW 43.21C.075 and Thurston County Code 17.09.160, a project denial based upon environmental information, and a conditioned or mitigated DNS may be appealed by any agency or aggrieved person. Appeals may only be filed for those conditions or mitigating measures identified in this DNS and the threshold determination is not appealable. Appeals are filed either with the Planning Department when there is also an underlying government action or with the Board of County Commissioners if there is no underlying governmental action. Appeals to the Board must be filed within ten (10) working days of the issuance of the written decision (refer to the Thurston County Code for time periods on appeals filed with the Planning Department).

Thurston County Planning Department, Environmental Review Officer  
Building #1, Administration  
2000 Lakeridge Drive S.W.  
Olympia, WA 98502 (206) 786-5554

37:sd

cc: Department of Ecology  
Thurston County Building Dept.  
Thurston County Health Dept.  
Thurston County Public Works







Sub-Area #6  
Adjacent Property Owners  
Robert Smith  
Roger Giebelhaus

8/17/90  
EK



# Asphalt Pellet Manufacturing Facility Site Plan

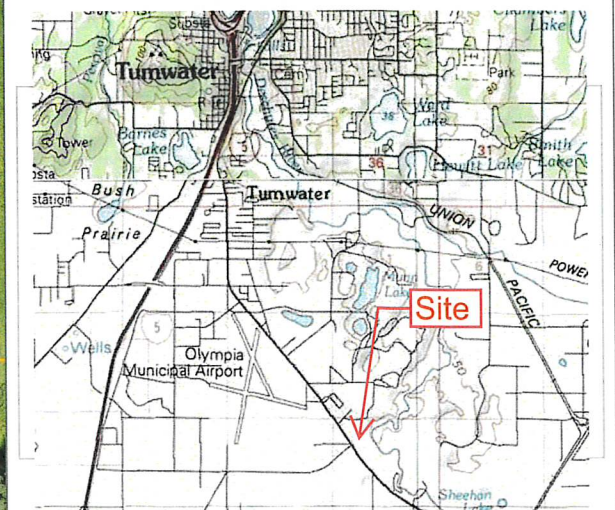
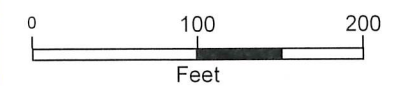
## Legend

-  Parcel Boundaries
-  1. Portable asphalt pellet manufacturing equipment under portable fabric cover
-  2. Recycled asphalt cement product storage (Asphalt Oil Feedstock)
-  3. Feedstock hopper under fabric cover
-  4. Dry Additive Silo (Pellet Coating Power Feedstock)
-  5. Asphalt pellet product storage silo with loadout
-  6. Reject pellet product storage under fabric cover
-  7. Pellet product storage under portable fabric cover
-  8. Tank and equipment storage shed
-  9. Equipment shop

## Notes

1. Property Parcel - #12713240100
2. Property Zoning - Light Industrial
3. Property Size - 13 acres
4. Portable Equipment Area - 15,000 square feet

Scale 1: 2,028



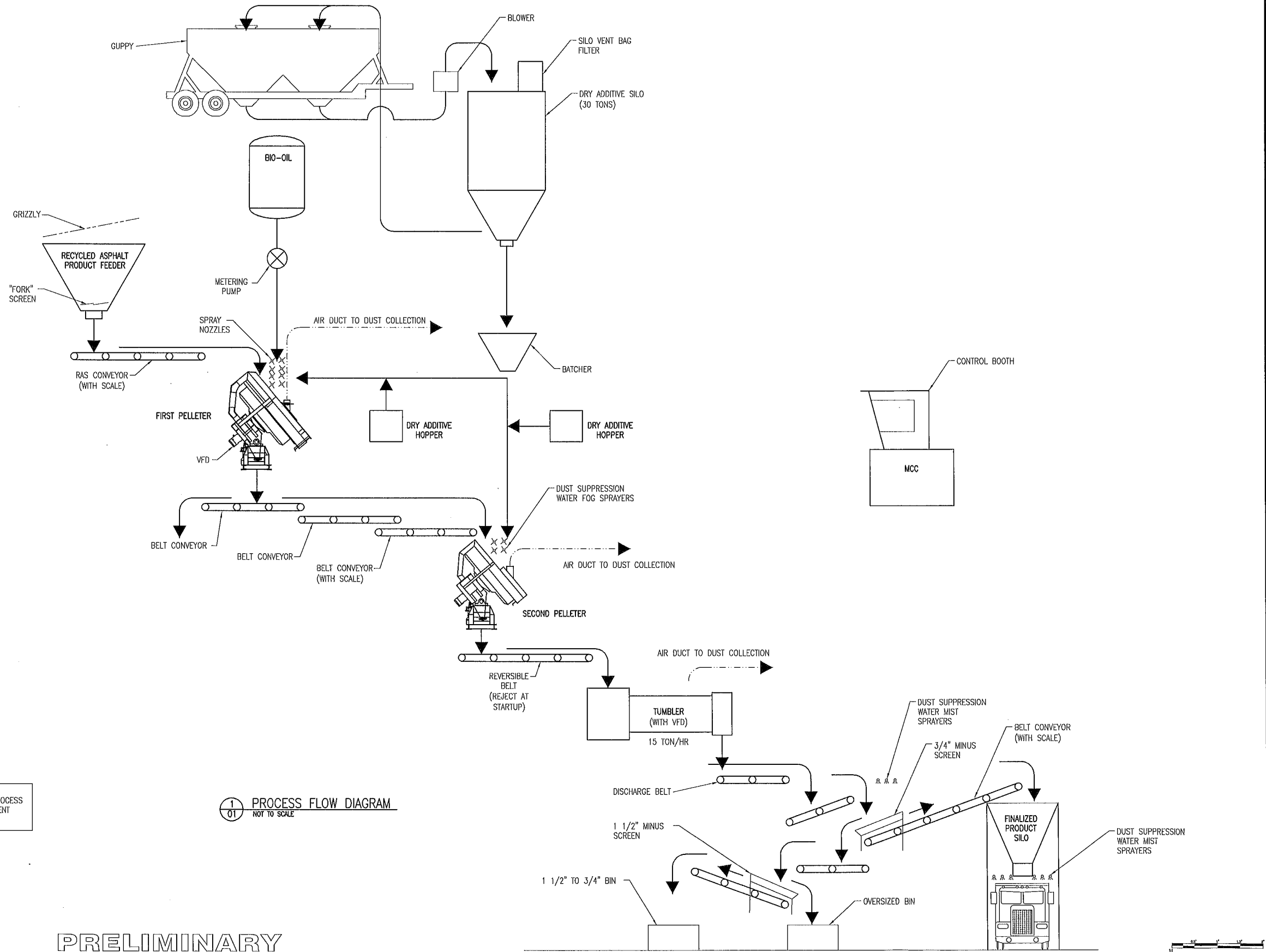
Vicinity Map

8840 Old Highway 99 SE  
Tumwater, WA 98501



The information included on this map has been compiled by Thurston County staff from a variety of sources and is subject to change without notice. Additional elements may be present in reality that are not represented on the map. Ortho-photos and other data may not align. The boundaries depicted by these datasets are approximate. This document is not intended for use as a survey product. ALL DATA IS EXPRESSLY PROVIDED 'AS IS' AND 'WITH ALL FAULTS'. Thurston County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. In no event shall Thurston County be liable for direct, indirect, incidental, consequential, special, or tort damages of any kind, including, but not limited to, lost revenues or lost profits, real or anticipated, resulting from the use, misuse or reliance of the information contained on this map. If any portion of this map or disclaimer is missing or altered, Thurston County removes itself from all responsibility from the map and the data contained within. The burden for determining fitness for use lies entirely with the user and the user is solely responsible for understanding the accuracy limitation of the information contained in this map. Authorized for 3rd Party reproduction for personal use only.





NOTES:  
SEE ATTACHED NOTE SHEET FOR PROCESS  
DESCRIPTION AND CONTROL EQUIPMENT  
SPECIFICATIONS

1 PROCESS FLOW DIAGRAM  
01 NOT TO SCALE

PRELIMINARY

THIS DRAWING, INCLUDING THE PRINCIPLES OF DESIGN IS THE PROPERTY OF SMG INC. THE DESIGN SHOWN IN THIS DRAWING IS SITE SPECIFIC AND SHALL BE USED ONLY FOR THE PROJECT SHOWN ON THE TITLE BLOCK. IF THIS DRAWING IS NOT STAMPED WITH AN ENGINEER'S SEAL, THE DRAWING MAY HAVE BEEN REPRODUCED FROM AN UNAUTHORIZED COPY. AUTHORIZED CONTROL DOCUMENT IS EITHER A STAMPED HARD COPY OR DIGITALLY PROTECTED ORIGINAL. THIS DRAWING SHALL NOT BE USED IN A MANNER THAT WOULD BE A DERIVATION TO SMG. ACCEPTANCE OF THIS DRAWING IS AN AGREEMENT TO THE ABOVE.

SYL	REVISIONS	BY	DATE	CHK'D
E	UPDATE	JWC	07/20/23	
D	REVISED PER COMMENTS	JWC	08/17/22	
C	REVISED PER SITE VISIT	JWC	08/15/22	
B	REVISED PER COMMENTS	JWC	03/22/21	
A	ISSUED FOR REVIEW	JWC	03/20/21	

**SMG**  
Smith Monroe Gray  
ENGINEERS, INC.

8625 SW Cascade Ave.  
Suite 800  
Beaverton, Oregon 97008  
Phone: 503.643.8595  
Fax: 503.643.8810  
www.smgenr.com

**LAKESIDE INDUSTRIES**  
OLYMPIA, WASHINGTON  
ASPHALT PELLET PLANT  
PROCESS FLOW DIAGRAM

DRAWN BY JWC	DATE 03/20/21	CHK'D BY	DATE	SCALE AS NOTED	DWG. NO. 21-059B-01	REV. E
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FILE: C:\1\1009 LAKESIDE INDUSTRIES OLYMPIA PELLET PLANT\PHASE II PELLETERING PLANT - LAYOUT\DWG\21-059B-01.dwg, PLOT: 1-1, 07/20/23 AT 11:50, Printed By: Vofehr

## **Portable Asphalt Pellet Manufacturing Facility Process Flow Diagram NOTES:**

### **Facility Description**

The Portable Asphalt Pellet Manufacturing facility produces pelletized asphalt cement using reclaimed raw material products as a sustainable alternative to conventional liquid asphalt for use in the manufacture of products requiring asphalt cement.

Equipment used to manufacture the pelletized asphalt includes raw material transfer, pelleter, final product transfer, and storage equipment. The manufacturing process takes place under cover and is electrically powered by line power.

Raw material feedstock includes recycled asphalt cement grindings product, bio-oil produced from recycled fats and oils, and a dry additive. The pellets are formed by mixing approximately 77% recycled asphalt cement grindings product with 6% binding agent (bio-oil) in a primary pelleter. The formed asphalt pellets are then lightly coated in a secondary pelleter with a dry additive to harden the pellet shell preventing individual pellets from sticking together. A finishing Tumbler ensures coating is uniform prior to storage.

The recycled asphalt cement grinding product is from reclaimed roofing shingles. A facility in Centralia imports reclaimed architectural and 3-tab roofing shingles from manufacturer's new roofing shingle reject and asbestos free tear-off shingles. The asphalt roofing shingles are resized by grinding creating recovered asphalt cement feedstock for use. The ground shingles are sampled and lab tested to confirm the asphalt cement feedstock product is asbestos free.

At the Asphalt Pellet Manufacturing facility, the recycled asphalt cement product is imported in bulk via truck and stored under cover in piles, bio-oil is imported in bulk and stored under cover in storage tanks, and dry additive is delivered in bulk and stored in a 30-ton silo. See Attachment A for a copy of the most recent reclaimed roofing shingle asbestos testing, and copies of the Safety Data Sheets for the binding agent and dry additive feedstocks.

### **Production and Material Feed Rates**

The facility has the capability of producing 15 tons of asphalt pellets per hour and 105 tons of asphalt pellets per day. The facility operates on demand; therefore, annual production will vary. Raw material feed rates based on maximum production of 15 tons/hour are as follows:

Recycled Asphalt Product: 11.5 tons/hour

Binding Liquid: 1 ton/hour

Dry Additive: 2.5 tons/hour



## **Portable Asphalt Pellet Manufacturing Facility Process Flow Diagram NOTES:**

### **Fugitive Dust Control Description**

The recycled asphalt product feedstock does not produce fugitive dust at material transfer points. There is a potential for fugitive dust from: dry additive material transfer points; screening of the final asphalt pellet product following dry additive coating at the secondary pelleter; and final product load-out into trucks for transport.

### **Dry Additive Silo Operation and Vent Filter Dust Control**

Dry Additive (hydrated lime (calcium hydroxide)) is delivered and stored in a 30-ton silo. The dry additive is pneumatically conveyed from a delivery truck to the top of the silo. A stationary blower supplies low pressure air. A filter on the top of the silo cleans the conveying air before it exits the silo. A filter shaker mechanism actuates at the conclusion of the filling cycle to knock the accumulated dust off the inside of the filter bags where it falls back into the silo. Filter bag material is selected to be compatible with the dry additive in use.

The top of silo vent filter installed on the silo is for the control of pneumatically filled silos and is commonly used for control of hydrated lime storage and transfer. Vent filter details are as follows:

- Dimensions: 3ft x 3ft x 7.5ft
- 36 – Destex polyester Dacron® filter bags
- Mechanical shaker cleaning mechanism

Attachment B provides details of a like-in-kind silo vent filter and filter bags used.

### **Dust Control Baghouse**

A cartridge filter baghouse collects potential fugitive emissions from Primary and Secondary Pelleters and Tumbler. The baghouse is designed for manufacturing environments that include bulk powder handling. Nanofiber filtration media removes submicron dust particles to control air quality in the covered manufacturing areas. Baghouse details are as follows:

- Make and Model: UAS Baghouse Model #SFC 24-3 (19075)
- 24 Nanofiber Cartridges
- Total filter media area = 6,120 ft
- 12,000 CFM
- Pulse jet cleaning mechanism

**Portable Asphalt Pellet Manufacturing Facility Process Flow Diagram NOTES:**

Attachment C provides dimensions and specifications for the SFC Series Downward Flow Cartridge Dust Collector and nanofiber filtration.

**Wet Suppression Systems**

Wet suppression for secondary control of fugitives around the secondary pelleter includes an atomizing spray system with four spray nozzles that produces a finely atomized, low-capacity spray in a hollow cone pattern without the use of compressed air. Wet suppression is not used around the primary pelleter because application of liquid binder in the pelletizer mitigates dust formation. Spray system details are as follows:

- Spraying System Co. Atomizing spray nozzles
- TN-3 Cone Spray Tip
- Operating pressure: 40 psi
- Water flow rate: 3 GPH

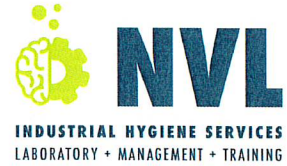
Attachment D provides additional specifications for the atomizing nozzles.

Wet suppression for final 3/4" Minus product screen and Finalized Product Silo load-out are standard generic irrigation mister nozzles operating at 40 psi water pressure to produce a fine mist that controls residual fugitive dust from the powder coated asphalt pellet.

## NOTES - ATTACHMENT A



June 12, 2023



Ben Bailey  
Lakeside Industries  
PO Box 7016  
Issaquah, WA 98027

**RE: Bulk Asbestos Fiber Analysis; NVL Batch # 2308844.00**

Client Project: RAS  
Location: Centralia Grinder

Dear Mr. Bailey,

Enclosed please find test results for the 1 sample(s) submitted to our laboratory for analysis on 6/5/2023.

Examination of these samples was conducted for the presence of identifiable asbestos fibers using polarized light microscopy (PLM) with dispersion staining in accordance with **U. S. EPA 40 CFR Appendix E to Subpart E of Part 763**, Interim Method for the Determination of Asbestos in Bulk Insulation Samples and **EPA 600/R-93/116**, Method for the Determination of Asbestos in Bulk Building Materials.

For samples containing more than one separable layer of materials, the report will include findings for each layer (labeled Layer 1 and Layer 2, etc. for each individual layer). The asbestos concentration in the sample is determined by calibrated visual estimation.

For those samples with asbestos concentrations between 1 and 10 percent based on visual estimation, the EPA recommends a procedure known as point counting (NESHAPS, 40 CFR Part 61). Point counting is a statistically more accurate means of quantification for samples with low concentrations of asbestos.

The detection limit for the calibrated visual estimation is <1%, 400 point counts is 0.25% and 1000 point counts is 0.1%

Samples are archived for two weeks following analysis. Samples that are not retrieved by the client are discarded after two weeks.

Thank you for using our laboratory services. Please do not hesitate to call if there is anything further we can assist you with.

Sincerely,

Kunga Woser, Senior Laboratory Analyst

Testing

Lab Code: 102063-0

Enc.: Sample Results

Phone: 206 547.0100 | Fax: 206 634.1936 | Toll Free: 1.888.NVL.LABS (685.5227)  
4708 Aurora Avenue North | Seattle, WA 98103-6516





# Bulk Asbestos Fibers Analysis

By Polarized Light Microscopy

Client: Lakeside Industries  
Address: PO Box 7016  
Issaquah, WA 98027

**Batch #: 2308844.00**  
Client Project #: RAS  
Date Received: 6/5/2023  
Samples Received: 1  
Samples Analyzed: 1  
Method: EPA/600/R-93/116

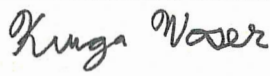
**Attention: Mr. Ben Bailey**  
Project Location: Centralia Grinder

**Lab ID: 23053970      Client Sample #: 1**

Location: Centralia Grinder

**Layer 1 of 1      Description:** Black asphaltic crumbly elastic material with debris

	Non-Fibrous Materials:	Other Fibrous Materials: %	<b>Asbestos Type: %</b>
Asphalt/Binder, Asphaltic Particles, Rubber/Binder		Glass fibers 24%	<b>None Detected ND</b>
Debris, Mineral grains, Granules		Cellulose 12%	
Fine grains, Wood flakes, Plastic			

<b>Sampled by:</b> Client		
<b>Analyzed by:</b> Muhammad Yousuf	<b>Date:</b> 06/09/2023	
<b>Reviewed by:</b> Kunga Woser	<b>Date:</b> 06/12/2023	Kunga Woser, Senior Laboratory Analyst

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using both EPA 600/R-93/116 and EPA 40 CFR Appendix E to Subpart E of Part 763 with the following measurement uncertainties for the reported % Asbestos (1%=0-3%, 5%=1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If sample was not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the US Government

# ASBESTOS LABORATORY SERVICES



Company Lakeside Industries	NVL Batch Number <b>2308844.00</b>
Address PO Box 7016	TAT 5 Days AH No
Issaquah, WA 98027	Rush TAT
Project Manager Mr. Ben Bailey	Due Date 6/12/2023 Time 8:00 AM
Phone (425) 313-2600	Email ben.bailey@lakesideindustries.com
Cell (360) 349-7368	Fax () -

**Project Name/Number:** RAS                      **Project Location:** Centralia Grinder

**Subcategory** PLM Bulk

**Item Code** ASB-02                      EPA 600/R-93-116 Asbestos by PLM <bulk>

**Total Number of Samples** 1                      Rush Samples \_\_\_\_\_

Lab ID	Sample ID	Description	A/R
1	23053970	1	A

	Print Name	Signature	Company	Date	Time
<b>Sampled by</b>	Client				
<b>Relinquished by</b>	Drop Box				

Office Use Only	Print Name	Signature	Company	Date	Time
<b>Received by</b>	Kelly AuVu		NVL	6/5/23	800
<b>Analyzed by</b>	Muhammad Yousuf		NVL	6/9/23	
<b>Results Called by</b>					
<input type="checkbox"/> Faxed <input type="checkbox"/> Emailed					

**Special Instructions:** \_\_\_\_\_

Date: 6/5/2023  
 Time: 8:39 AM  
 Entered By: Kelly AuVu

2308844



# ASBESTOS CHAIN OF CUSTODY

- Turn Around Time
- 1 Hour
  - 2 Hours
  - 4 Hours
  - 24 Hours
  - 2 Days
  - 3 Days
  - 4 Days
  - 5 Days
  - 10 Days

Please call for TAT less than 24 Hours

Company Lakeside Industries Project Manager Ben Bailey  
 Address 8840 OLD HIGHWAY 99 SE Cell (360) 349-7368  
Olympia, WA 98501 Email ben.bailey@lakesideind.com  
 Phone (360) 349-7368 Fax ( )

Project Name/Number RAS Project Location CENTRALIA GRINDER

- PCM Air (NIOSH 7400)
- PLM (EPA 600/R-93-116)
- PLM Gravimetry (600/R-93-116)
- Asbestos Friable/Non-Friable (EPA 600/R-93/116)
- TEM (NIOSH 7402)
- EPA 400 Points (600/R-93-116)
- Asbestos in Vermiculite (EPA 600/R-04/004)
- Other
- TEM (AHERA)
- EPA 1000 Points (600/R-93-116)
- Asbestos in Sediment (EPA 1900 Points)
- TEM (EPA Level II Modified)

Reporting Instructions \_\_\_\_\_  
 Call ( )  Fax ( )  Email

### Total Number of Samples

Sample ID	Description	A/R
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

	Print Name	Signature	Company	Date	Time
Sampled by					
Relinquish by	<u>Ben Bailey</u>	<u>[Signature]</u>	<u>Lakeside Ind.</u>	<u>5/30/23</u>	

### Office Use Only

	Print Name	Signature	Company	Date	Time
Received by	<u>Kenn Aron</u>	<u>[Signature]</u>	<u>huv</u>	<u>6/5/23</u>	<u>800 AM</u>
Analyzed by					
Called by					
Faxed/Email by					



Hydrated Lime – January 27, 2020

SAFETY DATA SHEET

SECTION 1	IDENTIFICATION
-----------	----------------

Product

Name: Hydrated Lime

Other Names: Hydrate; High-Calcium Hydrated Lime

Recommended Uses: Water Treatment; pH adjustment; FGT; Construction

Company Identification:

US Operations:

Lhoist North America, Inc.  
5600 Clearfork Main St, Ste. 300  
Fort Worth, TX 76109  
817-732-8164

Canadian Operations:

Lhoist North America of Canada, Inc.  
20303-102B Ave.  
Langley, BC V1M 3H1  
604-888-4333

Emergency Phone Number:

Chemtrec 1-800-424-9300

SECTION 2	HAZARDS(S) IDENTIFICATION
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Classification

Eye Damage – Category 1

Carcinogen – Category 1

Skin Irritation – Category 2

Specific Target Organ Toxicity Single Exposure – Category 3  
(Respiratory System)

Specific Target Organ Toxicity Repeat Exposure – Category 1  
(Respiratory System)

Labeling:

Pictograms:



Signal Word(s): Danger





Hydrated Lime – January 27, 2020

- Hazard Statements: Causes serious eye damage.  
Causes skin irritation.  
May cause respiratory irritation.  
Causes damage to lungs through prolonged or repeated exposure when inhaled.  
May cause cancer through inhalation.

Precautionary Statements:

Wear protective gloves and eye protection. Wash exposed skin thoroughly after handling. Do not breathe dust. Use only outdoors or in a well-ventilated area. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not eat, drink or smoke when using this product.

If on skin: wash exposed skin with plenty of water. If skin irritation occurs: Get medical attention. Take off contaminated clothing and wash it before reuse.

If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing. Seek medical attention immediately. If inhaled: Remove person to fresh air and keep comfortable for breathing. Seek medical attention if you feel unwell.

If exposed or concerned: Get medical advice

Dispose of contents or containers in accordance with applicable regulations.

Other Hazards: None.

SECTION 3	COMPOSITION/ INFORMATION ON INGREDIENTS
-----------	---

Chemical Name: Calcium hydroxide

Common names and synonyms: Hydrate; High-Calcium Hydrated Lime

Chemical Identity	CAS #	Concentration, % Wt.
Calcium Hydroxide	1305-62-0	> 90%
Magnesium Oxide	1309-48-4	< 3%
Crystalline Silica	14808-60-7	< 2%





SECTION 4	FIRST AID MEASURES
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**Eye Contact:** Contact can cause severe irritation or burning of eyes, including permanent damage. Immediately flush eyes with generous amounts of water for as long as needed. This may take several minutes. Pull back the eyelid to ensure that all lime dust has been washed out. Seek medical attention immediately. Do not rub eyes.

**Inhalation:** This product can cause severe irritation of the respiratory system. Move victim to fresh air. Seek medical attention if necessary. If breathing has stopped, give artificial respiration.

**Skin Contact:** Contact can cause severe irritation or burning of skin, especially in the presence of moisture. Wash exposed area with large amounts of water. Seek medical attention immediately.

**Ingestion:** This product can cause severe irritation or burning of gastrointestinal tract if swallowed. Do not induce vomiting. Seek medical attention immediately. Never give anything by mouth unless instructed to do so by medical personnel.

**Most important symptoms and effects, both acute and delayed:** Irritation of skin, eyes, gastrointestinal tract or respiratory tract. Long-term exposure by inhalation may cause permanent damage. This product contains crystalline silica, which has been classified by IARC as (Group I) carcinogenic to humans when inhaled. Inhalation of silica can also cause a chronic lung disorder, silicosis.

**Note to Physician:** Provide general supportive measures and treat symptomatically.

SECTION 5	FIREFIGHTING MEASURES
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**Extinguishing Media**

**Appropriate Extinguishing Media:** Use dry chemical fire extinguisher

**Inappropriate Extinguishing Media:** Do not use halogenated compounds.

**Firefighting**

**Fire Hazards:** Hydrated Lime is not combustible or flammable. Hydrated Lime is not considered to be an explosive hazard, although reaction with incompatible materials may rupture containers.



Hazardous Combustion Products: None

Special Protective Equipment and Fire Fighting Instructions: Keep personnel away from and upwind of fire. Wear full fire-fighting turn-out gear (full Bunker gear), and respiratory protection (SCBA).

SECTION 6	ACCIDENTAL RELEASE MEASURES
-----------	-----------------------------

Personal Precautions: Use proper protective equipment.

Environmental Precautions: For large spills, as much as possible, avoid the generation of dusts. Prevent release to sewers or waterways.

Methods and Materials for Containment and Cleaning Up:

Small Spills: Use dry methods to collect spilled materials. Avoid generating dust. Do not clean up with compressed air. Store collected materials in dry, sealed plastic or metal containers. Residue on surfaces may be washed with water or dilute vinegar.

Large Spills: Use dry methods to collect spilled materials. Evacuate area downwind of clean-up operations to minimize dust exposure. Store spilled materials in dry, sealed plastic or metal containers.

SECTION 7	HANDLING AND STORAGE
-----------	----------------------

Precautions for Safe Handling: Keep in tightly closed containers. Protect containers from physical damage. Avoid direct skin contact with the material.

Conditions for Safe Storage, Including any Incompatibilities: Store in a cool, dry, and well-ventilated location. Do not store near incompatible materials (see Section 10 below). Keep away from moisture. Do not store or ship in aluminum containers.

SECTION 8	EXPOSURE CONTROLS/ PERSONAL PROTECTION
-----------	--

Control Parameters:

Component	CAS #	Exposure Limits
Calcium Hydroxide	1305-62-0	OSHA PEL: 15 mg/m <sup>3</sup> (total) 5 mg/m <sup>3</sup> (respirable) ACGIH TLV: 5 mg/m <sup>3</sup>
Magnesium Oxide	1309-48-4	OSHA PEL: 15 mg/m <sup>3</sup> ACGIH TLV: 10 mg/m <sup>3</sup>
Crystalline Silica	14808-60-7	OSHA PEL: 0.050 mg/m <sup>3</sup> as an 8 hr. TWA (respirable) ACGIH TLV: 0.025 mg/m <sup>3</sup> (respirable)



## Hydrated Lime – January 27, 2020

Appropriate Engineering Controls: Provide ventilation adequate to maintain PELs.

### Personal Protection

Respiratory Protection: Use NIOSH approved respirators if airborne concentration exceeds PEL.

Eye Protection: Use safety glasses with side shields or safety goggles. Contact lenses should not be worn when working with lime products.

Skin Protection: If there is a risk of skin contact, wear appropriate clothing and gloves to prevent contact.

Other: Eye wash fountain and emergency showers are recommended.

SECTION 9	PHYSICAL AND CHEMICAL PROPERTIES
-----------	----------------------------------

### Appearance

Physical State:	Solid
Color:	White
Odor:	Odorless
Odor Threshold:	N/ A
pH:	12.44 @ 25° C when made into a saturated solution
Melting Point:	N/ AF
Initial Boiling Point:	N/ A
Freezing Point:	N/ A
Flash Point:	N/ A
Evaporation Rate:	N/ A
Flammability (solid, gas):	Non-flammable
Explosion Limits:	N/ A
Vapor Pressure:	N/ A
Vapor Density:	N/ A
Relative Density:	0.4 – 0.7 g/ cm <sup>3</sup> (apparent)
Solubility(ies):	Solubility is 1.6 g/L at 25° C





Partition coefficient: Relatively insoluble

Auto-ignition Temperature: N/A

Decomposition Temperature: 580° C / 1076° F

Viscosity: N/A

SECTION 10	STABILITY AND REACTIVITY
------------	--------------------------

Reactivity:

Chemical Stability: Hydrated Lime is chemically stable.

Possibility of Hazardous Reactions: See reactivity above

Conditions to Avoid: Do not allow Hydrated Lime to come into contact with incompatible materials.

Incompatible Materials: Hydrated Lime should not be mixed or stored with the following materials, due to the potential for violent reaction and release of heat:

- Acids (unless in a controlled process)
- Reactive Fluoridated Compounds
- Reactive Brominated Compounds
- Reactive Powdered Metals
- Organic Acid Anhydrides
- Nitro-Organic Compounds
- Reactive Phosphorous Compounds
- Interhalogenated Compounds

Hazardous Decomposition Products: None

SECTION 11	TOXICOLOGICAL INFORMATION
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Health Effects: see First Aid discussion in Section 4

Routes of Exposure: see First Aid discussion in Section 4

Symptoms Related to Exposure: see First Aid discussion in Section 4

Carcinogen Listing: Hydrated Lime is not listed by MSHA, OSHA, or IARC as a carcinogen, but this product contains crystalline silica, which has been classified by IARC as (Group I) carcinogenic to humans when inhaled.

SECTION 12	ECOLOGICAL INFORMATION
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Ecotoxicity: Because of the high pH of this product, it would be expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems in high concentrations.



**Hydrated Lime – January 27, 2020**

**Persistence and Degradability:** Reacts with atmospheric CO<sub>2</sub> over time to form calcium carbonate

**Bioaccumulation Potential:** This material shows no bioaccumulation effect or food chain concentration toxicity.

**Mobility in Soil:** Minimal mobility in soil. Reacts with clay portion of soil to form calcium silicates and calcium aluminates

**Other Adverse Effects:** This material is alkaline and if released into water or moist soil will cause an increase in pH

<b>SECTION 13</b>	<b>DISPOSAL CONSIDERATIONS</b>
-------------------	--------------------------------

**Disposal Recommendations:** Dispose of in accordance with all applicable federal, state, and local environmental regulations.

**Regulatory Disposal Information:** If this product as supplied, and unmixed, becomes a waste, it will not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act.

<b>SECTION 14</b>	<b>TRANSPORT INFORMATION</b>
-------------------	------------------------------

**UN Number:** Not Regulated

**UN Proper Shipping Name:** Not Regulated

**Transport Hazard Class(es):** Not Regulated

**Packing Group:** Not Regulated

**Marine Pollutant (y/n):** This material is alkaline and if released into water or moist soil will cause an increase in pH.

**Special Precautions:** None

<b>SECTION 15</b>	<b>REGULATORY INFORMATION</b>
-------------------	-------------------------------

**National Chemical Inventory Listings:**

All chemical ingredients are listed on the USEPA TSCA Inventory List.

**US Regulations:**

- RCRA Hazardous Waste Number: not listed (40 CFR 261.33)
- RCRA Hazardous Waste Classification (40 CFR 261): not classified
- CERCLA Hazardous Substance (40 CFR 302.4) unlisted specific per RCRA, Sec. 3001; CWA, Sec. 311 (b) (4); CWA, Sec. 307(a), CAA, Sec. 112
- CERCLA Reportable Quantity (RQ) not listed.
- SARA 311/312 Codes: not listed.
- SARA Toxic Chemical (40 CFR 372.65): not listed.
- SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed, Threshold Planning Quantity (TPQ): not listed





**Hydrated Lime – January 27, 2020**

Specific State Regulations: **⚠ WARNING:** This product can expose you to chemicals, including crystalline silica, which is known to the State of California to cause cancer. For more information, go to [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov)

These naturally occurring impurities may also be regulated by other States.

Canadian DSL: Listed

Canadian NPRI: None of the components are listed

CEPA Toxic Substances: None of the components are listed

SECTION 16	OTHER INFORMATION
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Prepared By: Lhoist North America Technical Services

Date Prepared: January 27, 2020

Revision: 2020-1

**Abbreviations:**

- N/A Not Available or Not Applicable
- IARC International Agency for Research on Cancer
- IATA International Air Transport Association
- ACGIH American Conference of Governmental Industrial Hygienists
- TWA Time Weighted Average
- PEL Permissible Exposure Limit
- TLV Threshold Limit Value
- REL Recommended Exposure Limit

*Lhoist North America provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person. Individuals receiving this information must consult their own technical and legal advisors and/or exercise their own judgment in determining its appropriateness for a particular purpose. Lhoist North America makes no representations or warranties, either express or implied, including without limitation and warranties of merchantability or fitness for a particular purpose with respect to the Information set forth herein or the product(s) to which the information refers. Accordingly, Lhoist North America will not be responsible or liable for any claims, losses or damages resulting from the use of or reliance upon or failure to use this information.*



# Safety Data Sheet (SDS)

ID: SDS 105-US


## Section 1 – Identification

Product identifier	REG Bio-Residual Oil
Other means of identification	
Synonyms	Heavy Esters, bioester, Methyl Ester distillation residue, pitch, biodiesel bottoms, industrial fuel, BioResidual Oil
Recommended use	Industrial feedstock / blendstock
Restrictions on use	Not intended for direct human consumption
Supplier information	REG Marketing & Logistics Group, LLC 416 S. Bell Ave Ames, IA 50010 (888) 734-8686
Emergency phone number	Call ChemTel LLC for emergency service 24 hours a day (800) 255-3924 (North America) +1 (813) 248-0585 (International)

## Section 2 – Hazard(s) Identification

### Classification (in accordance with 29 CFR 1910.1200)

Hazard Class	Hazard Category	Route of Exposure
Skin Irritation	Category 2 (irritation)	Absorption
Eye Irritation	Category 2B (mildly irritating)	Absorption

Signal word	Warning
Pictograms	
Hazard Statements	H315 Causes skin irritation H320 Causes eye irritation
Ingredient(s) with unknown acute toxicity (if ≥ 1%)	This product is not classified based on testing of the mixture as a whole. Up to 100% of this mixture contains ingredients of unknown acute toxicity.
Precautionary statements	
Prevention	Wear appropriate protective gloves, protective garments, and eye protection. Avoid breathing mists and sprays.
Response	If on skin, wash thoroughly with soap and water. Take off contaminated clothing and wash it before reuse. If skin irritation or rash occurs, get medical advice. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If irritation persists: Get medical attention.



# Safety Data Sheet (SDS)

ID: SDS 105-US

Storage Store in cool tightly closed container

Disposal Dispose of contents/container in accordance with local, state, and federal regulations.

Hazards not otherwise specified None identified

## Section 3 – Composition / Information on Ingredients

Note: This SDS represents a product with batch-to-batch variability and/or a group of substantially similar mixtures

Chemical Name	Common Name & Synonyms	CAS number	% of product
Fatty acids, C14-18 and C16-18-unsatd., Me esters	Methyl esters, biodiesel	67762-26-9	20 – 85%
Glycerides, C14-C22 & C16-C22 unsaturated	Glycerides	68424-59-9	20 – 50%
Various unsaponified compounds from vegetable oils and animal fats	Not applicable	NA	10 – 40%
Fat / Oil feedstock (mixed)	Fat / Oil feedstock (mixed)	129828-20-2	10 – 20%

## Section 4 – First-Aid Measures

First-aid measures for exposure

Inhalation Move to fresh air

Skin Wash affected skin with soap and water.

Eyes Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

Ingestion Take off contaminated clothing and wash it before reuse.

Most important symptoms / effects

Acute May cause eye and skin irritation.

Delayed / Chronic No information available

Indication of immediate medical attention Treat symptomatically and supportively.

Special treatment needed, if necessary No special treatment identified.

## Section 5 – Fire-Fighting Measures

Suitable extinguishing media Water mist, firefighting foam, dry chemical, carbon dioxide, or clean extinguishing agents (such as Halon or Halotron)



# Safety Data Sheet (SDS)

ID: SDS 105-US

Unsuitable extinguishing media	Do not use a solid water stream, as it may scatter and spread the fire
Specific hazards arising from the chemical	May burn if heated, but does not readily ignite. Materials saturated with this product, such as oily rags, used oil dri, soaked insulation pads, etc., may spontaneously combust due to product decomposition in the presence of oxygen. Place all such materials into appropriate oily waste containers (such as metal cans with metal lids or oily waste dumpsters with lids), and dispose of according to local, state, and federal regulations.
Hazardous combustion products include	Carbon monoxide, carbon dioxide, nitrogen oxides, and hydrocarbons
Protective equipment and precautions for firefighters	Incipient stage fires may be controlled with a portable fire extinguisher. For fires beyond the incipient stage, evacuate all unnecessary personnel. Emergency responders in the immediate area should wear standard firefighting protective equipment, including self-contained breathing apparatus (SCBA) and full bunker gear. In case of external fires in proximity to storage containers, use water spray to keep containers cool, if it can be done safely. Prevent runoff from entering streams, sewers, storm drains, or drinking water supply.

## Section 6 -- Accidental Release Measures

Personal precautions, protective equipment, and emergency procedures	Keep all sources of ignition away from spill. Wear protective garments, impervious oil resistant boots, protective chemical-resistant gloves, and safety glasses. If product has been heated, wear appropriate thermal and chemical protective equipment. If splash is a risk, wear splash resistant goggles and face shield. Shut off source of spill, if safe to do so. Contain spill to the smallest area possible. Isolate immediate hazard area and remove all nonessential personnel. Prevent spilled product from entering streams, sewers, storm drains, unauthorized treatment drainage systems, and natural waterways. Place dikes far ahead of the spill for later recovery and disposal. Immediate cleanup of any spill is recommended. <b>If material spills into or upon any navigable waters and causes a film or sheen on the surface of the water, immediately notify the National Response Center at 1-800-424-8802.</b>
Methods for containment and clean-up	
Small spill / incidental release	Small spills can be cleaned up with a properly rated vacuum system, absorbent inert media (oil dri, sand, or earth), or absorbent pads. Use soapy water or degreaser to remove oily residue from the affected area, then rinse area with water. Place saturated materials in an appropriate oily waste container (metal can with a metal lid or an enclosed oily waste dumpster), and dispose of according to local, state, and federal regulations.
Large spill / release	A spill remediation contractor with oil booms and skimmers may be needed for larger spills or spills that come into contact with a waterway or sensitive wetland. Recover as much product as possible by pumping it into totes or similar intermediate containers. Remove any remaining product with a properly rated vacuum system, absorbent inert media (oil dri, sand, or earth), or absorbent pads. Use soapy water or degreaser to remove oily residue from the affected area, then rinse area with water. Place saturated materials in an appropriate oily waste container (metal can with a metal lid or an enclosed oily waste dumpster), and dispose of according to local, state, and federal regulations.



# Safety Data Sheet (SDS)

ID: SDS 105-US

Other information

Materials saturated with this product, such as oily rags, used oil dri, soaked insulation pads, etc., may spontaneously combust due to product decomposition in the presence of oxygen. Place all such materials into appropriate oily waste containers (such as metal cans with metal lids or oily waste dumpsters with lids), and dispose of according to local, state, and federal regulations.

## Section 7 – Handling and Storage

Precautions for safe handling

Store the product in a cool dry place, in a tightly closed container. When transferring product, use pipes, hoses, and tanks that are electrically bonded and grounded to prevent the accumulation of static electricity. Storage tanks should have an appropriate ventilation and pressure relief system.

Conditions for safe storage, including incompatibilities

Keep away from strong oxidizing agents, strong reducing agents, strong acids, and strong bases.

## Section 8 – Exposure Controls / Personal Protection

Precautions for safe handling

Component exposure limits

At this time, the constituents have no known exposure limits.

Appropriate engineering controls

Keep product enclosed in primary containment (hoses, pipes, tanks, etc.) to avoid contact with skin. Handle in accordance with good industrial hygiene and safety practices.

Individual Protection Measures

Personal protective equipment

Eyes / face

Wear safety glasses. If splash potential exists, use splash resistant goggles and a face shield.

Skin

Wear disposable nitrile or other similar chemical-resistant gloves for incidental contact. For more substantial contact, wear thicker nitrile or other similar chemical-resistant gloves. Wear protective garments, such as a chemical apron, chemical resistant coveralls, or chemical resistant coat and pants, along with impervious oil-resistant boots. Remove soaked protective equipment, decontaminate with soapy water, and rinse thoroughly before reuse. **Note:** product will cause natural rubbers to degrade at a very rapid rate. Such protective equipment will need to be carefully inspected after decontamination to see if it is still in serviceable condition. Any defective or worn out equipment should be immediately discarded.

Respiratory

No exposure limits are available, but appropriate organic vapor or supplied air respiratory protection may be worn if irritation or discomfort is experienced. Respiratory protection must be provided and used in accordance with all local, state, and federal regulations.



# Safety Data Sheet (SDS)

ID: SDS 105-US

## Section 9 – Physical and Chemical Properties

<b>Appearance - Physical State:</b>	Liquid	<b>Appearance - Color:</b>	Viscous, brown
<b>Odor:</b>	Mild fatty odor	<b>Odor Threshold:</b>	No information available
<b>pH:</b>	6 – 8 pH (varies by batch)	<b>Melting/Freezing Point:</b>	<110 °F
<b>Boiling Point/Range:</b>	No information available	<b>Flash Point:</b>	>130 °C (>266 °F)
<b>Evaporation Rate:</b>	No information available	<b>Flammability (solid/gas):</b>	No information available
<b>LFL:</b>	No information available	<b>UFL:</b>	No information available
<b>Vapor Pressure:</b>	Reid Vapor Pressure = 0 @ 98 °F	<b>Vapor Density:</b>	No information available
<b>Relative Density:</b>	0.86 – 0.95 g/mL @ 60 °C	<b>Volatile Organic Compounds:</b>	No information available
<b>Solubility (H<sub>2</sub>O):</b>	No information available	<b>Solubility (other):</b>	No information available
<b>Auto Ignition Temp.:</b>	No information available	<b>Decomposition Temp.:</b>	No information available
<b>Viscosity:</b>	4 – 100 cSt @ 60 °C	<b>Partition coefficient (n-octanol/water):</b>	No information available

## Section 10 – Stability and Reactivity

Reactivity	When handled and stored appropriately, no dangerous reactions are known
Chemical stability	Stable in closed containers at room temperature under normal storage and handling conditions
Possibility of hazardous reactions	When handled and stored appropriately, no dangerous reactions are known  See Sections 5 and 6 regarding spontaneous combustion of product-saturated absorbent materials.
Conditions to avoid	Ignition sources, accumulation of static electricity, heating product to its flash point, or allowing the product to cool below its melting point (otherwise it may solidify and not be transferable until it is reheated).
Incompatible materials	Keep away from strong oxidizing agents, strong reducing agents, strong acids, and strong bases.
Hazardous decomposition products	Carbon oxides, hydrogen sulfide, nitrogen oxides, and hydrocarbons

## Section 11 – Toxicological Information

Likely routes of exposure	Absorption, Ingestion, and Inhalation
Symptoms	
Inhalation	Coughing or Irritation
Ingestion	Nausea, vomiting, or feeling unwell
Skin contact	Redness or Irritation
Eye contact	Redness or Irritation and tearing
Acute toxicity	
Oral	No Information available
Dermal	No information available



# Safety Data Sheet (SDS)

ID: SDS 105-US

Inhalation	No information available
Skin corrosion / irritation	rat) after 24 hr exposure, some irritation which subsided within 12 – 14 days (human) after 24 hr exposure, some minor irritation (less than that of a 4% soap & water solution)
Serious eye damage / eye irritation	Industrial experience has shown that product in the eyes can cause redness and irritation which subsides within 7 days.
Sensitization ( <i>Respiratory or Skin</i> )	No information available
Germ cell mutagenicity	No information available
Carcinogenicity	This product is not listed as a carcinogen by NTP, IARC, or OSHA.
Component carcinogenicity	Not applicable
Reproductive / developmental toxicity	No information available
Specific target organ toxicity	
Single exposure	No information available
Repeated exposure	No information available
Aspiration hazard	No information available

## Section 12 – Ecological Information

Acute ecotoxicity - short-term exposure	
Fish	48hr LC50 (rainbow trout) 2.8-4.6 ug/L 96hr LC50 (bluegill) >1000mg/L
Invertebrates	LC-50 (Daphnia Manga) 23 ppm
Algae	No information available
Acute ecotoxicity - long-term exposure	NOEL >100mg/L (fish, invertebrate, and algae)
Persistence and degradability	Product is biodegradable in aerobic conditions (90% biodegraded within 23 days)
Bioaccumulative potential	Accumulation in organisms is not to be expected
Mobility in soil	No information was available
Other adverse effects	No information was available





# Safety Data Sheet (SDS)

ID: SDS 105-US

## Section 13 – Disposal Considerations

Disposal (*waste / unwanted product*)

This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate local, state, regional, or federal regulations for additional requirements.

Disposal (*containers with residue*)

Dispose of all containers with residue according to local, state, regional, and federal regulations.

## Section 14 – Transport Information

### DOT

ID Number	Not Regulated as a hazardous material
UN Proper Shipping Name	Not Regulated as a hazardous material
Transport Hazard Class(es)	Not Regulated as a hazardous material
Packing Group	Not Regulated as a hazardous material
Placard	Not Regulated as a hazardous material
Marine Pollutant	No
Transport In Bulk Requirements	Not Regulated as a hazardous material
Special Transportation Provisions	Not Regulated as a hazardous material
Special Note	Not Regulated as a hazardous material

Shipping Label

None

Placard

None

(*Shipment by truck or rail in bulk*)

## Section 15 – Regulatory Information

### Inventory Listings

DSL

Listed  Exempt

TSCA

Listed  Exempt

### U.S. Federal Regulations

**CERCLA:** This material, as supplied, does not contain any chemicals regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

**Clean Water Act:** This product does not contain any chemicals regulated as toxic pollutants pursuant to the Clean Water Act (40 CFR 401.15) when used as recommended.





# Safety Data Sheet (SDS)

ID: SDS 105-US

## SARA 311/312 Hazard Categories

Hazard Class
Skin Irritation
Eye Irritation
<input type="checkbox"/> Hazard Not Otherwise Classified (HNOC) – see Section 2 for more information

**SARA 313:** Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

## U.S. State Regulations

### California Proposition 65:

This product does not contain any Proposition 65 chemicals.

### U.S. State Right-to-Know Regulations:

Component	State
Oleic Acid	Pennsylvania, Rhode Island

## International Regulations

### European Union Regulations

#### European Chemicals Agency (ECHA)

Fatty acids, C6-24 and C6-24-unsatd., Me esters, distn. residues

EC | 310-083-8

REACH | 01-2119552408-36-0021

Tonnage Band | over 1000 tonnes/year

Fatty acids, C14-18 and C16-18-unsatd., Me esters

EC | 267-007-0

REACH | 01-2119471662-36-0039

Tonnage Band | over 1000 tonnes/year

## Section 16 – Other Information

Issuing Date: Jun 04, 2013

Revision Date: Jan 11, 2021

Version #: 202101011

Revision Notes: Replaced acronym VOC in Section 9. Replaced language for consistence with DOT in Section 14. Updated REACH Registration information, removed hazard category and added check box for HNOC for SARA 311/312 in Section 15.

WARNING: POTENTIALLY HAZARDOUS MATERIAL. IMPROPER USE OR MISHANDLING CAN RESULT IN SERIOUS INJURY OR DEATH. THIS PRODUCT CONTAINS SUBSTANCES WHICH, IF MODIFIED, MAY BE FLAMABLE AND MAY BURN OR EXPLODE IF HEATED OR EXPOSED TO FLAME OR OTHER IGNITION SOURCE OR WATER, OXIDIZING AGENTS, ACIDS OR OTHER CHEMICALS. AVOID INGESTION, INHALATION AND CONTACT WITH SKIN AND EYES.

### Disclaimer

The information provided on this SDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS



# Safety Data Sheet (SDS)

ID: SDS 105-US

## NOTES - ATTACHMENT B





C&W **DustTech**  
CLEAN AIR TECHNOLOGIES

**DUST SETTLES. WE DON'T.™**

## Silo Dust Collectors That Set the Performance Standard

### Most Popular Options:

- Silo Anti-Overfill System
- Pressure Relief Valves and Bin Indicators

Are you seeking a compact, efficient dust collection solution for your rugged application? Look no further than C&W DustTech's Silo Dust Collection Systems. Designed with pulse jet or mechanical shaking technologies, our Silo Collectors are custom engineered to outperform in industries such as Ready-Mix Concrete, Cement Production, Mining and Minerals, and more.

Whether your application requires a Low-Profile Round (LPR), Cartridge Pulse (CP) or a Shaker (SK) collector, our team of experts is committed to specifying the most effective Silo Dust Collector for your operational needs.

### Silo Dust Collector Features and Benefits

- **Easy to Maintain:**  
Toolless exchange of filter media – top entry (CP and LPR) or side entry (SK) for clean side filter exchange.
- **Filtration Efficiency:**  
99.99% filtration efficiency. \*

- **Reliable, Easy to Operate:**  
Solid state adjustable timer with LED display or a gentle, reliable mechanical shaker (SK-Series only).
- **Long Lasting, Durable:**  
12-gauge, heavy duty steel construction.

*\*At Standard Test Conditions*





## Low Profile Round (LPR-Series)

C&W's Low Profile Round (LPR) Silo Dust Collectors deliver a compact footprint, coupled with user-friendly pulse jet technology and cartridge filters to provide a durable dust collection solution. The LPR-Series features a low-profile design and pop in-out filter media exchange that requires no tools and eliminates the need to remove blow pipes.

The LPR can also expand to higher capacities without having to replace the entire unit, housing anywhere from four to eight cartridges. Consider optimizing your unit with a flow switch, one of our most popular add-ons, to help detect the flow of air through the silo and automatically trigger the cleaning cycle on and off.

### Additional Features and Benefits

- **Efficiency:** 99.99% filtration efficiency with vertical, wide-pleat cartridges.
- **User Friendly:** Pop in-out filter media exchange with no tools or need to remove blow pipes.

### Available Options

- Automatic On/Off Flow Switch
- Minihelic Gauge
- Special Adaptable Mounting Flange
- Air Tank Auto-Drain



## Cartridge Pulse (CP-Series)

Built to control various levels of fugitive dust, our Cartridge Pulse Silo Dust Collector ensures cleaner work environments for maximum productivity. This traditional collector leverages our highly efficient and effective pulse jet cleaning technology to capture and manage a range of particulates to be re-introduced back into the process, or disposed. Built to withstand the most rugged environments, these units include an inlet air regulator and moisture separator, and test ports to monitor filter media to ensure ongoing performance.

Our weigh batcher collectors (CP-35, CP-70, CP-88) seamlessly integrate into your Ready-Mix Concrete or Cement Production operation. These collectors effectively capture dust, release clean air back into the environment and return materials directly to the weigh batcher.

### Additional Features and Benefits

- **Efficiency:** 99.99% filtration efficiency with vertical, wide-pleat cartridges.
- **Performance:** Inlet air regulator and moisture separator.

### Available Options

- Pressure Switch for Automatic Cleaning
- Custom Designs and Sizes
- Blower Packages, Standard or Custom-Build
- Minihelic Gauge
- Special Mounting Flange for Adapting to Existing Flange
- Special Filter Media





## Shaker Silo (SK-Series)

The Shaker Series Silo Collector is specifically designed to operate without compressed air, making it the ideal solution for sub-zero temperatures. Not susceptible to freezing in cold weather or moist applications, the collector is equipped with a ¼ horse power 115v motorized shaker cleaning system. The mechanical shaker provides a thorough cleaning of the filter media to provide customers with a high-performing, durable and user-friendly dust control solution.

### Additional Features and Benefits

- **Efficiency:** 99.99% filtration efficiency and polyester filter media.
- **Greater Temperature Range:** Will not freeze in sub-zero weather.
- **Performance:** Handles up to 1200 CFM.

### Available Options

- **Silo Mounting Flange:** Available in 6" & 12" heights, or an angle flange for sloped silos.
- **Blower Package:** 2 or 3 HP blowers offering 850-1200 CFM.
- **Automatic Controls:** Timer controlled automatic off.



## Additional Services & Support

We support our customers with a range of specialized services to deliver a solution that exceeds expectations, including:

- Customized Layouts
- Startup, Maintenance and Training
- Professional Consultation
- Ongoing Aftermarket Part Support
- Air Permit Calculations
- Airflow Design Engineering and Performance Software

## Need a Full Silo Dust Collection System?

Depending on your operation, needs and regulatory environment, utilizing a complete dust collection system can help you maximize production efficiencies. Our systems include:

- Ducting
- Dust Collector
- Cleaning System
- Recycle Systems
- Additional accessories include: hoods, shrouds, slump masters, anti-overfill systems, etc.

Contact us at [sales@cwdusttech.com](mailto:sales@cwdusttech.com) to learn about our customized dust collection system options and package offerings.



## LPR-Series

	LPR-4-S	LPR-6-S	LPR-8-S
Total Filtration Area (Sq. Ft.)	210	315	420
Number of Cartridges	4	6	8
Cartridge Size	8" X 39	8" X 39	8" X 39
Air To Cloth Ratio	5.57	5.57	5.57
Overall Height (Includes Mounting Flange)	72"	72"	72"
Flange Diameter	44" o.d	44" o.d	44" o.d
Approx. Weight (Lbs.)	670	695	720
Compressed Air Required (CFM)	3	3	3
Max CFM Recommended*	1,170	1,760	2,340
Min. Design Efficiency**	99.99%	99.99%	99.99%
Cleaning Mechanism	Pulse Jet	Pulse Jet	Pulse Jet

\*CFM shown for typical application – unique application may change CFM

\*\*At standard test conditions

## CP-Series

	CP-35	CP-70	CP-88	CP-1335S	CP-2000S	CP-2665S	CP-3335S
Total Filtration Area (Sq. Ft.)	45	90	90	210	315	420	525
Number Of Cartridges	2	4	4	4	6	8	10
Air To Cloth Ratio	4.78	4.78	4.78	6.36	6.35	6.35	6.35
Cartridge Size	8" x 19"	8" x 19"	8" x 19"	8" x 39"	8" x 39"	8" x 39"	8" x 39"
Static Pressure Drop	6" W.C	6" W.C	6" W.C	6" W.C	6" W.C	6" W.C	6" W.C
Compressed Air Req. (CFM)	2	2	2	2	2	3	4
CFM Recommended	216	432	432	1335	2000	2665	3335
Min. Design Efficiency*	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%
Cleaning Mechanism	Pulse Jet	Pulse Jet	Pulse Jet	Pulse Jet	Pulse Jet	Pulse Jet	Pulse Jet

\*At standard test conditions



## SK-Series

	SK250-436
Total Filtration Area (Sq. Ft)	250
Number Of Bags	36
Ibag Size (Diameter X Length)	4" x 78"
Overall Height	7' 6"
Flange Width	38"
Flange Length	38"
Approx. Weight (Lbs.)	500
Cfm Recommended	1200
Air To Cloth Ratio (ACFM/Sq. Ft.)	4.8
Min. Design Efficiency*	99.99%
Cleaning Mechanism	1/4 Hp 115v Single Phase Motorized Shaker

\*At standard test conditions

# Silo Filter Vents

Industrial Silo Filter Vents are used to vent silos into which material is conveyed. As the material fills the silo, it displaces air, which must be vented without loss of product. Product collected on the filter bags is returned to the silo by shaking the bags after filling has been completed. Silo Filter Vents are available in two series:

- **Natural Vented**, where a low positive silo pressure is acceptable.
- **Blower Assisted**, where a negative silo pressure is desirable.

A **Continuous Duty Vent (72-CS)** is also available to provide continuous filtration through two individual compartments, one in the collecting mode while the other is being cleaned.

All options are electric, so no air supply is required.



## Silo Filter Vent Operation

### Natural Vents (IS & KS Models)

Displaced air from the silo filling operation is filtered through the bags. After each truck is unloaded the bags must be cleaned. To clean the bags, shake them for approximately 60 seconds. (Mini-C10 control is optional)

### Blower Assisted Vents (JS & LS Models)

Displaced air from the silo filling operation is filtered through the bags, while being assisted by a blower. After each truck is unloaded the bags must be cleaned. To clean the bags, turn the blower off and shake them for approximately 60 seconds. (Mini-C8 control is optional)

### Continuous Duty Vent (72 CS)

The baghouse is split into two 36 bag compartments so that one is in use at all times. A timer switches the diverter valve to the opposite side once every hour. The timer can be adjusted to switch sides more frequently if necessary. Each time the damper position is switched, the compartment taken off line is shaken for 60 seconds. (C6G2E control is included)

### Optional Controls



**Mini C-8**

Includes solid state one minute timer with automatic stop, terminal blocks, indicator light, and fuse for manual control of blower and activation of cycle (cleaning cycle actuates after blower shuts down), in a NEMA 4 enclosure [115VAC /1/60]. Motor starters not included. Shipped loose for field installation.

**Mini C-10**

Includes solid state one minute timer with automatic stop, terminal blocks indicator light, fuse and push button control to activate cleaning cycle, in a NEMA 4 enclosure [115VAC/1/60]. Motor starters not included. Shipped loose for field installation.

## Automatic Overfill Control System

The Griffin Overfill Control System, consisting of a closing valve, limit switch and control panel, completely automates silo filling and venting while preventing overfill and resulting damage. It is designed to operate on any pneumatic silo filling system with any number of fill pipes. If the high bin signal is clear when the trucker connects his hose to the fill pipe, the butterfly valve will open and the silo will accept material. When the high bin indicator is activated, an alarm will sound telling the trucker to stop his unloading operation. In 90 seconds the butterfly valve will close, sealing off the fill pipe and making it impossible for the trucker to continue pumping in material. The bags in the dust collection system will then automatically shake.

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## Fiber Data

### Properties of textile fibers for low and medium temperatures

Fiber's Generic Name, Trade Name	Cotton	Polyamid Nylon 66	Polypropylene Herculon(R)	Polyester Dacron(R)	Acrylic Copolymer Orlon(R)	Homopolymer Acrylic Dacron T
Recommended continuos operation temp (dry heat)	180°F 82°C	200°F 94°C	200°F(1) 94°C	270°F 132°C	248°F 120°C	284°F 140°C
Water vapor saturated condition (moist heat)	180°F 82°C	200°F 94°C	200°F 94°C	200°F(2) 94°C	230°F 110°C	260°F 125°C
Maximum (short time) Operation temp (dry Heat)	200°F 94°C	250°F 121°C	225°F 107°C	300°F 150°C	248°F 120°C	284°F 140°C
Specific density	1.5	1.14	0.9	1.38	1.16	1.17
Relative moisture region in % (at 68°F & 65% relative moisture)	8.5	4.0-4.5	0.1	0.4	1	1
Supports combustion	Yes	Yes	Yes	Yes	No	Yes
Biological Resistance (bacteria, mildew)	No, If not treated	No Effect	Excellent	No Effect	Very Good	Very Good

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**SUBMIT**

Resistance to alkalis	Good	Good	Excellent	Fair	Fair	Fair
Resistance to mineral acids	Poor	Poor	Excellent	Fair	Good	Very Good
Resistance to organic acids	Poor	Poor	Excellent	Fair	Good	Excellent
Resistance to oxidizing agents	Fair	Fair	Good	Good	Good	Good
Resistance to organic solvents	Very Good	Very Good	Excellent	Good	Very Good	Very Good

**For dry filtration, High Temperatures**

**Hot Gas**

<b>Fiber's Generic Name, Trade Name</b>	<b>Polyphenylene Sulfide Ryton(R)</b>	<b>Aramid Nomex(R)</b>	<b>Glass Fiberglass(R)</b>	<b>PTFE Teflon(R)</b>	<b>Polybenzimidazole PBI(R)</b>	<b>Metal Bekinox(R)</b>	<b>Ceramic Nextel 312(R)</b>
<b>Recommended continuos operation temp (dry heat)</b>	375°F 190°C	400°F 204°C	500°F 260°C	500°F 260°C	500°F 260°C	840°F 450°C	2100°F 1150°C
<b>Water vapor saturated condition (moist heat)</b>	375°F 190°C	350°F 177°C	500°F 260°C	500°F(3) 260°C	500°F 260°C	750°F 400°C	2100°F 1150°C
<b>Maximum (short time) Operation temp (dry Heat)</b>	450°F 232°C	450°F 232°C	550°F 290°C	550°F 290°C	650°F 343°C	950°F 510°C	2600°F 1427°C
<b>Specific density</b>	1.38	1.38	2.54	2.3	1.43	7.9	2.7
<b>Relative moisture region in % (at 68°F &amp; 65% relative moisture)</b>	0.6	4.5	0	0	14	0	0
<b>Supports combustion</b>	No	No	No	No	No	No	No

<b>Biological Resistance (bacteria, mildew)</b>	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
<b>Resistance to alkalis</b>	Excellent	Good	Fair	Excellent	Good	Very Good	Good
<b>Resistance to mineral acids</b>	Excellent	Fair	Very Good	Excellent	Excellent	Very Good	Very Good
<b>Resistance to organic acids</b>	Excellent	Fair	Very Good	Excellent	Excellent	Very Good	Very Good
<b>Resistance to oxidizing agents</b>	4	Poor	Excellent	Excellent	Fair	Very Good	Excellent
<b>Resistance to organic solvents</b>	Excellent	Very Good	Very Good	Excellent	Excellent	Very Good	Excellent

(1) = 250 F for Type 154

(2) = Not Recommended  
(3) = 475 F for reverse air and shaker collector

(4) = PPS fiber is attached by strong oxidizing agents (for example, at 200 F for 7 days)

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DESTEX, INC. 1080  
Broadway Albany, NY  
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Toll-Free 800-344-3210  
Fax 518-463-2094





# Baghouse Filter Guide

Material ⇨ Fiber	Cotton	Polypropylene	Polyester (Dacron)	Homopolymer Acrylic	Aramid (Nomex)	Felted Fiberglass (Huyglas)	Polymid (P84)	Glass * (Fiberglass)	Polytetrafluoro ethylene PTFE Membrane (Teflon)	Polyphenylene Sulfide (Ryton) PPS	Metal (Bekinox)	Ceramic (Cerafil)
<b>Characteristics</b> ⇩												
Upper temperature- continuous dry heat (degrees F/C)	180 / 82	200 / 94	270 / 132	284 / 140	400 / 204	500 / 260	500 / 260	500 / 260	500 / 260	375 / 190	1020 / 550	1650 / 900
Upper temperature- saturated moist heat (degrees F/C)	180 / 82	200 / 94	200 / 94	260 / 125	350 / 177	500 / 260	500 / 260	500 / 260	500 / 260	375 / 190	1020 / 600	1650 / 900
Maximum temperature- surge dry heat	200 / 94	225 / 107	300 / 150	284 / 140	450 / 232	550 F	Up to 500 F	550 / 290	550 / 290	450 / 232	1110 / 550	1650 / 900
Supports combustion (note 1)	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No
Biological resistance (bacteria, mildew)	No, if not treated	Excellent	No Effect	Very Good	No Effect	No Effect	Very Good	No Effect	No Effect	No Effect	No Effect	No Effect
Resistance to alkalis	Good	Excellent	Fair	Fair	Good	Excellent	Poor	Fair	Excellent	Excellent	Excellent	Good
Resistance to mineral acids	Poor	Excellent	Fair	Very Good	Fair	Good	Excellent	Very Good*	Excellent	Excellent	Good	Very Good
Resistance to organic acids	Poor	Excellent	Fair	Excellent	Fair	Good	Excellent	Very Good*	Excellent	Excellent	Very Good	Very Good Except HF
Resistance to oxidizing agents	Fair	Good	Good	Good	Poor	Excellent	Good	Excellent**	Excellent	Not Recommend ed	Excellent	Good
Resistance to organic solvents	Very Good	Excellent	Good	Very Good	Very Good	Good	Excellent	Very Good*	Excellent	Excellent	Excellent	Excellent
Tensile Strength	Good	Excellent	Excellent		Very Good			Excellent	Average	Very Good		
Abrasion Resistance	Good	Excellent	Excellent		Excellent		Excellent	Fair	Fair	Excellent		
Available In	Woven	Woven Felted	Woven, Felted, Spun- bonded, Knit		Woven Felted	Felted	Felted	Woven Felted	Woven Felted	Woven Felted		
Relative cost of fabrics 6=highest	1	2	2	3	4	5	5	3	6	5	6	6

Note 1 - Avoid "Yes" fabrics in processes where sparks or other sources of ignition might be in the gas stream

Pulse Jet System – Felted, Never Woven

\* With special treatment, i.e., Teflon



## GRIFFIN FILTERS L.L.C.

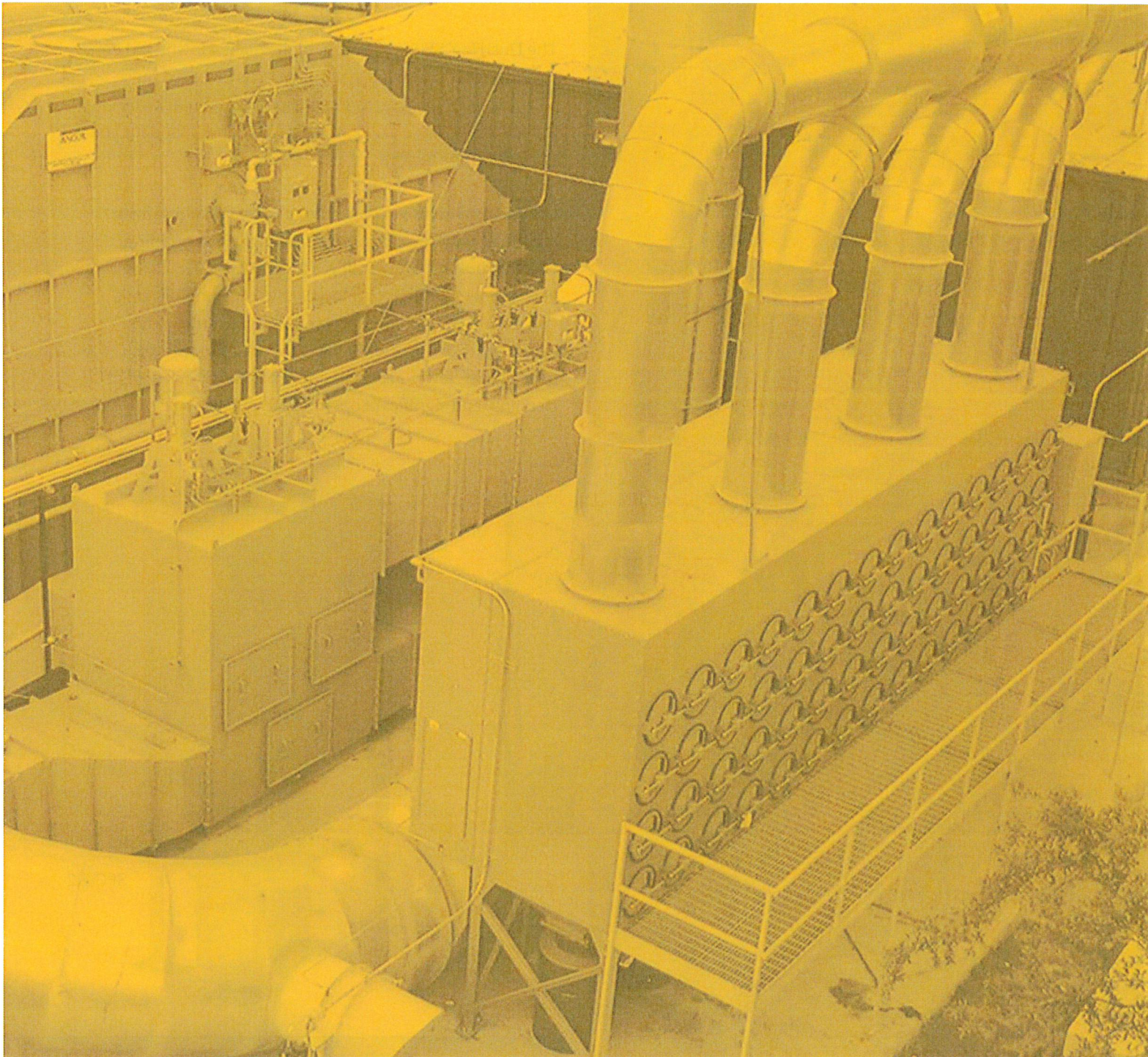
106 METROPOLITAN PARK DRIVE ♦ LIVERPOOL, NY 13088, USA

Tel: (315) 451-5300 ♦ Fax: (315) 451-2338

[www.griffinfilters.com](http://www.griffinfilters.com) ♦ email: [info@griffinfilters.com](mailto:info@griffinfilters.com)

## NOTES - ATTACHMENT C





# SFC Series

DOWNWARD FLOW CARTRIDGE DUST COLLECTORS



ENGINEERING YOUR SUCCESS.



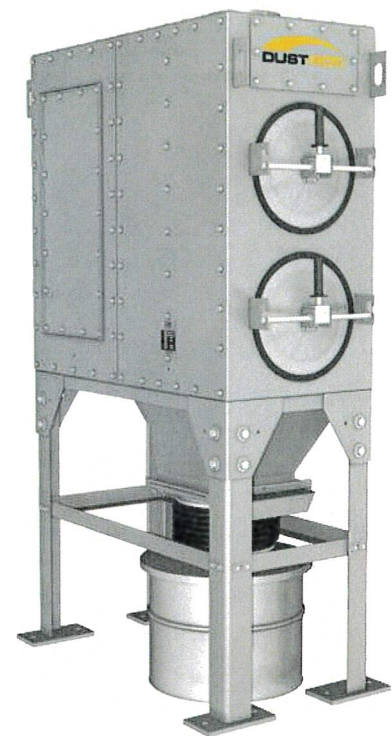
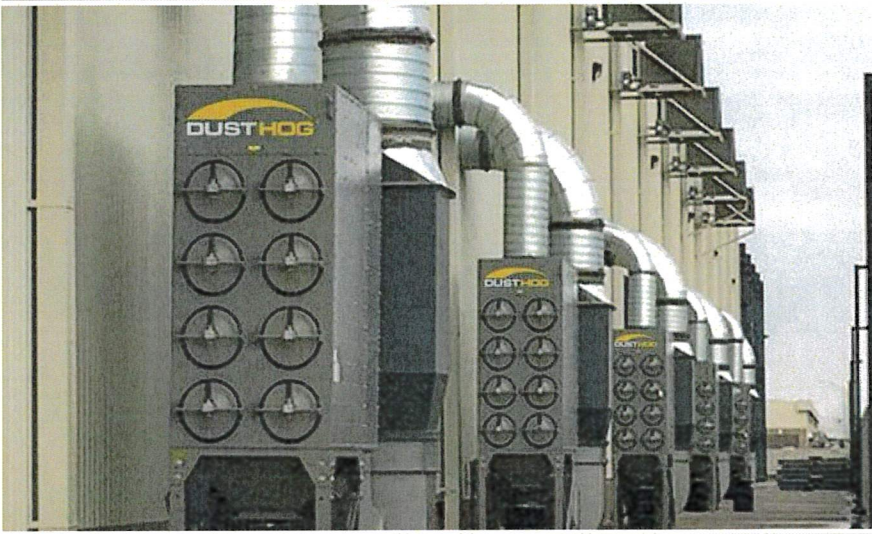


# SFC Series

## High Performance, Energy Efficient Dust Collector

The DustHog® SFC is a proven, high-quality downward flow cartridge dust collection system. With its patented pulse cleaning technology, greater air capacity and quick and easy maintenance, there's no better air filtration method for your manufacturing facility.

Our SFC unit removes harmful pollutants resulting from common manufacturing processes — such as grinding, welding, buffing and sanding. The result: a safer, cleaner environment for your employees. By using our SFC unit, you're virtually eliminating air quality concerns in the workplace. Plus, you're ensuring increased employee productivity, fewer absences and illnesses, more efficient cleaning, and significant operational savings.



SFC 2-2

## A Wide Range Of Applications

The high-performance SFC unit is ideal for all your dust and fume collection needs. Filtering out the polluted air that commonly occurs within a manufacturing environment, SFC's many industrial applications include grinding, welding, buffing, sanding, smelting, bulk powder handling, and more. Plus, our design allows for field expandability — so you can add modules and increase the capacity of your system at any time.





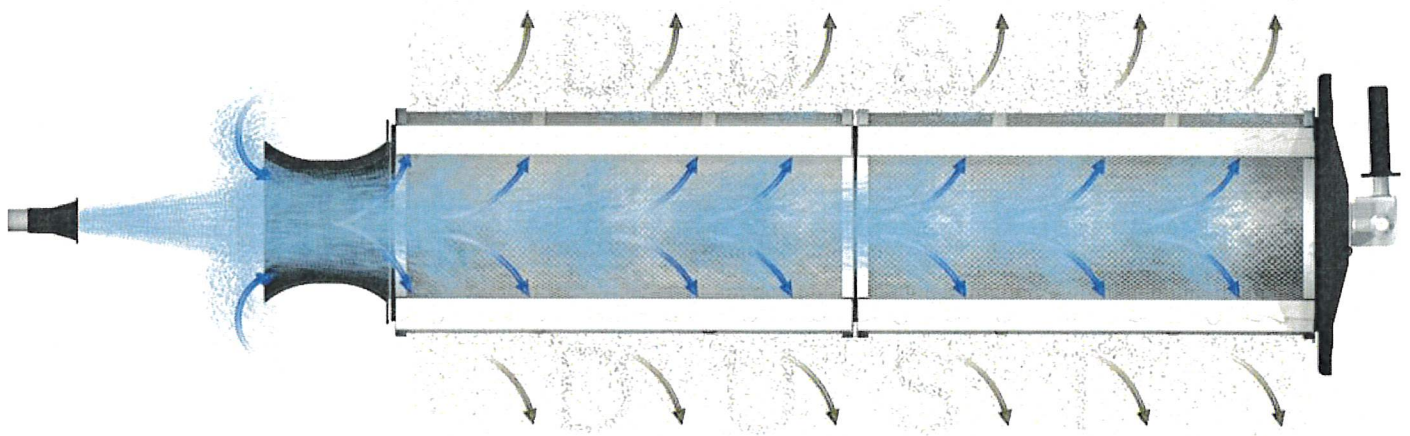
## Patented Pulse Cleaning Technology

At the heart of the SFC system is the industry's most advanced pulse cleaning system technology. In designing the SFC unit, Parker Hannifin engineers used Computational Fluid Dynamics computer modeling to develop the most effective system that "pulses off" dust from the filter — greatly improving the cartridge cleaning power. Utilizing an optimized nozzle and venturi, air is pulsed at a precisely calculated distance through an unobstructed airway. The result: increased pulse cleaning energy, lower pressure drop and longer cartridge life. Plus, our patented pulse system cleans the full length of the cartridge. These unique, proprietary features assure years of dependable, efficient and cost effective performance.

## Extended Cartridge Life with More Power & Less Energy

Unlike competitors, the SFC system uses external filter tracks to support the filters instead of "yokes" that interfere with cleaning. This allows for unobstructed airflow and increased cleaning power with less energy. By designing the SFC with optimized cabinets that broaden the space between cartridges and sidewalls, we ensured lower velocities and reduced cartridge abrasion. The result: dramatically increased cartridge life.

### SFC Pulse Blast



At any point along the cartridge filter, the SFC unit provides 25% or more pulse cleaning power than the competition.

### *Pulse Blast Benefits*

Fewer pulses are needed to clean the cartridge filters, so less compressed air is used. This is a substantial cost savings for the customer over the life of the unit.

Filter life is increased because fewer pulse cycles mean less stress on the filter media. This equates to less frequent filter changes and significant reduction in operating costs.

Unobstructed airflow means there is more cleaning energy delivered to the filters to clean the entire length of the cartridge filter.

Optimized cleaning provides maximum filter efficiency with the lowest possible outlet emissions.





## Protura® Advanced Nanofiber Cartridge Filters

All SFC Series dust collectors come with the industry's best performing, most efficient standard cartridge filter. Independently certified at MERV 15\*, Protura Advanced Nanofiber cartridge filters last 50% longer than commodity filters, and are nearly 50% more efficient on sub-micron dust particles than MERV 13 filters.

Protura Advanced Nanofiber Filtration technology is proven to achieve higher efficiency, cleaner air, lower pressure drop, longer filter life and greater energy savings than any other standard cartridge filter media. And, when used with the SFC Series dust collector, the advantages quickly add up to unsurpassed bottom-line savings—the most efficient and best value dust collector available for industrial air cleaning processes today.

### Surface Loading Is Key

Protura Advanced Nanofiber filters feature a special surface treatment of synthetic fibers so extremely fine, they are measured in fractions of a micron (nanometers). This ultra-thin layer traps dust and fume particulate on the surface of the filter before it can embed deeper in the media—leading to better cleaning efficiency with fewer pulses and significantly less compressed air use.

Our Protura Advanced Nanofiber filters (MERV 15) are more than 85% efficient in capturing sub-micron particles from a contaminated air stream. In contrast, conventional cartridge filters, or 80/20 cellulose filters (MERV 8-10), are not capable of capturing such small particles and often require the additional use of a costly HEPA filter to ensure a safe breathing environment. This adds to overall filter cost and system upkeep.



### Invest In The Best

A cartridge dust collector is an important investment that impacts the performance of plant equipment and the health of your employees. To yield the best return and provide the safest work environment possible, it's important to choose a dust collector that utilizes an optimized pulse cleaning system to reap the full benefits of a nanofiber filter.

The result is:

### Less Energy Use

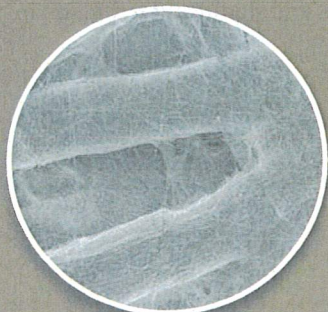
The SFC's patented pulse cleaning system actually uses less compressed air—a costly but necessary utility expense. This is achieved through the combination of increased power behind each pulse blast and the superior surface-loading ability of nanofiber filters. Each cleaning cycle is much more effective in removing dust from cartridge filters than other downflow collectors.

### Longer Filter Life

With less pulsing needed to clean surface-loading nanofiber cartridges, stress on the filters is minimized, resulting in double the filter life of a commodity filter.

### A Smaller Dust Collection System Footprint

The combination of the SFC's patented pulse cleaning system and nanofiber cartridge filters also allow for higher air-to-media ratios, potentially reducing the size of the dust collector and number of cartridges needed for your facility—a significant cost savings overall.



Advanced Nanofiber at 600x



80/20 Cellulose at 600x

\* Minimum Efficiency Reporting Value (MERV) is based on ASHRAE Standard 52.2-1999, and has been deemed the most accurate scale for determining a filter's efficiency and ability to filter submicron dust particles. MERV 15 efficiency has been tested per this standard by independent lab testing.



# Features and Benefits

## Heavy-duty Lifting Lugs

Ensure safe and secure support during installation.

## Modular Design

Provides flexibility to increase unit capacity by adding modules at your facility.

## Optimized Cartridge Cleaning System

Springless pulse valves and patented nozzle/venturi offer maximized cleaning power.

## Horizontal Filters

Quick and easy access when replacing filters.

## Heavy-duty Construction

Designed and manufactured to meet Seismic Zone 4 and 100 mph wind load structural rating.

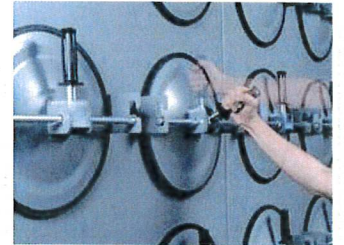


## Powder Coated Finish

All components have electrostatically applied paint applied inside and out that prevents fading and chalking.

## Quick & Easy Maintenance

With one simple movement of the handle, the SFC's "Quickseal" release door provides extremely fast filter removal and maintenance.

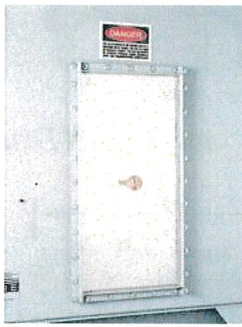


# Options and Accessories



## Bag-In / Bag-Out Option

provides clean, safe, easy removal of fine, hazardous or difficult-to-handle dusts.



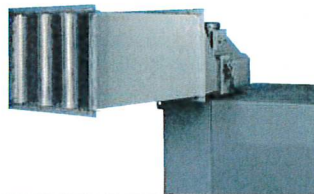
## Explosion Relief Vents

help ensure facility and worker safety in the unlikely event of an explosion that may result when collecting explosive dusts.



## Digital Pressure Control / Digital Pressure Monitor

allows users to program dust collector for continuous or on-demand pulse cleaning.



## Direct Drive Blowers

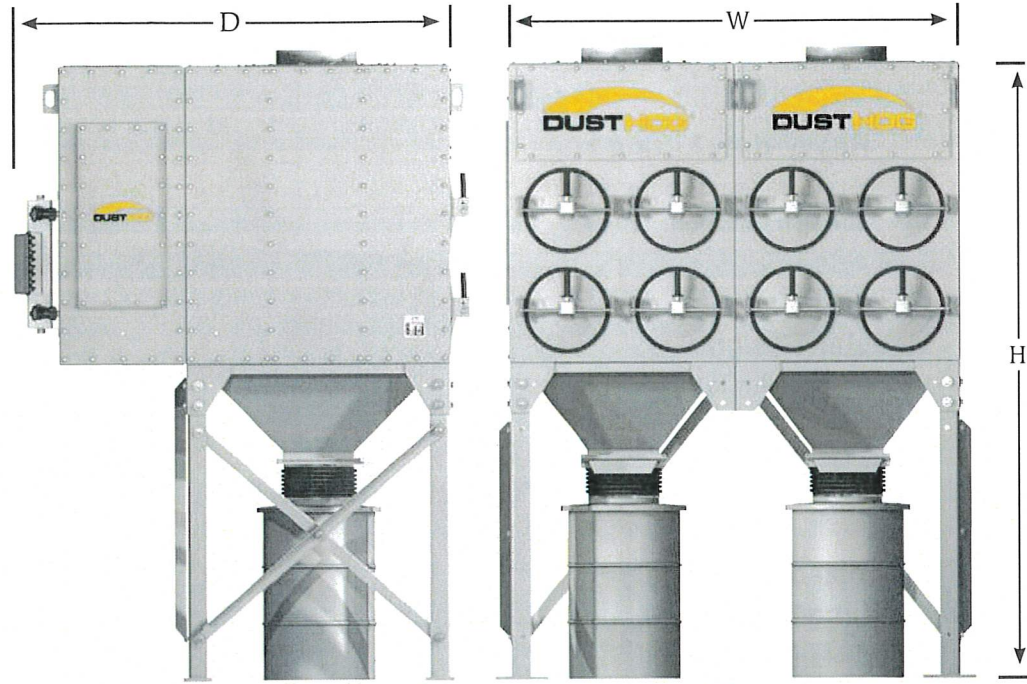
Fans integrally mounted to the dust collector saving floor space and easy installation.

## Add-Ons

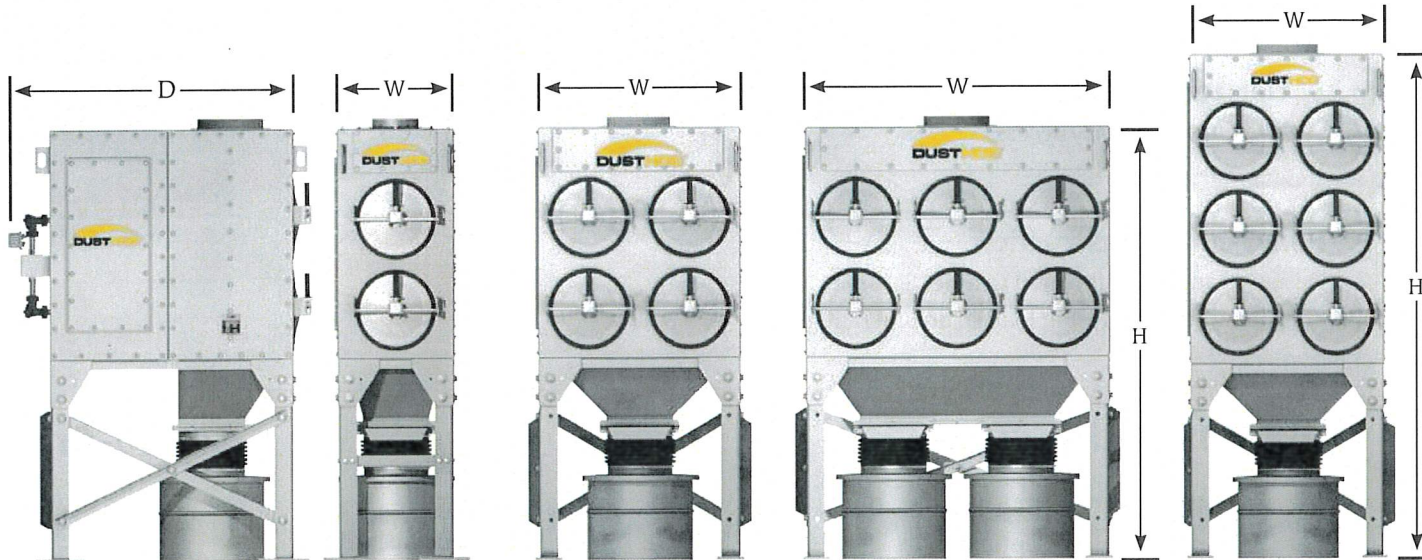
- VFDs
- Abrasive Inlet
- Safety After-Filters
- Fan
- Fan Silencers
- Drum Lid Latch Kit
- Short Drums
- Drawer Base
- Service Platforms
- Control Panels
- Pneumatic Valve Assemblies
- Sprinkler Heads

Additional options and accessories available.





SFC8-2 And Larger With Drum (H55)



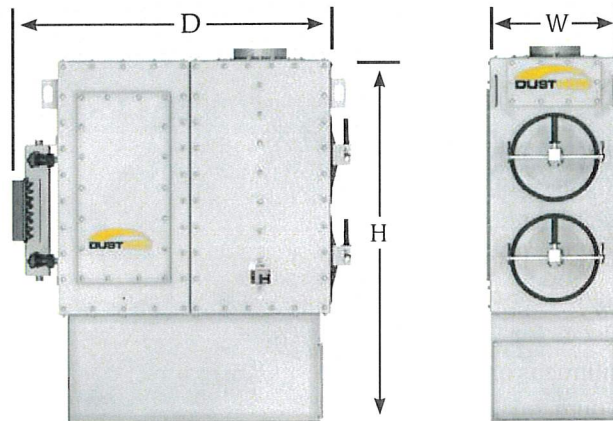
SFC2-2

SFC4-2

SFC6-2

SFC6-3

*with Short Drum (SD)*



SFC2-2, 4-2 and 6-3 with Dust Drawer (DD)  
(SFC2-2 Shown)





# Dimensions and Specifications

SFC Models	Filter Quantity	Total Filter Media Area (FT)	Valve Quantity	Module Quantity	Appox. Weight (LBS)	Compressed Air Consumption		Height	Width	Depth
						SFC/ PULSE	SCFM 6P/Min			
SFC 2 - 2 - SD	2	510	1	1	954	1.7	10.2	7' 8"	2' 1"	5' 1"
SFC 4 - 2 - SD	4	1,020	1	1	1,317	1.7	10.2	8' 7"	3' 9"	5' 1"
SFC 6 - 2 - SD	6	1,530	1	1	1,726	1.7	10.2	7' 8"	5' 4"	5' 1"
SFC 2 - 2 - DD	2	510	1	1	890	1.7	10.2	5' 4"	2' 1"	5' 1"
SFC 4 - 2 - DD	4	1,020	1	1	1,197	1.7	10.2	4' 3"	3' 9"	5' 1"
SFC 6 - 3 - DD	6	1,530	1	1	2,020	1.7	10.2	7' 10"	3' 9"	5' 1"
SFC 6 - 3 - SD	6	1,530	1	1	1,726	1.7	10.2	9' 4"	3' 9"	5' 1"
SFC 2L - 2 - H55	2	768	2	1	1,225	1.7	10.2	9' 1"	3' 9"	6' 2"
SFC 4L - 2 - H55	4	1,536	4	1	1,600	1.7	10.2	9' 1"	3' 9"	6' 2"
SFC 6L - 3 - H55	6	2,304	6	1	2,000	1.7	10.2	11' 6"	3' 9"	6' 2"
SFC 8L - 4 - H55	8	3,072	8	1	2,500	1.7	10.2	13' 2"	3' 9"	6' 2"
SFC 8 - 2 - H55	8	2,040	1	1	1,922	1.7	10.2	10' 3"	3' 9"	7' 3"
SFC 16 - 2 - H55	16	4,080	2	2	3,237	3.4	20.4	10' 3"	7' 6"	7' 3"
SFC 24 - 2 - H55	24	6,120	3	3	4,552	5.1	30.6	10' 3"	11' 3"	7' 3"
SFC 32 - 2 - H55	32	8,160	4	4	5,947	6.8	40.8	10' 3"	15' 0"	7' 3"
SFC 12 - 3 - H55	12	3,060	1	1	2,420	1.7	10.2	11' 11"	3' 9"	7' 3"
SFC 24 - 3 - H55	24	6,120	2	2	4,016	3.4	20.4	11' 11"	7' 6"	7' 3"
SFC 36 - 3 - H55	36	9,180	3	3	5,612	5.1	30.6	11' 11"	11' 3"	7' 3"
SFC 48 - 3 - H55	48	12,240	4	4	7,288	6.8	40.8	11' 11"	15' 0"	7' 3"
SFC 60 - 3 - H55	60	15,300	5	5	8,884	8.5	51.0	11' 11"	18' 9"	7' 3"
SFC 72 - 3 - H55	72	18,360	6	6	10,480	10.2	61.2	11' 11"	22' 6"	7' 3"
SFC 16 - 4 - H55	16	4,080	1	1	2,873	1.7	10.2	13' 7"	3' 9"	7' 3"
SFC 32 - 4 - H55	32	8,160	2	2	4,762	3.4	20.4	13' 7"	7' 6"	7' 3"
SFC 48 - 4 - H55	48	12,240	3	3	6,651	5.1	30.6	13' 7"	11' 3"	7' 3"
SFC 64 - 4 - H55	64	16,320	4	4	8,620	6.8	40.8	13' 7"	15' 0"	7' 3"
SFC 80 - 4 - H55	80	20,400	5	5	10,509	8.5	51.0	13' 7"	18' 9"	7' 3"
SFC 96 - 4 - H55	96	24,480	6	6	12,398	10.2	61.2	13' 7"	22' 6"	7' 3"
SFC 112 - 4 - H55	112	28,560	7	7	14,367	11.9	71.4	13' 7"	26' 3"	7' 3"
SFC 128 - 4 - H55	128	32,640	8	8	16,256	13.6	81.6	13' 7"	30' 0"	7' 3"
SFC 20 - 5 - H55	20	5,100	1	1	3,400	1.7	10.2	17' 6"	3' 9"	7' 3"
SFC 40 - 5 - H55	40	10,200	2	2	5,700	3.4	20.4	17' 6"	7' 6"	7' 3"
SFC 60 - 5 - H55	60	15,300	3	3	7,900	5.1	30.6	17' 6"	11' 3"	7' 3"
SFC 80 - 5 - H55	80	20,400	4	4	10,250	6.8	40.8	17' 6"	15' 0"	7' 3"
SFC 100 - 5 - H55	100	25,500	5	5	12,600	8.5	51.0	17' 6"	18' 9"	7' 3"
SFC 120 - 5 - H55	120	30,600	6	6	14,950	10.2	61.2	17' 6"	22' 6"	7' 3"

Short Drum (SD) units available in SFC 8 and larger. Subtract 16" from height.  
Additional models and hopper configurations are available





Parker Hannifin is committed to providing clean air solutions that protect your employees, improve plant performance and enable you to realize your operating goals.

Our commitment is backed by continuous investment in research, leading-edge technology and product development, our people whom are the most knowledgeable in the industry, and a product portfolio that is proven to deliver results. We have been solving problems for you, our customers across the globe for over 50 years.

## Industrial Applications

- Abrasive Blasting
- Grinding
- Powder Coating
- Welding
- Batch Mixing
- Metal Working
- Sanding

**Important** - Understand and follow NFPA guidance in selecting equipment for your intended application, including required safety devices and testing your dust to determine combustion hazards. At your election, we can coordinate sample collection and testing.

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by Travis Haynam, Senior Product Manager,  
Ed Ravert, Senior Application Engineer,  
Parker Hannifin

## Nanofiber Filtration In Combination With Dusthog® SFC Dust Collectors

How To Achieve Maximum System Performance and Efficiency—  
Plus Significant Savings In Energy, Operational Costs



ENGINEERING YOUR SUCCESS.





Call it “The Best of Both Worlds”! Today, for a dust collector to perform to its full potential and your expectations, it is important to use the advanced surface-loading capabilities of nanofiber filters instead of traditional commodity filters. The combination of nanofiber filtration in conjunction with an optimized downward flow dust collector will result in less pulse cleaning cycles (less compressed air use) and significantly longer filter life. Most importantly, this combination, in addition to maximizing overall system performance and efficiency, will bring significant savings in energy and operational costs.

Downward flow (Figure 1) dust collectors are among the most common pieces of equipment used to remove harmful pollutants from such processes as grinding, sanding, thermal spraying and the manufacture of graphite, ink dyes, silica, talc and toner that produce submicron dust particles. These air pollution removal systems are critical to helping you control the air quality in your plant, increasing employee productivity and maintaining the performance of your manufacturing equipment.

Choosing an optimally designed downward flow dust collector is critical to providing clean workplace air. Although there are many factors to consider when evaluating the performance and quality of a cartridge collector, two elements are critical to your purchase/use decision:

- Quality of the filter media
- Performance of the cleaning mechanism

Both factors have the most overall profound impact on the air quality you will achieve and filter life. If your collector is lacking in either of these two factors, your dust collection system will never perform to its full potential.

#### Filter Technology

There are two basic types of cartridge dust collection filters on the market today:

- Traditional commodity filters
- Latest technology advanced nanofiber filters



Figure 1: DustHog SFC downward flow dust collectors

They differ in the type of substrate material and surface coating used. Traditional commodity filters are straight cellulose (Figure 2) with one homogenous layer of cellulose fiber. Blended cellulose filters typically consist of 80 percent cellulose and 20 percent synthetic fiber. Sometimes these commodity filters come with a melt-blown surface layer added to improve efficiency at capturing submicron particles.

As shown in Figure 2, if you look at any cartridge filter media through large magnification, you will see open spaces or “holes.” The smaller the holes, the better the media will be at capturing fine particulate. The best way to do this is to use the smallest fibers possible.

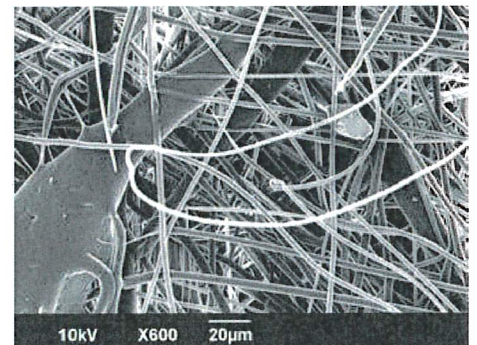


Figure 2: Commodity Filter 600x



The most technologically advanced and highest performing filters are nanofiber filters. These filters, such as genuine Advanced Nanofiber cartridges, use fibers 1/1,000 of a micron (Figure 3).

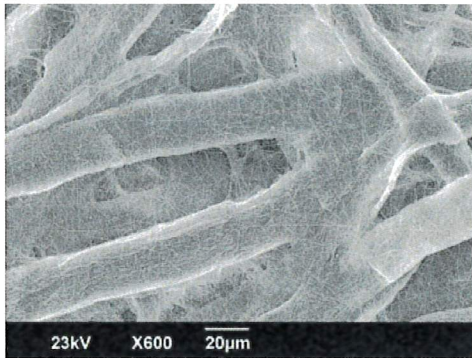


Figure 3: Nanofiber Filter 600x

Just how small are these fibers? Consider that there are 25,400 microns in an inch. The lower limit of visibility with the naked eye is 40 microns. And, the average pore openings in your skin are 10 microns. As such, an extremely thin nanofiber layer on a cartridge filter is capable of capturing submicron particles and trapping them on the surface of the media. Nanofiber filters are scientifically proven to outperform commodity filters in three main measures of quality: efficiency, pressure drop and emissions.

### Higher Efficiency

The fibers that make up nanofiber filters are produced using an innovative electrostatic process that yields the finest synthetic fiber used in any current filtration product. The thin fibers form a permanent mesh-like surface with exceptionally small openings, or pores. These tiny openings are extremely efficient in filtering even submicron particles (less than 1 micron) from the contaminated air stream.

In rating filter efficiency, the MERV<sup>1</sup> (Minimum Efficiency Reporting Value) system is the industry-respected benchmark. The higher the MERV, (Figure 4), the better the filter's efficiency and ability to remove submicron dust particles from the air and minimize emissions. MERV ratings are based on a scale of 1 to 20, and broken into three particle size ranges:

- Range 1 - 0.30 to 1.0 micron
- Range 2 - 1.0 to 3.0 microns
- Range 3 - 3.0 to 10.0 microns

Standard commodity filters typically achieve MERV 10 and are only rated to capture 1.0 micron and larger particulate. Independent lab testing has certified our nanofiber filters at MERV 15—the highest of any standard cartridge filter used in industrial dust collection. This means the filter is between 85 - 95 percent efficient at capturing particle sizes 0.30 to 1.0 micron in Range 1, and more than 90 percent efficient capturing 1.0 micron particles or greater in Ranges 2 and 3.

As noted, commodity filters do not perform as well. The key point here is that they are not even efficient enough to be rated in Range 1 because they cannot capture dust that is in the 0.30 to 1.0 micron range. In Range 2, commodity filters are only rated to be 50 to 65 percent efficient. Importantly, this means that submicron dust passes right through commodity filters and back into the workspace and your employees' breathing zones. For reference, the manufacture of the following products that produce submicron dust would be a major problem with a commodity filter system:

- Graphite 0.3 micron
- Ink dyes 0.1 micron
- Silica 0.5 micron
- Talc 0.5 micron
- Toner 0.5 micron

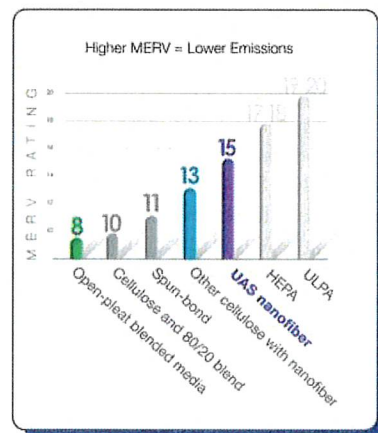


Figure 4: MERV ratings compared with filter type

While MERV is the most accurate efficiency measurement available, filters should not be selected on just MERV alone. Other criteria, such as pressure drop, cleanability, compressed air usage and filter life are important in determining a filter's total performance and life cycle cost. Commodity filters with a melt blown layer may achieve a higher MERV rating but operate at a higher pressure drop, have shorter life and require additional compressed air and electrical power to operate.

### Lower Pressure Drop

The surface layer of a nanofiber filter provides the highest possible filtering efficiency. In effect, this nanofiber layer does all of the work, preventing particulate from building up within the filter's substrate and restricting airflow. As a result, pressure does not build up as rapidly as it will with a commodity filter. Because the pressure drop is low, your dust collection system requires less energy to run, and you may be able to use a smaller, less expensive blower.

### Reduced Emissions

In addition to removing smaller particles from the air, nanofiber filters also reduce the amount of dust that escapes back into the workplace air.

An unavoidable by-product of the filter cleaning process is that a small percentage of the collected dust is released back into the atmosphere. Because nanofiber filters require less frequent pulse cleaning, total outlet emissions are reduced.

Commodity filters typically emit up to 35 times more dust back into the atmosphere than our nanofiber filters.



### Cleaning System Technology

Most cartridge dust collectors use pulse-jet cleaning technology (Figure 5) to dislodge dust from the filters into a collection bin. While factory air is being cleaned, the system's cartridges are also being cleaned by a pulse blast of compressed air that is periodically sent through the center of the filter, causing dust to "pulse" off into a drawer or hopper for easy disposal.

While all pulse-jet cleaning systems are similar in concept, they differ in important ways that directly affect cleaning efficiency, ease of use and filter life.

### Design of Nozzle and Venturi

The nozzle and venturi are the key components of a pulse-jet cleaning system. Their design determines the cleaning efficiency that can be achieved with each blast of air. By optimizing the spacing of the compressed air nozzle and perfecting the geometry of the venturi, air can be pulsed at a precise calculated distance with enough power to completely clean the entire filter length.

### Filter Support

In the DustHog SFC downward cartridge flow collectors, the filters rest on rails. Competitive systems use an internal yoke support that acts as an obstruction to block the pulse cleaning jet. This interference also creates turbulence and thus, less pulse power and reduced cleaning efficiency. In that DustHog collectors have no internal obstruction at any point along the cartridge filter, the DustHog unit provides 25 percent more pulse cleaning power than competitive systems.

### Ability to Clean the Full Length of the Filter

Maximum pulse power allows a pulse-jet cleaning system to remove particulate from the entire length of the cartridge filter. Systems with a poorly designed nozzle and venturi, and/or that have internal filter supports, can have difficulty overcoming high air velocities. These systems typically do not thoroughly clean the portion of the filter closest to the cleaning system.

### Best of Both Worlds

As pointed out at the beginning of this paper, today for a dust collector to perform

## SFC Pulse Blast

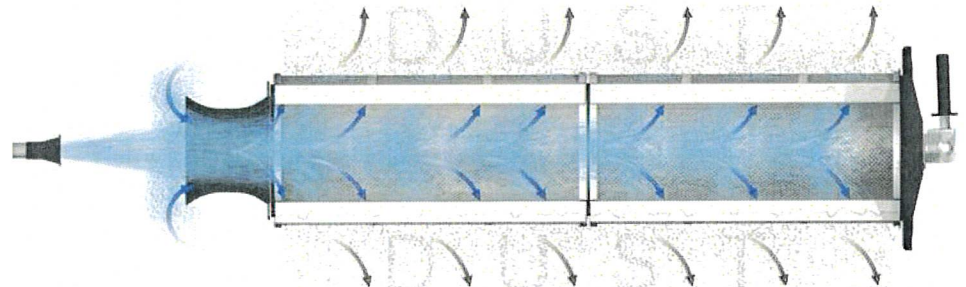


Figure 5: Patented Pulse Jet Cleaning Technology

to its full potential it must utilize the advanced surface-loading capabilities of a nanofiber filter, and its downward flow cartridge dust cleaning system must be optimized to reap the full benefits of a surface-loading filter. The combination of these two elements directly results in less pulse cleaning cycles (less compressed air usage) and significantly longer filter life.

### Less Compressed Air Use

A cartridge collector's pulse-jet cleaning system can more easily remove dust from a nanofiber filter because dust remains on the surface, not deep within the substrate as happens with commodity filters. Hence, each pulse is more effective, the system pulses less and less compressed air is used. A commodity filter may pulse as much as 17 times more than a filter with our Advanced Nanofiber Filtration Technology.

Compressed air is one of the most expensive utilities in a manufacturing plant. About eight horsepower of electricity is used to generate one horsepower of compressed air. Over time, the additional usage from a depth-loading commodity filter media can add up to substantial cost. For example, if airflow is 20.4 SCFM at six pulses per minute, compressed air cost with a 32-cartridge system using commodity filters would be approximately \$1,279. Compressed air cost for the same system using genuine our Advanced Nanofiber filters would be about \$191, or a savings of \$1,088 per year. (Based on the dust collection system running 4,160 hr/year and energy cost of 10 cents/kWh.)

### Longer Filter Life

Because a nanofiber filter creates lower pressure drop and requires fewer pulse blasts, stress on the filter is reduced. This results in longer filter life. Advanced Nanofiber Filtration Technology as much as doubles the filter life than is possible with commodity filters and reduces replacement costs by half.

A cartridge dust collector is an important investment that impacts the performance of the equipment in your operation and the health of your employees. To yield the greatest return on your investment and provide the safest work environment possible, your best option is to choose a surface-loading nanofiber filter and dust collection system that is specifically optimized to gain the maximum benefits of the filter's capabilities.



### **Cabinet design**

Most cartridge dust collectors use pulse-jet. The design of a dust collector's cabinet directly affects airflow and cleaning efficiency. The cabinet of DustHog SFC downward flow dust collectors, for example, is designed to evenly distribute air throughout the cabinet. This is accomplished using one of the largest volume pre-filter plenum available in combination with larger spacing between filters. The spacing is also designed to reduce the speed at which air hits the cartridge filters to eliminate the potential of particulate being driven deep into the filter substrate.

### **Maintenance and serviceability**

A "push to seal" closure on the SFC's "QuickSeal" cartridge access doors eliminates the need to turn knobs and hook latches, significantly easing the cartridge replacement process. Some systems use angled filters, which cause dust to accumulate against the inside of the door and the top of the filter. When the door is opened and the filter removed, dust falls onto the maintenance worker. With the improved DustHog design, those dust

particles that accumulate on the top of the filter are easily removed by rotating the filter. Dust drops directly into the hopper, not onto the maintenance worker. And, since maintenance workers don't have to change nanofiber filters as often as commodity filters, cartridge change outs occur less often and machine downtime is minimized.

### **Cabinet quality**

A dust collector's cabinet should be entirely coated with an electro-statically applied, powder-coated finish to prevent fading and chalking. Also, it needs to be well constructed to withstand exterior conditions. Designed and manufactured with 10 gauge steel construction, DustHog cabinets meet the Seismic Zone 4 and 100 mph wind load structural ratings.

### **Add-on flexibility**

Dust collector design should be modular to provide the flexibility to increase capacity as needed by just adding modules. DustHog units feature a screw panel fastening system that permits easy addition of new modular units by simply removing side panels.

### **Smaller footprint**

The combination of the Parker Hannifin SFC patented cleaning system in combination with the use of nanofiber cartridge filters also allows for higher air-to-media ratios. This can potentially reduce the size of the dust collector and the number of filter cartridges needed – a significant cost savings.

### **Factory support**

Some equipment customization is required for the installation of many dust collection systems. Hence, it is important to utilize a knowledgeable manufacturer's representative who has access to factory application engineers to ensure that your equipment will meet all environmental needs and operate effectively well into the future.



## Providing Clean Air Solutions

Parker Hannifin is committed to providing clean air solutions that protect your employees, improve plant performance and enable you to realize your operating goals.

**State-of-the-Art Labs and Advanced Filtration Research for Optimized Performance.** Purpose-built labs and test facilities with the latest equipment allow our engineers and technicians to quickly and accurately assess filter capabilities and develop innovative new medias.

**High Performance Filters & Specialized Equipment Solutions.** With decades of experience manufacturing high performance original equipment and aftermarket

filters to meet a variety of system types and configurations, we can satisfy whatever requirement is needed including customized solutions.

**World-class Manufacturing Processes with a Global Footprint.** We produce top quality filtration solutions through stringent manufacturing processes.

**Application Expertise for Any Filtration Challenge.** Our ability to design a solution to fit your application begins with engineering expertise proven by hundreds of global installations.

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## NOTES - ATTACHMENT D

# TECHNICAL REFERENCE TABLE OF CONTENTS

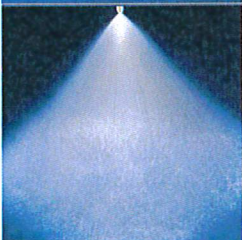
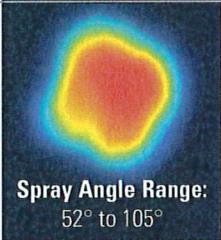
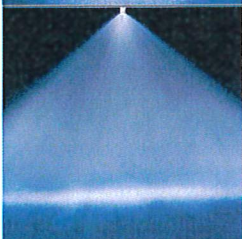

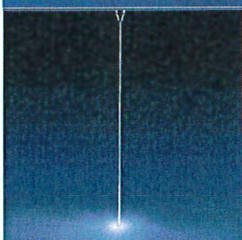
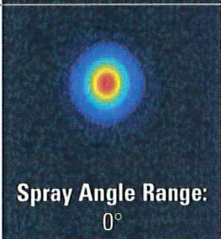
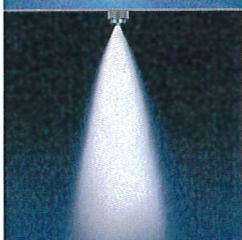
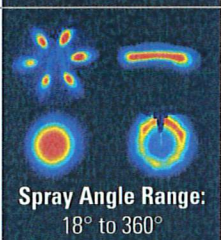
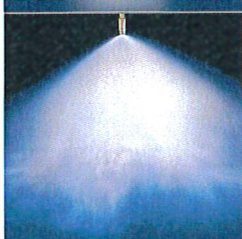
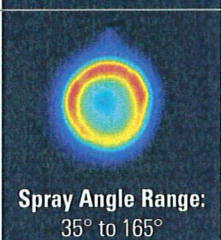


Basic Nozzle Characteristics	A2
Capacity and Specific Gravity	A3
Spray Performance Considerations	A4
Pump Selection Guidelines	A5
Spray Drop Size, Drop Size Terminology, Operating Pressure and Nozzle Materials	A6
Nozzle Wear, Viscosity, Temperature and Surface Tension	A7
Pressure Drop	A8
Maintenance Tips	A10
Weights, Measurements and Formulas	A11
General Safety Instructions	A12





Spray nozzles are precision components designed to yield very specific performance under specific conditions. To help you determine the best nozzle type for your application, the following chart summarizes the performance that each nozzle type is designed to deliver. Visit [youtube.com/sprayingystems](https://www.youtube.com/sprayingystems) for video demonstrations of spray patterns.

The spray pattern images on the right were acquired in our spray laboratories using Laser Sheet Imaging (LSI). LSI images are collected by passing a laser sheet through a cross-section of the spray plume and imaging with a light-filtered camera. The distributions are directly proportional to the surface area distribution of the sprayed material (red: high; blue: low; black: zero). Volume distributions typically are similar to surface area distributions for these nozzles, depending on the local drop size distributions.

			LASER SHEET IMAGE
	<p><b>FULL CONE NOZZLES</b></p> <ul style="list-style-type: none"> <li>• Uses a unique internal vane design to produce a solid cone-shaped spray pattern</li> <li>• Spray pattern consists of medium- to large-sized drops</li> </ul>	<p><b>Typical applications:</b></p> <ul style="list-style-type: none"> <li>• Chemical injection</li> <li>• Dust suppression</li> <li>• Fire protection</li> <li>• Metal cooling</li> <li>• Washing/rinsing</li> </ul>	
	<p><b>FULL CONE (SQUARE SPRAY) NOZZLES</b></p> <ul style="list-style-type: none"> <li>• Uses a unique internal vane to produce a solid cone-shaped spray with square impact area</li> <li>• Spray pattern is uniform across entire spray area</li> <li>• Spray pattern consists of medium- to large-sized drops</li> </ul>	<p><b>Typical applications:</b></p> <ul style="list-style-type: none"> <li>• Air/gas washing</li> <li>• Cooling and quenching</li> <li>• Dust control</li> <li>• Fire suppression</li> </ul>	 <p><b>Spray Angle Range:</b> 52° to 105°</p>
	<p><b>FLAT SPRAY (TAPERED) NOZZLES</b></p> <ul style="list-style-type: none"> <li>• Produces a tapered-edge flat spray pattern</li> <li>• Used on spray headers to provide uniform coverage as a result of overlapping distributions</li> </ul>	<p><b>Typical applications:</b></p> <ul style="list-style-type: none"> <li>• Coating</li> <li>• Lubricating</li> <li>• Glazing</li> </ul>	 <p><b>Spray Angle Range:</b> 15° to 110°</p>
	<p><b>SOLID STREAM NOZZLES</b></p> <ul style="list-style-type: none"> <li>• Produces a solid stream spray with the highest impact per unit area</li> </ul>	<p><b>Typical applications:</b></p> <ul style="list-style-type: none"> <li>• Marking</li> <li>• Laminar flow application</li> </ul>	 <p><b>Spray Angle Range:</b> 0°</p>
	<p><b>AIR ATOMIZING AND AIR ASSISTED NOZZLES</b></p> <ul style="list-style-type: none"> <li>• Produces a variety of cone and flat spray patterns through atomization of liquid by compressed air</li> <li>• Internal mix impingement atomization forms very fine drops</li> </ul>	<p><b>Typical applications:</b></p> <ul style="list-style-type: none"> <li>• Coating</li> <li>• Evaporative cooling</li> <li>• Humidification</li> <li>• Moisturizing</li> </ul>	 <p><b>Spray Angle Range:</b> 18° to 360°</p>
	<p><b>ATOMIZING (HYDRAULIC, FINE MIST) NOZZLES</b></p> <ul style="list-style-type: none"> <li>• Produces a finely atomized, low capacity spray in a hollow cone pattern without use of compressed air</li> </ul>	<p><b>Typical applications:</b></p> <ul style="list-style-type: none"> <li>• Dust suppression</li> <li>• Evaporative cooling</li> <li>• Moisturizing</li> <li>• Spray drying</li> </ul>	 <p><b>Spray Angle Range:</b> 35° to 165°</p>





**CAPACITY – FLUID CAPACITY FOR HYDRAULIC NOZZLES VARIES WITH SPRAYING PRESSURE**

The relationship of pressure and flow with a given orifice is:

$$\frac{Q_1}{Q_2} \sim \left(\frac{P_1}{P_2}\right)^n$$

**Q** = Flow Rate (in gpm or lpm)  
**P** = Liquid pressure (in psi or bar)  
**n** = Flow exponent

To approximate any unknown flow or pressure, use this formula when the other variables are known. The "n" exponent is used to approximate the ratio of pressure to flow based on the type of spray pattern.

**Example:**

To determine the flow rate of water for a 1/4G-10 standard full cone nozzle at 150 psi (10 bar), consult the performance charts in this catalog.

You will find that:

- The spray angle is 65°
- Flow (Q<sub>1</sub>) at 40 psi = 1.9 gpm
- Pressure (P<sub>1</sub>) = 40 psi
- Pressure (P<sub>2</sub>) = 150 psi

Solving for Q<sub>2</sub> = 3.5 gpm

$$Q_2 = \frac{Q_1}{(P_1/P_2)^n} = \frac{1.9 \text{ gpm}}{(40/150)^{.46}}$$

- The spray angle is 65°
- Flow (Q<sub>1</sub>) at 3 bar = 7.5 lpm
- Pressure (P<sub>1</sub>) = 3 bar
- Pressure (P<sub>2</sub>) = 10 bar

Solving for Q<sub>2</sub> = 13 lpm

$$Q_2 = \frac{Q_1}{(P_1/P_2)^n} = \frac{7.5 \text{ lpm}}{(3/10)^{.46}}$$

**FLOW EXPONENT FOR SPECIFIC HYDRAULIC NOZZLE TYPES**

Nozzle Type	Exponent "n"
Flat Spray Nozzles – All	.50
Full cone Nozzles – Vaneless, 15° and 30° Series	
Hollow Cone Nozzles – All	
Solid Stream Nozzles – All	
Full Cone Nozzles – Standard and Square	.46
Full Cone Nozzles – Wide Spray and Wide Square Spray	.44

Visit [spray.com/sprayware](http://spray.com/sprayware) for online flow rate and spray coverage calculators.

**SPECIFIC GRAVITY**

All capacity tabulations in this catalog are based on water. Since the specific gravity of a liquid affects its flow rate, tabulated catalog capacities must be multiplied by the conversion factor that applies to the specific gravity of the liquid being sprayed as explained below.

Specific gravity is the ratio of the density of a fluid compared to the density of water. The specific gravity of water is defined as 1. When spraying fluids other than water, specific gravity must be considered in the flow calculations.

$$Q_2 = Q_1(\text{water}) \times \frac{1}{\sqrt{\text{SG}}}$$

**Using the previous example:**

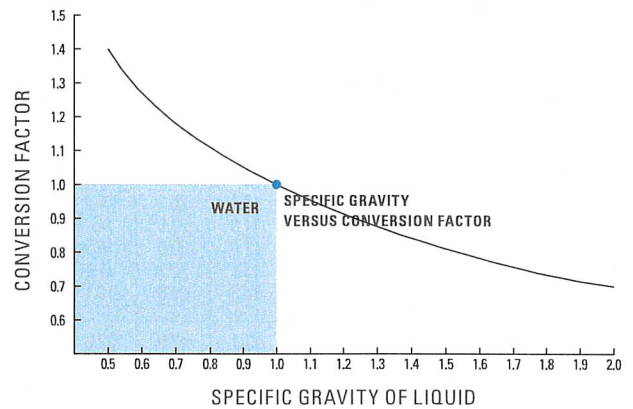
- Fluid sprayed is heavier than water and has a specific gravity of 1.4
- Flow of water at 150 psi = 3.5 gpm
- Heavy fluid (Q<sub>2</sub>) = Q<sub>1</sub>(water)\*1/√1.4

$$Q_2 = \frac{3.5 \text{ gpm} * 1}{\sqrt{1.4}} = 2.95 \text{ gpm}$$

- Fluid sprayed is heavier than water and has a specific gravity of 1.4
- Flow of water at 10 bar = 13 lpm
- Heavy fluid (Q<sub>2</sub>) = Q<sub>1</sub>(water)\*1/√1.4

$$Q_2 = \frac{13 \text{ lpm} * 1}{\sqrt{1.4}} = 11 \text{ lpm}$$

**SPECIFIC GRAVITY VERSUS CONVERSION FACTOR**

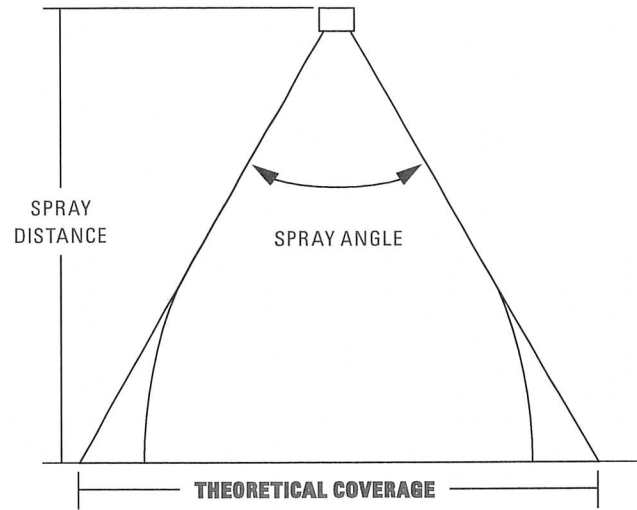


KEY: Conversion factor multiplied by the capacity of the nozzle when spraying water gives the capacity of the nozzle when spraying a liquid with a specific gravity corresponding to the conversion factor. This conversion factor accounts only for the effect of specific gravity on capacity and does not account for other factors affecting capacity.



SPRAY ANGLE AND COVERAGE

Tabulated spray angles indicate approximate spray coverage based on spray or distribution of water. In actual spraying, the effective spray angle varies with spray distance. Liquids more viscous than water form relatively smaller spray angles (or even a solid stream), depending upon viscosity, nozzle capacity and spraying pressure. Liquids with surface tensions lower than water will produce relatively wider spray angles than those listed for water. This table lists the theoretical coverage of spray patterns as calculated from the included spray angle of the spray and the distance from the nozzle orifice. Values are based on the assumption that the spray angle remains the same throughout the entire spray distance. In actual practice, the tabulated spray angle does not hold for long spray distances. If the spray coverage requirement is critical, request data sheets for specific spray coverage data.



**Example:** A spray nozzle with an angle of 65° spraying 15" (39 cm) from the target provides 19.2" (48.8 cm) of coverage

THEORETICAL SPRAY COVERAGE AT VARIOUS DISTANCES IN INCHES (CM) FROM NOZZLE ORIFICE

Spray Angle	2 in.	5 cm	4 in.	10 cm	6 in.	15 cm	8 in.	20 cm	10 in.	25 cm	12 in.	30 cm	15 in.	40 cm	18 in.	50 cm	24 in.	60 cm
5°	.2	.4	.4	.9	.5	1.3	.7	1.8	.9	2.2	1.1	2.6	1.3	3.5	1.6	4.4	2.1	5.2
10°	.4	.9	.7	1.8	1.1	2.6	1.4	3.5	1.8	4.4	2.1	5.3	2.6	7.0	3.1	8.8	4.2	10.5
15°	.5	1.3	1.1	2.6	1.6	4.0	2.1	5.3	2.6	6.6	3.2	7.9	3.9	10.5	4.7	13.2	6.3	15.8
20°	.7	1.8	1.4	3.5	2.1	5.3	2.8	7.1	3.5	8.8	4.2	10.6	5.3	14.1	6.4	17.6	8.5	21.2
25°	.9	2.2	1.8	4.4	2.7	6.7	3.5	8.9	4.4	11.1	5.3	13.3	6.6	17.7	8.0	22.2	10.6	26.6
30°	1.1	2.7	2.1	5.4	3.2	8.0	4.3	10.7	5.4	13.4	6.4	16.1	8.1	21.4	9.7	26.8	12.8	32.2
35°	1.3	3.2	2.5	6.3	3.8	9.5	5.0	12.6	6.3	15.8	7.6	18.9	9.5	25.2	11.3	31.5	15.5	37.8
40°	1.5	3.6	2.9	7.3	4.4	10.9	5.8	14.6	7.3	18.2	8.7	21.8	10.9	29.1	13.1	36.4	17.5	43.7
45°	1.7	4.1	3.3	8.3	5.0	12.4	6.6	16.6	8.3	20.7	9.9	24.9	12.4	33.1	14.9	41.4	19.9	49.7
50°	1.9	4.7	3.7	9.3	5.6	14.0	7.5	18.7	9.3	23.3	11.2	28.0	14.0	37.3	16.8	46.6	22.4	56.0
55°	2.1	5.2	4.2	10.4	6.3	15.6	8.3	20.8	10.3	26.0	12.5	31.2	15.6	41.7	18.7	52.1	25.0	62.5
60°	2.3	5.8	4.6	11.6	6.9	17.3	9.2	23.1	11.5	28.9	13.8	34.6	17.3	46.2	20.6	57.7	27.7	69.3
65°	2.5	6.4	5.1	12.7	7.6	19.1	10.2	25.5	12.7	31.9	15.3	38.2	19.2	51.0	22.9	63.7	30.5	76.5
70°	2.8	7.0	5.6	14.0	8.4	21.0	11.2	28.0	14.0	35.0	16.8	42.0	21.0	56.0	25.2	70.0	33.6	84.0
75°	3.1	7.7	6.1	15.4	9.2	23.0	12.3	30.7	15.3	38.4	18.4	46.0	23.0	61.4	27.6	76.7	36.8	92.1
80°	3.4	8.4	6.7	16.8	10.1	25.2	13.4	33.6	16.8	42.0	20.2	50.4	25.2	67.1	30.3	83.9	40.3	101
85°	3.7	9.2	7.3	18.3	11.0	27.5	14.7	36.7	18.3	45.8	22.0	55.0	27.5	73.3	33.0	91.6	44.0	110
90°	4.0	10.0	8.0	20.0	12.0	30.0	16.0	40.0	20.0	50.0	24.0	60.0	30.0	80.0	36.0	100	48.0	120
95°	4.4	10.9	8.7	21.8	13.1	32.7	17.5	43.7	21.8	54.6	26.2	65.5	32.8	87.3	39.3	109	52.4	131
100°	4.8	11.9	9.5	23.8	14.3	35.8	19.1	47.7	23.8	59.6	28.6	71.5	35.8	95.3	43.0	119	57.2	143
110°	5.7	14.3	11.4	28.6	17.1	42.9	22.8	57.1	28.5	71.4	34.3	85.7	42.8	114	51.4	143	68.5	171
120°	6.9	17.3	13.9	34.6	20.8	52.0	27.7	69.3	34.6	86.6	41.6	104	52.0	139	62.4	173	83.2	208
130°	8.6	21.5	17.2	42.9	25.7	64.3	34.3	85.8	42.9	107	51.5	129	64.4	172	77.3	215	103	257
140°	10.9	27.5	21.9	55.0	32.9	82.4	43.8	110	54.8	137	65.7	165	82.2	220	98.6	275	-	-
150°	14.9	37.3	29.8	74.6	44.7	112	59.6	149	74.5	187	89.5	224	112	299	-	-	-	-

Visit [spray.com/sprayware](http://spray.com/sprayware) for online flow rate and spray coverage calculators.



**PUMPS**

Every operation using spray nozzles requires a method to provide fluid flow. Fluid flow can be provided by gravity, air pressure or mechanical pumps. It is important to understand that pumping systems provide flow, not pressure. Pressure is the result of restricting flow. The output of an unrestricted pump is 0 psi (bar). When a restriction is placed in the flow, line pressure will result.

The main types of pumps are positive displacement and centrifugal. There are others, but the operational principles are the same as for positive displacement and centrifugal pumps.

**Positive displacement pumps**

A fixed volume of fluid is delivered for every stroke of a piston, or plunger or rotation of a shaft. Examples include piston pumps, plunger pumps, peristaltic pumps and gear pumps. Positive displacement pumps provide high pressure, and regardless of the system characteristics, will deliver a fixed flow every rotation. These pumps must have an unrestricted bypass valve and a pressure relief valve.

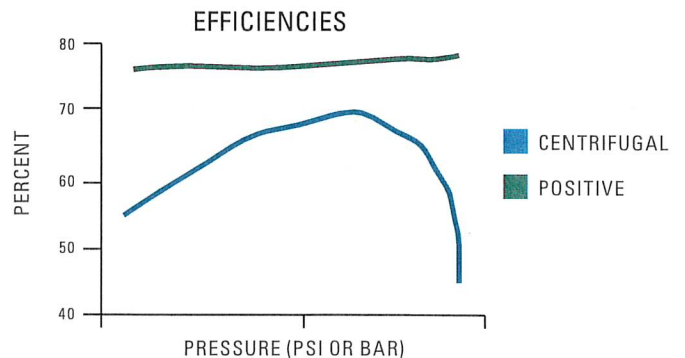
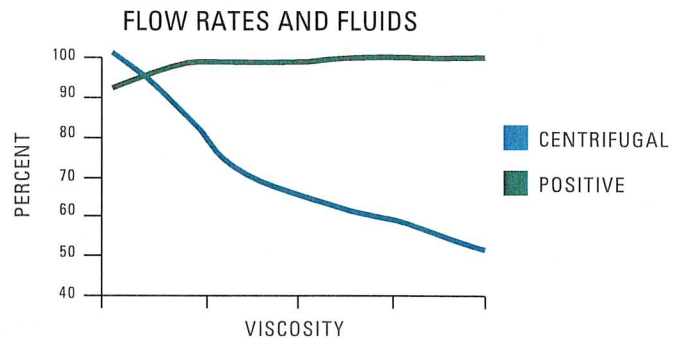
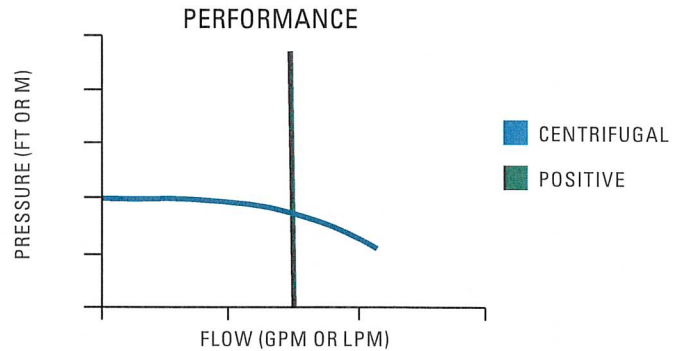
**Centrifugal pumps (velocity pumps)**

These pumps typically consist of a large vane (impeller) which is turned by a shaft inside a cavity (casing). The geometry of the impeller and casing moves the fluid in a tangential motion. The fluid gets restricted to a smaller volume and is then discharged into the system piping. These types of pumps typically operate at low pressure and high volume. They may also consist of several stages to increase the number of pressures available. These pumps have the unique feature of being able to run while the outlet is blocked. Since the pumps are velocity based, the impeller will spin in the casing fluid without “dead heading” the system itself. It will produce heat and may cavitate the fluid, but it will not build pressure like positive displacement pumps. However, a system bypass and pressure safety valve is still installed in the system to protect components.

**HOW PUMP TYPE AFFECTS NOZZLE SELECTION**

The flow rates and pressures required by the system will determine the pump choice. There are many styles, sizes and types of pumps available but these general guidelines should prove helpful.

- High flows usually require a centrifugal style pump
- High pressures usually require a positive displacement pump
- Variable Frequency Drive (VFD) pumps may be an option. These pumps allow variable control of speed and flow rates
- Consider the fluid. Specific gravity will affect pump flow rates just as it affects nozzle flow rates
- Pump efficiencies, heat, available power, maintenance and plant conditions should also be considered





### SPRAY DROP SIZE (ATOMIZATION)

Accurate drop size information is an important factor in optimizing spray nozzle performance, particularly in industrial applications such as gas cooling, gas conditioning, fire suppression and spray drying.

Drop size refers to the size of the individual spray drops that comprise a nozzle's spray pattern. Each spray provides a range of drop sizes; this range is referred to as drop size distribution. Drop size distribution is dependent on the spray pattern type and varies significantly from one type to another. The smallest drop sizes are achieved by air atomizing nozzles while the largest drops are produced by full cone hydraulic spray nozzles.

**ACTUAL DROP SIZES**

- 500  $\mu\text{m}$
- 1200  $\mu\text{m}$
- 5500  $\mu\text{m}$

One inch = 25,400  $\mu\text{m}$   
 One millimeter = 1,000  $\mu\text{m}$   
 $\mu\text{m}$  = micrometers

Liquid properties, nozzle capacity, spraying pressure and spray angle also affect drop size. Lower spraying pressures provide larger drop sizes. Conversely, higher spraying pressures yield smaller drop sizes. Within each type of spray pattern the smallest capacities produce the smallest spray drops, and the largest capacities produce the largest spray drops.

### DROP SIZE BY SPRAY PATTERN TYPE AT VARIOUS PRESSURES AND CAPACITIES

Spray Pattern Type	10 psi (0.7 bar)			40 psi (2.8 bar)			100 psi (7 bar)		
	Capacity		VMD	Capacity		VMD	Capacity		VMD
	gpm	lpm	microns	gpm	lpm	microns	gpm	lpm	microns
Air Atomizing	.005 .02	.02 .08	20 100	.008 8	.03 30	15 200	12	45	400
Fine Spray	.22	.83	375	.03 .43	.1 1.6	110 330	.05 .69	.2 2.6	110 290
Hollow Cone	.05 12	.19 45	360 3400	.10 24	.38 91	300 1900	.16 38	.61 144	200 1260
Flat Fan	.05 5	.19 18.9	260 4300	.10 10	.38 38	220 2500	.16 15.8	.61 60	190 1400
Full Cone	.10 12	.38 45	1140 4300	.19 23	.72 87	850 2800	.30 35	1.1 132	500 1720

Based on a sampling of nozzles selected to show the wide range of possible drop sizes available.

### DROP SIZE TERMINOLOGY

Terminology is often a major source of discrepancy and confusion in understanding drop size. To accurately compare drop sizes from one nozzle to another, the same diameters have to be used. Drop size is usually expressed in microns (micrometers). Following are the most popular characteristic diameters and their definitions.

#### $D_{v0.5}$ : VOLUME MEDIAN DIAMETER (VMD)

A means of expressing drop size in terms of the volume of liquid sprayed. The Volume Median Diameter drop size when measured in terms of volume is a value where 50% of the total volume of liquid sprayed is made up of drops with diameters larger than the median value and 50% with smaller diameters.

#### $D_{v0.9}$

A value where 90% of the total volume of liquid sprayed is made up of drops with diameters smaller or equal to this value. This measurement is best suited when complete evaporation of the spray is required.

#### $D_{32}$ : SAUTER MEAN DIAMETER (SMD)

A means of expressing the fineness of a spray in terms of the surface area produced by the spray. The Sauter Mean Diameter, is the diameter of a drop having the same volume-to-surface area ratio as the total volume of all the drops to the total surface area of all the drops.

**More drop size data is available on all types of spray nozzles. For more information contact your local Spraying Systems Co. sales engineer.**

### OPERATING PRESSURE

The values given in the tabulation sections of this catalog indicate the most commonly used pressure ranges for the associated spray nozzle or accessory.

**Contact your local Spraying Systems Co. sales engineer if your application requires pressure ranges beyond those stated in this catalog.**

### NOZZLE MATERIALS

For each nozzle there is a selection of "standard" materials that have been determined to meet the usual requirements of the applications most commonly associated with that type of nozzle. Standard materials include brass, steel, various stainless steels, hardened stainless steels, many plastics and various carbides. Spray nozzles can also be supplied in other materials upon special request.





**NOZZLE WEAR**

Nozzle wear is typically characterized by an increase in nozzle capacity, followed by a general deterioration of the spray pattern. Flat fan spray nozzles with elliptical orifices experience a narrowing of the spray pattern. In other spray pattern types, the distribution within the spray pattern deteriorates without substantially changing the coverage area. The increase in nozzle capacity can sometimes be recognized by a decrease in system operating pressure, particularly when using positive displacement pumps.

Materials having harder surfaces generally provide longer wear life. The chart below provides standard abrasion resistance ratios for different materials to help you determine if you should consider a different material for your nozzles, orifice inserts and/or spray tips.

Materials that offer better corrosion resistance are also available. However, the rate of chemical corrosion on specific nozzle materials is dependent on the solution being sprayed. The corrosive properties of the liquid being sprayed, its percent concentration and temperature, as well as the corrosion resistance of the nozzle material to the chemical must all be considered.

**APPROXIMATE ABRASION RESISTANCE RATIOS**

Spray Nozzle Material	Resistance Ratio
Brass	1
Polypropylene	1-2
Stainless Steel	4-6
HASTELLOY	4-6
Hardened Stainless Steel	10-15
Stellite	10-15
Ceramics	90-200
Carbides	180-250

See Trademark Registration and Ownership, page i-1.

**VISCOSITY**

Absolute (dynamic) viscosity is the property of a liquid which resists change in the shape or arrangement of its elements during flow. Liquid viscosity is a primary factor affecting spray pattern formation and, to a lesser degree, capacity. High viscosity liquids – 100 cp or higher – require a higher minimum pressure to begin formation of a spray pattern and provide narrower spray angles as compared to those of water.

**TEMPERATURE**

The values given in this catalog are based on spraying water at 70°F (21°C). Although liquid temperature changes do not affect the spray performance of a nozzle, they often affect viscosity, surface tension and specific gravity which do influence spray nozzle performance.

**SURFACE TENSION**

The surface of a liquid tends to assume the smallest possible size; acting, in this respect, like a membrane under tension. Any portion of the liquid surface exerts a tension upon adjacent portions or upon other objects with which it is in contact. This force is in the plane of the surface and its amount per unit of length is surface tension. Its value for water is about 73 dynes per cm at 70°F (21°C). The main effects of surface tension are on minimum operating pressure, spray angle and drop size.

The property of surface tension is more apparent at low operating pressures. A higher surface tension reduces the spray angle, particularly on hollow cone and flat fan spray nozzles. Low surface tensions can allow a nozzle to be operated at a lower pressure.

**SUMMARY OF SPRAY PERFORMANCE CONSIDERATIONS**

The factors below can affect a spray nozzle’s performance, and the effects can vary based on nozzle type and size. In some applications, there are interrelated factors which may counteract certain effects. For instance, in the case of a hollow cone spray nozzle, increasing the temperature of the liquid decreases the specific gravity, thereby producing a greater flow rate while at the same time decreasing the viscosity which reduces the flow.

Nozzle Characteristics	Increase in Operating Pressure	Increase in Specific Gravity	Increase in Viscosity	Increase in Fluid Temperature	Increase in Surface Tension
Pattern Quality	Improves	Negligible	Deteriorates	Improves	Negligible
Drop Size	Decreases	Negligible	Increases	Decreases	Increases
Spray Angle	Increases then decreases	Negligible	Decreases	Increases	Decreases
Capacity	Increases	Decreases	Full/hollow cone – increases Flat – decreases	Depends on fluid sprayed and nozzle used	No effect
Impact	Increases	Negligible	Decreases	Increases	Negligible
Velocity	Increases	Decreases	Decreases	Increases	Negligible
Wear	Increases	Negligible	Decreases	Depends on fluid sprayed and nozzle used	No effect



**ESTIMATING PRESSURE DROPS THROUGH FLUIDLINE ACCESSORIES**

The rated capacities listed in this catalog for valves, strainers and fittings typically correspond to pressure drops of approximately 5% of their maximum operating pressure.

Visit [spray.com/sprayware](http://spray.com/sprayware) for an online pressure drop calculator. Or contact your local sales engineer.

**APPROXIMATE FRICTION LOSS IN PIPE FITTINGS IN EQUIVALENT FEET (METERS) OF STRAIGHT PIPE**

Use the chart below to determine the equivalent length of pipe through fittings to equate the friction loss.

Pipe Size Standard Wt. (in.)	Actual Inside Dia. in. (mm)	Gate Valve FULL OPEN ft. (m)	Globe Valve FULL OPEN ft. (m)	45° Elbow ft. (m)	Run of Standard Tee ft. (m)	Standard Elbow or Run of Tee Reduced 1/2 ft. (m)	Standard Tee Through Side Outlet ft. (m)
1/8	.269 (6.8)	.15 (.05)	8.0 (2.4)	.35 (.11)	.40 (.12)	.75 (.23)	1.4 (.43)
1/4	.364 (9.2)	.20 (.06)	11.0 (3.4)	.50 (.15)	.65 (.20)	1.1 (.34)	2.2 (.67)
1/2	.622 (15.8)	.35 (.11)	18.6 (5.7)	.78 (.24)	1.1 (.34)	1.7 (.52)	3.3 (1.0)
3/4	.824 (21)	.44 (.13)	23.1 (7.0)	.97 (.30)	1.4 (.43)	2.1 (.64)	4.2 (1.3)
1	1.049 (27)	.56 (.17)	29.4 (9.0)	1.2 (.37)	1.8 (.55)	2.6 (.79)	5.3 (1.6)
1-1/4	1.380 (35)	.74 (.23)	38.6 (11.8)	1.6 (.49)	2.3 (.70)	3.5 (1.1)	7.0 (2.1)
1-1/2	1.610 (41)	.86 (.26)	45.2 (13.8)	1.9 (.58)	2.7 (.82)	4.1 (1.2)	8.1 (2.5)
2	2.067 (53)	1.1 (.34)	58 (17.7)	2.4 (.73)	3.5 (1.1)	5.2 (1.6)	10.4 (3.2)
2-1/2	2.469 (63)	1.3 (.40)	69 (21)	2.9 (.88)	4.2 (1.3)	6.2 (1.9)	12.4 (3.8)
3	3.068 (78)	1.6 (.49)	86 (26)	3.6 (1.1)	5.2 (1.6)	7.7 (2.3)	15.5 (4.7)
4	4.026 (102)	2.1 (.64)	113 (34)	4.7 (1.4)	6.8 (2.1)	10.2 (3.1)	20.3 (6.2)
5	5.047 (128)	2.7 (.82)	142 (43)	5.9 (1.8)	8.5 (2.6)	12.7 (3.9)	25.4 (7.7)
6	6.065 (154)	3.2 (.98)	170 (52)	7.1 (2.2)	10.2 (3.1)	15.3 (4.7)	31 (9.4)

**AIR FLOW (SCFM AND NLPM) THROUGH SCHEDULE 40 STEEL PIPE**

Applied Pressure psig	Nominal Standard Pipe Size (scfm)											Applied Pressure bar	Nominal Standard Pipe Size (nlpm)										
	1/8"	1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"		1/8"	1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
5	.5	1.2	2.7	4.9	6.6	13.0	27	40	80	135	240	0.3	14.2	34.0	76.5	139	187	370	765	1130	2265	3820	6796
10	.8	1.7	3.9	7.7	11.0	21	44	64	125	200	370	0.7	22.7	48.1	110	218	310	595	1245	1810	3540	5665	10480
20	1.3	3.0	6.6	13.0	18.5	35	75	110	215	350	600	1.4	36.8	85.0	187	370	525	990	2125	3115	6090	9910	16990
40	2.5	5.5	12.0	23	34	62	135	200	385	640	1100	2.8	70.8	155	340	650	960	1755	3820	5665	10900	18120	31150
60	3.5	8.0	18.0	34	50	93	195	290	560	900	1600	4.1	99.1	227	510	965	1415	2630	5520	8210	15860	25485	45305
80	4.7	10.5	23	44	65	120	255	380	720	1200	2100	5.5	133	297	650	1245	1840	3400	7220	10760	20390	33980	59465
100	5.8	13.0	29	54	80	150	315	470	900	1450	2600	6.9	164	370	820	1530	2265	4250	8920	13310	25485	41060	73625





FLOW OF WATER THROUGH SCHEDULE 40 STEEL PIPE – PRESSURE DROP

Flow gpm	Pressure Drop in psi for Various Pipe Diameters 10 ft. Length Pipe																Flow lpm	Pressure Drop in bar for Various Pipe Diameters 10 m Length Pipe																				
	1/8"	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"		1/8"	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"					
.3	.42																1	.07																				
.4	.70	.16															1.5	.16	.04																			
.5	1.1	.24															2	.26	.06																			
.6	1.5	.33															2.5	.40	.08																			
.8	2.5	.54	.13														3	.56	.12	.03																		
1.0	3.7	.83	.19	.06													4	.96	.21	.05	.02																	
1.5	8.0	1.8	.40	.12													6	2.0	.45	.10	.03																	
2.0	13.4	3.0	.66	.21	.05												8	3.5	.74	.17	.05	.01																
2.5		4.5	1.0	.32	.08												10		1.2	.25	.08	.02																
3.0		6.4	1.4	.43	.11												12		1.7	.35	.11	.03																
4.0		11.1	2.4	.74	.18	.06											15		2.6	.54	.17	.04	.01															
5.0			3.7	1.1	.28	.08											20			.92	.28	.07	.02															
6.0				5.2	1.6	.38	.12										25			1.2	.45	.11	.03															
8.0					9.1	2.8	.66	.20	.05								30				2.1	.62	.15	.04	.01													
10						4.2	1.0	.30	.08								40					1.1	.25	.08	.02													
15							2.2	.64	.16	.08							60					.54	.16	.04	.02	.006												
20							3.8	1.1	.28	.13	.04						80					.93	.28	.07	.03	.009												
25								1.7	.42	.19	.06						100					.43	.12	.05	.01													
30								2.4	.59	.27	.08						115					.58	.14	.06	.015													
35								3.2	.79	.36	.11	.04					130					.72	.18	.08	.02	.01												
40									1.0	.47	.14	.06					150							.23	.10	.03	.012											
45									1.3	.59	.17	.07					170							.29	.13	.04	.016											
50									1.6	.72	.20	.08					190							.36	.16	.05	.02											
60									2.2	1.0	.29	.12	.04				230							.50	.23	.07	.03	.009										
70										1.4	.38	.16	.05				260							.32	.09	.04	.01											
80										1.8	.50	.20	.07				300							.38	.11	.04	.02	.007										
90										2.2	.62	.25	.09	.04			340							.50	.14	.06	.02	.009										
100										2.7	.76	.31	.11	.05			380							.61	.18	.07	.03	.01										
125											1.2	.47	.16	.08	.04		470								.28	.11	.04	.02	.009									
150											1.7	.67	.22	.11	.06		570								.39	.15	.05	.03	.01									
200											2.9	1.2	.39	.19	.10		750								.64	.26	.09	.04	.02	.007								
250												.59	.28	.15	.05		950										.14	.06	.03	.01								
300												.84	.40	.21	.07		1150										.19	.09	.05	.02								
400												.70	.37	.12	.05		1500											.16	.08	.03	.01							
500													.57	.18	.07		1900												.13	.04	.02							
750														.39	.16	.04		2800												.09	.03	.009						
1000														.68	.27	.07		3800												.16	.06	.02						
2000															1.0	.26		7500													.23	.06						

Recommended capacity range for each size is shown in shaded areas.  
 For pipe lengths greater than 10 ft. (3 m), the pressure loss is proportional to the length. For 50 ft. (15 m) of pipe, the pressure drop is approximately 5 times the value in the table.



## MAINTAINING SPRAY NOZZLES

Like any precision component, spray nozzles wear over time. Spray nozzle wear can be hard to detect. Small changes in performance can result in quality problems and wasted water, chemicals and electricity. The cost of using worn nozzles can be very significant – tens of thousands of dollars or more per year. Detecting nozzle wear in the early stages can prevent a significant profit drain.

USING NOZZLES THAT ARE SPRAYING JUST 15% OVER THE RATED CAPACITY\*

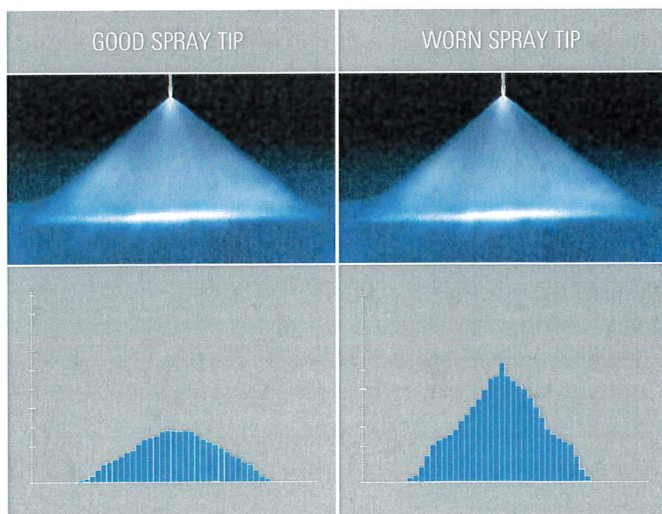
	WASTE	COST OF EXCESS
WATER	1,701,835 gallons (6,442,146 liters)	US \$4,680
CHEMICALS	170,165 gallons (644,145 liters)	US \$170,164
WASTEWATER DISPOSAL	1,872,000 gallons (7,086,291 liters)	US \$7,956
<b>TOTAL COST OF USING WORN NOZZLES:</b>		<b>US \$182,800</b>

\*Based on total system flow of 100 gpm (379 lpm). Water cost of US \$2.75/1000 gallons (3,785 liters). Chemical cost of US \$1.00 per gallon (liter) and a dilution ratio of 10:1. System operates 2080 hours per year. Increased electricity cost, scrap and downtime due to quality problems are not included.

## DETECTING WORN SPRAY NOZZLES

Visually inspecting nozzles is a start but unless wear is significant, it may not be detectable.

The graphic below illustrates this problem. The spray tip on the left is new and sprays properly. The spray tip on the right is worn and sprays 30% over capacity. The difference is undetectable by inspecting the nozzle, but spray collection data reveals the difference between the two tips.



WATCH FOR THESE SIGNS OF NOZZLE WEAR:

- **Quality control issues and increased scrap.** Check for uneven coating, cooling, drying or cleaning and changes in temperature, dust content and humidity
- **Flow rate change:**
  - For centrifugal pumps: monitor flow meter readings to detect increases or collect and measure the flow from the spray nozzle for a given period of time at a specific pressure and compare them to flow rate readings from new, unused spray nozzles
  - For positive displacement pumps: monitor the liquid line pressure for decreases; the flow rate will remain constant
- **Spray pressure in the nozzle manifold:**
  - For centrifugal pumps: monitor for increases in liquid volume sprayed. The spraying pressure is likely to remain the same
  - For positive displacement pumps: monitor pressure gauge for decreases in pressure and reduction in impact on sprayed surfaces. The liquid volume sprayed is likely to remain the same. Also, monitor for increases in pressure due to clogged spray nozzles
- **Deterioration of spray pattern quality.** Visually inspect the spray pattern for changes. Check the spray angle with a protractor. Measure the width of the spray pattern on the sprayed surface

## REPLACING WORN NOZZLES

Inspecting and maintaining your nozzles on a regular basis will help identify wear and extend service life. However, wear will occur over time and the only solution is to replace your nozzles.

Here are a few guidelines to help you determine the optimal replacement interval:

- Are worn nozzles affecting product or process quality? If so, replace nozzles as soon as any wear is evident
- Is water conservation a priority? If so, replace nozzles as soon as wear is evident
- How much are you spending by continuing to use worn nozzles? How do the additional costs for water, chemicals, electricity and wastewater disposal compare with the cost of replacement nozzles?
- Is precise spray performance important to your overall process? If so, you may want to set pre-determined dates for nozzle replacement such as annual or semi-annual maintenance shutdowns

**For more information on nozzle maintenance and replacement, visit [spray.com](http://spray.com). Or, contact your local sales engineer for assistance developing a nozzle maintenance program.**



TABLE OF EQUIVALENTS

VOLUMETRIC UNIT

	Cubic Centimeter	Fluid Ounce	Pound of Water	Liter	US Gallon	Cubic Foot	Cubic Meter
Cubic Centimeter	•	.034	$2.2 \times 10^{-3}$	.001	$2.64 \times 10^{-4}$	$3.53 \times 10^{-5}$	$1.0 \times 10^{-6}$
Fluid Ounce	29.4	•	.065	.030	$7.81 \times 10^{-3}$	$1.04 \times 10^{-3}$	$2.96 \times 10^{-5}$
Pound of Water	454	15.4	•	.454	.12	.016	$4.54 \times 10^{-4}$
Liter	1000	33.8	2.2	•	.264	.035	.001
US Gallon	3785	128	8.34	3.785	•	.134	$3.78 \times 10^{-3}$
Cubic Foot	28320	958	62.4	28.3	7.48	•	.028
Cubic Meter	$1.0 \times 10^6$	$3.38 \times 10^4$	2202	1000	264	35.3	•

LIQUID PRESSURE

	lb/in <sup>2</sup> (psi)	Ft Water	Kg/Cm <sup>2</sup>	Atmosphere	Bar	Inch Mercury	kPa (kilopascal)
lb/in <sup>2</sup> (psi)	•	2.31	.070	.068	.069	2.04	6.895
Ft Water	.433	•	.030	.029	.030	.882	2.99
Kg/Cm <sup>2</sup>	14.2	32.8	•	.968	.981	29.0	98
Atmosphere	14.7	33.9	1.03	•	1.01	29.9	101
Bar	14.5	33.5	1.02	.987	•	29.5	100
Inch Mercury	.491	1.13	.035	.033	.034	•	3.4
kPa (kilopascal)	.145	.335	.01	.009	.01	.296	•

LINEAR UNIT

	Micron	Mil	Millimeter	Centimeter	Inch	Foot	Meter
Micron	•	.039	.001	$1.0 \times 10^{-4}$	$3.94 \times 10^{-5}$	–	–
Mil	25.4	•	$2.54 \times 10^{-2}$	$2.54 \times 10^{-3}$	.001	$8.33 \times 10^{-5}$	–
Millimeter	1000	39.4	•	.10	.0394	$3.28 \times 10^{-3}$	.001
Centimeter	10000	394	10	•	.394	.033	.01
Inch	$2.54 \times 10^4$	1000	25.4	2.54	•	.083	.0254
Foot	$3.05 \times 10^5$	$1.2 \times 10^4$	305	30.5	12	•	.305
Meter	$1.0 \times 10^6$	$3.94 \times 10^4$	1000	100	39.4	3.28	•

MISCELLANEOUS EQUIVALENTS

Unit	Equivalent
Ounce	28.35 g
Pound	.4536 kg
Horsepower	.746 kW
British Thermal Unit	.252 kcal
Square Inch	6.452 cm <sup>2</sup>
Square Foot	.09290 m <sup>2</sup>

MISCELLANEOUS FORMULAS

Unit	Formula
Fahrenheit (°F)	= $9/5$ (°C) + 32
Celsius (°C)	= $5/9$ (°F) – 32
Circumference of a Circle	= $3.1416 \times \text{Dia.}$
Area of a Circle	= $.7854 \times (\text{Dia.})^2$
Volume of a Sphere	= $.5236 \times (\text{Dia.})^3$
Area of a Sphere	= $3.1416 \times (\text{Dia.})^2$

DIMENSIONS

The catalog tabulations show orifice dimensions as “Nom.” (nominal).





READ THE FOLLOWING INSTRUCTIONS:



**WARNING:**

All safety related and operating instructions should be read before the nozzle is operated. Follow all operating instructions. Failure to do so could result in serious or fatal injury.



**WARNING:**

It is important to recognize proper safety precautions when using a pressurized spray system. Fluids under pressure can penetrate skin and cause severe injury. Seek medical attention immediately.



**WARNING:**

When dealing with pressure applications, the system pressure should never exceed the lowest rated component. Always know your system and all component capabilities, maximum pressures and flow rates.



**WARNING:**

Before performing any maintenance, make sure all liquid supply lines to the machine are shut off and/or disconnected and chemicals/fluids are drained and not pressurized.



**WARNING:**

The use of any chemicals requires careful control of all worker hygiene. Follow all MSDS or safety precautions provided by the manufacturer.



**WARNING:**

Spraying Systems Co. does not manufacture or supply any of the chemicals used with our nozzles and is not responsible for their effects. Because of the large number of chemicals that could be used and their different chemical reactions, the buyer and user of this equipment should determine compatibility of the materials used and any of the potential hazards involved.



**WARNING:**

Spraying Systems Co. strongly recommends the use of appropriate safety equipment when working with potentially hazardous chemicals.

**This equipment includes but is not limited to:**

- Protective hat
- Safety glasses or face shield
- Chemical-resistant gloves and apron
- Long sleeve shirt and long pants



**WARNING:**

Before use, be sure appropriate connections are secure and made to withstand weight and reaction forces of the operating unit.

NOTE: Always remember to carefully read the chemical manufacturer's label and follow all directions.



**WARNING:**

It is important to operate equipment within the temperature range of all components. Also, insure appropriate time lapse or proper safety equipment is used when handling components after they're exposed to high temperatures.



**WARNING:**

Do not use any equipment outside the intended purposes of the product. Misuse can result in personal injury or product damage.





**PERFORMANCE DATA:  
UNIJET® TX HYDRAULIC HOLLOW CONE SPRAY TIPS**

Body Inlet Conn. (in.)	Capacity Size	Inlet Openings (in.)	Orifice Dia. Nom. (in.)	Flow Rate Capacity (gallons per hour)									Spray Angle (°)	
				20 psi	30 psi	40 psi	60 psi	80 psi	100 psi	150 psi	200 psi	400 psi	20 psi	40 psi
1/4	.60	One .012 x .010	.014	–	–	–	.73	.85	.95	1.2	1.3	1.9	–	–
	1	One .016 x .015	.020	–	.87	1.0	1.2	1.4	1.6	1.9	2.2	3.2	–	54
	1.25	One .020 x .020	.022	–	1.1	1.3	1.5	1.8	2.0	2.4	2.8	4.0	–	59
	1.5	One .024 x .020	.024	–	1.3	1.5	1.8	2.1	2.4	2.9	3.4	4.7	–	63
	2	One .028 x .024	.028	1.4	1.7	2.0	2.4	2.8	3.2	3.9	4.5	6.3	40	68
	2.5	One .030 x .029	.031	1.8	2.2	2.5	3.1	3.5	4.0	4.8	5.6	7.9	48	70
	3	One .036 x .034	.034	2.1	2.6	3.0	3.7	4.2	4.7	5.8	6.7	9.5	57	72
	4	One .040 x .034	.041	2.8	3.5	4.0	4.9	5.7	6.3	7.7	8.9	12.6	61	73
	5	Two .032 x .032	.044	3.5	4.3	5.0	6.1	7.1	7.9	9.7	11.2	15.8	63	73
	6	Two .040 x .032	.047	4.2	5.2	6.0	7.3	8.5	9.5	11.6	13.4	19.0	65	74
	8	Two .040 x .036	.055	5.7	6.9	8.0	9.8	11.3	12.6	15.5	17.9	25	66	74
	10	Two .050 x .030	.060	7.1	8.7	10.0	12.2	14.1	15.8	19.4	22	32	68	75
	12	Two .050 x .034	.067	8.5	10.4	12.0	14.7	17.0	19.0	23	27	38	69	76
	14	Two .055 x .034	.070	9.9	12.1	14.0	17.1	19.8	22	27	31	44	70	76
	18	Two .060 x .031	.079	12.7	15.6	18.0	22	25	28	35	40	57	71	77
22	Two .065 x .030	.086	15.6	19.1	22	27	31	35	43	49	70	71	78	
26	Two .065 x .030	.094	18.4	23	26	32	37	41	50	58	82	72	78	

Spray angle of all above tips is 80° at 100 psi (7 bar). Other body types may be available. Contact your sales engineer for more information.

Highlighted column shows the rated pressure of the nozzles.



**PERFORMANCE DATA:  
UNIJET® TN HYDRAULIC HOLLOW CONE SPRAY TIPS**

Body Inlet Conn. (in.)	Capacity Size	Orifice Dia. Nom. (in.)	Core No.	Flow Rate Capacity (gallons per hour)									Spray Angle (°)		
				30 psi	40 psi	60 psi	100 psi	200 psi	300 psi	500 psi	700 psi	1000 psi	40 psi	80 psi	300 psi
1/4	.30	.016	106	–	–	–	–	–	.82	1.1	1.3	1.5	–	–	51
	.40	.016	108	–	–	–	–	–	1.1	1.4	1.7	2.0	–	–	58
	.60	.016	206	–	–	–	.95	1.3	1.6	2.1	2.5	3.0	–	35	65
	1	.020	210	–	1.0	1.2	1.6	2.2	2.7	3.5	4.2	5.0	45	62	72
	1.5	.020	216	1.3	1.5	1.8	2.4	3.4	4.1	5.3	6.3	7.5	65	70	72
	2	.028	216	1.7	2.0	2.4	3.2	4.5	5.5	7.1	8.4	10.0	70	75	77
	3	.028	220	2.6	3.0	3.7	4.7	6.7	8.2	10.6	12.5	15.0	65	70	73
	4	.042	220	3.5	4.0	4.9	6.3	8.9	11.0	14.1	16.7	20	72	81	84
	6	.042	225	5.2	6.0	7.3	9.5	13.4	16.4	21	25	30	73	79	81
	8	.060	225	6.9	8.0	9.8	12.6	17.9	22	28	33	40	85	89	91
	10	.064	420	8.7	10.0	12.2	15.8	22	27	35	42	50	82	84	86
	12	.076	420	10.4	12.0	14.7	19.0	27	33	42	50	60	78	82	85
	14	.076	421	12.1	14.0	17.1	22	31	38	49	59	70	85	88	90
	18	.076	422	15.6	18.0	22	28	40	49	64	75	90	81	84	86
	22	.076	625	19.1	22	27	35	49	60	78	92	110	70	72	75
26	.086	625	23	26	32	41	58	71	92	109	130	73	74	77	

Other body types may be available. Contact your sales engineer for more information. Highlighted column shows the rated pressure of the nozzles.

