BAGHOUSE FILTER BAGS

A Guideline and Comprehensive Study to Becoming an Expert
Filter Bags for Dry Fabric Filter Baghouses

Index – A Guide to Filter Bag Understanding and Control

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1.0 Opening Statement – Historical Prospective – Filter Bags in Filtration

Since the Clean Air Act in the 1970s, the utilization of fabric filter baghouses for both process and nuisance dust collection has experienced a 16% compound growth rate worldwide. Growth rates have leveled in the U.S., but maintained themselves in emerging countries. Government and social mandates have brought requirements for larger and more sophisticated baghouse cleaning designs, and more advanced fabric filter bag designs and filter media for use in baghouse filtration.

Operations of baghouses are major cost contributions to a typical industrial facilities yearly operating budget. Expert technicians in our industry should train end users in efficient utilization of filter bags for dry fabric filter dust collection.

IAC’s documentation of relevant information regarding filtration media and bags is key to saving operational costs. With this value-added information, you can make wise, practical, and informed decisions when it comes to the most cost-effective methods to operate baghouses for your organization.

2.0 Common Terminology Names Applied to Dry Fabric Filter Bags:
Summary: Filter Bags for any dust baghouse filtration are called by multiple names.

- Reverse Air Bags
- Filter Bags
- Filter Socks
- Filter Media Bags
- Tubular Bags
- Dust Bags
- Felted Bags
- Woven Bags
- Fiberglass Bags
- Envelope Bags
- Cartridges
- Pleated Elements
- Fabric Filter Bags
- Dry Dust Filters
- APC Filter Bags
- Baghouse Filter Bags
- Pulse-Jet Bags
- Shaker Bags
3.0 What Are You Searching For Relative to Dry Fabric Filtration?

Besides multiple names applied to the filter bags themselves, there are also several different designs and types of Baghouse equipment that utilize dry fabric filter bags to remove dust from the plant environment’s air.

Common questions heard by IAC:
A. What kind of baghouse do I have?
B. What are my bag size(s)?
C. Is there something special about the OEM baghouse manufacturer’s filter bag design that I need to know before purchasing replacement filter bags?
D. Why do I need such frequent bag purchases? What bag life should I expect?
E. Is there something wrong with the bag design and filter media that I am using?
F. What is the most frequent cause for my bags to fail?
G. I am getting ready to change the plant’s dust control process / nuisance system where our present baghouse is collecting dust. Do I need to change my bag specifications at the same time?
H. How can I be sure I will have the bags I need available during an emergency / shut down?
I. Can I find someone qualified to inspect my baghouse(s) and provide me with an inspection report detailing recommendations to improve my baghouse operation and increase bag life?
J. Who sells bags and can they sell me my bags?
K. Who sells baghouse accessories? Do they carry what I need? Can they help me determine what I need?
L. Where can I find help for some or all of these questions?
M. Is there a reliable Broken Bag Monitor?
N. Is there a baghouse control system that provides alarms, touchscreen, failed bag location, dust emissions alarm with trending, and optimizes my baghouse cleaning energy?

4.0 How Dust Filtration Works

Applications for baghouses:
Baghouses (dry fabric filters) are used to remove dust from the air by capturing airborne dust(s) suspended in the air. The air is directed using either vacuum suction or pressure into a series of ducts, which run horizontally and vertically from pick-up points at single and multiple plant process and nuisance dusting areas. The dust-laden air is sucked into a main gathering duct trunk line terminating at the air inlet of a baghouse fabric filter.

The baghouse itself is a large housing sometimes designed with multiple chambers. The baghouse is designed to capture the dust and thus filter the air from particulate laden (dirty air) turning the dirty air into clean air (virtually particle-free). The cleaned air is exhausted from the baghouse’s clean air side back into the atmosphere. The dirty solid particles are captured on the filter bags surface, while the gases being filtered pass through the filter bags media. The bags media is called “filter media” and will be discussed later.

Baghouses can automatically clean the filtered particles off of the filter media based on a periodic need to clean the filter bags media. This is called regenerating the filter bag medias permeability, which removes enough compacted dust cake to allow air to flow again at a low (<6” W.G. static loss) restriction (static loss) across the filter media. The system depends on a Fan or Blower to either pressure (push) or vacuum (suck) the air across the filter bags’ media. This means the filter bags media has a dirty side and a clean side. The dirty side intercepts, filters, and compacts the dirty air stream gases, while the clean side has contact with clean air stream gas as it passes through the media.
5.0 Popular Types of Baghouse Cleaning Mechanisms
Since baghouses must periodically clean themselves by purging the dust off of the fabric filter bags to regain permeability to support design air flow, it is time to identify the most popular types of baghouse equipment cleaning mechanisms:

1. Pulse-Jet: High Pressure compressed air; 80-100 psig; dust collects on the outside of the bag.
2. Pulse-Jet: Medium pressure compressed air; 50-55 psig; dust collects on the outside of the bag.
3. Reverse Air: Reverse Gas flow at 6-20" W.G. Pressure; dust collects on the inside of the bag.
4. Reverse Air: Reverse Gas flow at 3 to 15 psig; dust collects on the outside of the bag.
5. Shaking: Shaker style, using mechanical agitation to get up a sinusoidal wave over the bag’s length. Dust collects on the inside of the bag.

In addition to the above, there are also combinations of Reverse Air / Shaking and Acoustical Energy cleaning designs manufactured as baghouses.

Two other baghouse design distinctions that are important to be familiar with are inside bag dust collection and outside bag dust collection. Inside bag dust collection occurs when the dust is collected on the inside of the filter bag media’s surface. A filter tube with the dirty air flows into one end of the filter tube; the dirty side is inside the tube; and the clean gases exit to the outside surface area of the tube. In outside bag dust collection, dirty gases flow from the outside of the filter tube, through the media. Clean gases exit to the inside and out through the bag tube’s inside surfaces. Dust is collected and remains on the outside of the filter bags media.

Designs:
5.1 Shaker Cleaning Bags: Collect dust on inside; usually constructed from a woven media. All generic filter media can be used, although generally felts and anti-collapse rings are not used. Bags are installed with some slack in length, so that the shaker, if it provides for bag lift (amplitude), can raise and turn the bag in a rapid shaking motion to develop a clean motion along the media surface, called a “sinusoidal wave”. Inlet velocity through the bottom bag connection, called an orifice, is generally designed to be below 250 – 270 FPM. Air to cloth ratios are 2.0:1 to 3.0:1 and bags require off-line cleaning with air velocities at “null” (zero FPM).

5.2 Reverse Air Cleaning Bags: Collect dust inside the bag; use all popular media; often have anti-collapse rings and D-cap tops; and utilize a reverse flow of air, while the bags are at null, to backwash the dust down through the inside of the bag. Inlet velocity ranges from 250 – 270 FPM. Bags are cleaned off-line at null FPM. Air to cloth ratios are 2.0:1 to 2.5:1. These are tubular bags mounted vertically.

5.3 Traveling Reverse Arm Rotating Air Cleaning Bags: Mounted onto wire cages. These bags collect dust on the outside. Filter media is felted and uses a gentle blow back fan air on PD Blower air to clean multiple bags as the rotating arm sweeps around the top of the tubesheet, inside the clean air plenum. These are tubular, or oval, bags mounted vertically.

5.4 Pulse-Jet High Pressure (70-100 psig) Cleaning Bags: Bags are felted media, and can utilize all available types of media, including woven and special woven fiberglass for use in pulse-jet cleaning baghouse designs. Bag filter design type:
• Tubular Felted Bags: Open top; closed bottom; mounted to wire cages. Can mount from dirty side or clean side of baghouse on clean air plenum design. Cleans best at 90-100 psig air.

• Tubular Woven Bags: Open top; closed bottom; mounted to wire cages. Can mount from dirty side or clean side of baghouse on clean air plenum design. Cleans best at 90-100 psig air.

• Envelope Bags: 1” up to 2 ½” opening x 36” to 60” sq.; felt media and woven media are utilized. An inside support frame or high loft medium is used to maintain an open area across the bag’s depth.

• Cartridges: This filter design uses a tightly packed pleat counts (5 times the pleated elements pleat count per inch) and typically uses paper, synthetic/organic medias, and lightweight felts to collect fume, light inlet grain loading, powders, and plasma table dust. Top load, flanged, and bottom load styles are available.

• Pleated Elements: Elements are pleated using between 30, up to 60, pleats in a 6” dia. tube; pleat depths are from 1” up to 1 5/8” depth, both molded rubber and metal tops are used. An inner core made from metal or polypropylene is used. Medias range from 8 oz. spun polyester to 10 oz./sq. yd. Nomex. Solid polymer or metal caps are used as element bottoms. Top load and bottom load designs are available.

• Special High Loft Envelope Filter Block constructed from proprietary cindered materials are available.

5.5 Medium Pulse, High Air Volume Pulse-Jet Cleaning Bags: Special inlet baffling is designed to split the inlet air as stream to a 60% upward flow and 40% downward airflow. This Pulse-Jet baghouse design can accommodate 6 meter to 10 meter long filter lengths, ranging from 5.35” dia., up to 6” dia., and 2-piece cages. This baghouse design is typically applied to filter gas volumes greater than 140,000 ACFM and up to 2.5 million ACFM. Both on-line and off-line cleaning air offered. All generic filter media can be utilized in this medium pulse fabric filter design.

6.0 Tubular Filter Bag Designs, Sizes and Tailoring
There are many different dry fabric filter bag designs that can be manufactured using a range of generic filter media fibers, sizes and tailoring. The selection of generic fiber is dependent on the baghouse’s application at the manufacturing plant’s facility. Common application criteria used to select the type of generic fiber used in the filter media are: gas stream; chemistry; temperature; particle size and micron size range; EPA emission requirements for the type of dust and size of the APC system; percentages in the gas stream of sticky materials; and moisture by volume; and dew point considerations.

6.1 Common Filter Bag Diameters and Bags Flat Width Sizes Commonly Supplied to the US Market
• 4.00” dia; 6.75” FW
• 4.625” dia; 7.37” FW
• 5.00” dia; 7.87” FW
• 5.25” dia; 8.25” FW
• 5.33” dia.; 8.97” FW
• 5.875” dia.; 9.25” FW
• 6.00” dia.” 9.37” FW
• 6.12” dia.; 9.60” FW
• 6.25” dia.; 9.75” FW
• 6.375” dia.; 10.0” FW
• 6.62” dia.; 10.37” FW

6.2 Common Bag Length
• High Pressure Pulse-Jet; 18” up to 192” length
• Medium Pulse-Jet: 6 meter up to 10 meter length
6.3 Filter Bag Top Construction
- Side Load: raw edge top (3" longer than split collar cage length)
- Top Load: snap band; double beaded

6.4 Bottom Construction
- Single-ply felted disc bottom
- 3" bottom; double-ply wearguard
- 5" wear cuff with 2" overhang below bag disc bottom

6.5 Grounding wire to meet NFPA77; 2 301SST braided ground wire, sewn in 180 degrees apart at filter's snap band

Bag Specifications; Typical Detail Required to Provide a Replacement Bag Quotation

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<th>Detail</th>
<th>Notes</th>
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7.0 Characteristics of Filtration Fibers

Acrylic Fibers: Acrylic fibers are man-made fibers in which the fiber forming substance is any long-chain polymer composed of at least 85% acrylonitrile units and the remainder of copolymer. Acrylic is non-thermoplastic.

Orlon® (DuPont); Acilan® (Monsanto); Creslan® (American Cyanimid); Crylor® (Crylor SA); Zefran® (BASF); and Draylon-T® (Bayer) are tradenames used by various producers of acrylic fibers.

Draylon-T® (or equivalents), a homopolymer (100% acrylonitrile), is a widely used acrylic for high-pressure cleaned and needle felted. Fiber cross-sections are dumbbell shaped and surfaces are striated. Diameters are typically 15 to 35 microns. Where polyesters are not suitable because of potential hydrolysis, acrylcs offer a combination of abrasion resistance and resistance to wet head degradation, particularly under acid conditions. Homopolymer felt is a candidate for hot gas application of less than 284°F. Temperature resistance of copolymers is less: 240°F.
Acrylic felts are used in drying raw flour, coal, gold, and copper ores; galvanizing; and low temperature flue gas applications. Polyester is superior for most dry heat applications.

**Aromatic Polyamide (Nomex):** Nomex nylon was a proprietary (patent has expired) aromatic-polyamide (Aramid) linked structure developed by E.I. DuPont de Nemours, for application requiring dimensional stability and high heat resistance. Nomex is a non-thermoplastic, so it does not melt, but at temperatures above 700°F, degradation sets in rapidly. In heat up to and including 400°F, this fabric may be used satisfactorily as long as there is no acid dew point problem.

Nomex is unaffected by small amounts of water vapor and high temperatures. When exposed to saturated steam at high temperatures, Nomex will progressively lose strength. However, it withstands these conditions better than many other fibers.

Nomex withstands the attack by mild minerals and inorganic acids, mild alkali and most hydrocarbons. It is unaffected by florins and gases from metallurgical and rock processing operations. However, high active oxidizing agents, such as sulphur oxides, will rapidly degrade Nomex. The single biggest use for Nomex, needled felt, is asphalt batch plant dryers and drum-mix plants. Other uses include raw and finish mill grinding on cement plants, carbon bake, clinker coolers and many other hot gas processes.

**Polyester (PE):** A manufactured fiber in which the fiber forming substance is any long chain synthetic polymer composed of at least 85% by weight of an ester of a dihydric alcohol and terephthalic acid. This material is a thermoplastic. Fiber is added under various trade names: Dacron**(duPont); Enka Polyester**(American Enka); Fortel**(Fiber Industries/Celanese); and Kodel**(Eastman Chemical). Polyester is the most widely used needled felt for pulse jet applications.

Polyester is superior to most synthetics in dry heat installations, but it is not comparable to Teflon or Nomex. Recommended operating temperature is 275°F maximum.

Note: under moist near-saturation heat conditions (between 160°F and 210°F), polyester is inferior to other synthetics. The fibers will go through hydrolysis, weakening the fabric.

PE provides good resistance to most oxidizing agents, mineral acids and most organic solvents except high concentrations of sulfuric, carboxylic and nitric acids. It resists weak alkalis. However, strong alkalis at high temperatures will dissolve the fabric.

Polyester fiber makes an excellent filter fabric with efficient filtration and good energy absorption characteristics. It is used in agricultural, woodworking, chemical and other applications where chemical and mechanical characteristics are compatible. As needled felt, it is available in 12, 16 and 18 oz/yd² versions. The use of a 12 oz/yd² should be reserved for non-critical applications handling large particulate. Spun-bonded media is available in plain water/oil resistant (TR), metalized-antistatic (ME) and with laminated PTFE membrane.

**Polypropylene (PP)** - (polyolefin) is a manufactured fiber in which the fiber forming substance is any long chain synthetic polymer composed of at least 85% by weight of olefin units.

Herculon (Hercules) and Reevon (Phillips) are trade names used by various producers of polypropylene (PP) fibers. The fibers combine excellent resistance to most acids and alkalis, plus high strength. It has one of the lowest specific gravities of any synthetic fiber, and is one of the most economical synthetics (about the same price as polyester). PP is a good choice for replacement of cotton in low temperature applications.

PP absorbs no moisture and provides excellent cake discharge and resistance to blinding. Filtration efficiency is not quite as good as polyester. Polypropylene has very low heat resistance, even less than cotton, and should not be exposed to prolonged temperature of over 165°F. Since it does not absorb moisture, its degradation characteristics in dry heat and moist heat are virtually the same.
Within its limited temperature range, polypropylene provides good resistance to mineral and organic acids. It resists alkalies, reducing agents, and organic solvents. It is however, soluble at 160°F in chlorinated hydrocarbons.

P84 (Polyimide) - P84 is a proprietary fiber produced by Lenzing in Austria. P84 is a non-thermosetting, and in 100% form, may be used for temperature of 500°F. Its fiber is highly convoluted, having a high surface area-to-diameter ratio.

Extensive testing has shown that P84 fabric approaches Gortex in efficiency, but has all of the advantages of a needle felt. It may be layered on top of lower cost fibers to provide the benefits of the base fiber, but at lower costs than a 100% version of the P84 felt. Composites generally have a 4 oz./yd² P84 fiber layer, needled to a 12 oz./yd² carrier base. P84 is readily available in 14 oz weight, but other weights are available.

P84 needled felt and composites are used in many industrial applications where high efficiency is required. Examples are: gold and copper ore processing, incinerators, boiler and various chemical processes.

Teflon® is a proprietary fluorocarbon fiber manufactured by E.I. DuPont. It is composed of long chain carbon molecules in which all the available bonds are completely saturated with fluorine. These strong carbon-to-fluorine bonds create fibers that are exceptionally stable to both heat and chemicals. Teflon is the most chemically resistant fiber used in conventional dust filtration.

Teflon is not affected by any known solvents except some prefluorinated organic liquids at temperatures above 570° F. Exposure to temperatures above 550° F will cause some decomposition, although it is slow to develop. Teflon bags shrink when exposed to high temperatures, especially in length.

The low friction properties of Teflon fibers provide excellent cake discharge. In addition, Teflon fibers' chemical inertness and resistance to dry and moist heat degradation makes it ideal for use under severe conditions.

Teflon needled felt is extremely expensive. Recently, a lower cost version, Tefaire®, has been introduced. This felt is a blend of 85% Teflon and 15% fiberglass fibers. Commercial uses are limited to extreme chemical environments where the advantages of Teflon fibers' great chemical resistance outweighs cost disadvantages. Some boilers, carbon black plants, soil remediation systems and incinerators have been equipped with Teflon products.

Glass - Glass fiber is a product of fusion, a non-crystalline silicate analogous to other fiber polymeric materials. Selected silica sands, limestone, soda ash and borax or other ingredients are melted at about 2,500° F, and the mixture is extruded through spinnerets. The resulting filaments may be drawn while still molten and later twisted and plied into filament yarn.

Or, the extruded glass may be drawn and broken by jets of compressed air into lengths of 8 to 15 inches. The fibers are then treated with a lubricant which is of great importance in the durability of the eventual fabric. Following drying, the fibers are processed much like the more conventional fibers.

Woven fiberglass and felted fiberglass media are available for high energy cleaned fabric filters. These are specialty products that are used for very specific applications involving high (up to 500°F) temperatures, usually in the presence of oxidizing agents.

Some common trade names for woven fiberglass are GL65 Tri-Loft® and FL57 Hi-Loft; other companies have similar products. Available weights are 16 to 22 oz./yd². Huyglas felted fiberglass medias are available in a variety of weights, from 14 to 27 oz./yd². Bag/cage fit and support is very critical. Check with the vendors involved for specific recommendations.

Woven fiberglass in particular is very easy to damage, and is not as efficient as other media. Felted fiberglass tends to be heavy and difficult to handle. Suitable applications for this material are limited. Consult IAC engineering before using these products for any applications.
Ryton (Polyphenylene Sulfide) - Ryton (Phillips); commonly called PPS; is a long chain synthetic polysulfide, with at least 85% of the sulfide linkages attached directly to two aromatic rings. Standard fiber is 3-denier. The resin was developed by Phillips Petroleum in 1973.

Ryton is resistant to sulphur oxides and is used for high-temperature gas streams up to 360°F. Gas stream oxygen content should not exceed 15%. Ryton does not hydrolyze and has flame retarding characteristics.

Typical applications are industrial/municipal solid waste incinerators and coal-fired boilers.

8.0 Baghouse and Air Ventilation Vocabulary

ACFM - Actual cubic feet of gas per minute; the volume of the gas flowing per minute at the operating temperature, pressure, moisture and composition. The metric equivalent is expressed in terms of m3/min. at actual pressure, temperature and moisture.

AGGLOMERATION - Multiple particles joining or clustering together by surface tension to form larger particles, usually held by moisture, static charge or particle architecture.

AIR-TO-CLOTH (A/C) RATIO - The ratio between ACFM flowing through a filter and the sq. ft. of filter area available. This can also be thought of as the velocity of the gas passing through the filter in feet per minute (FPM).

Note: In the metric system the term used is “filtration velocity,” defined as the relation between the m3/min. of air flowing through a filter and the m2 of filter area available.

Examples of typical A/C ratios and filtration velocity ranges for various types of baghouse cleaning systems are:

<table>
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<tr>
<th>Cleaning Type</th>
<th>Air-to-Cloth Ratio</th>
<th>Filtration Velocity (m/min.)</th>
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<td>Shaker</td>
<td>2.5-3.0 : 1</td>
<td>0.76-0.91</td>
</tr>
<tr>
<td>Reverse-Air</td>
<td>1.5-2.5 : 1</td>
<td>0.61-0.76</td>
</tr>
<tr>
<td>Plenum-Pulse</td>
<td>3.5-4.0 : 1</td>
<td>1.07-1.22</td>
</tr>
</tbody>
</table>

**Pulse Jet with Filter Bags:**

| Nuisance Venting      | 4.5-5.5 : 1        | 1.37-1.67                    |
| Process Equipment     | 3.5-4.5 : 1        | 1.07-1.37                    |
| High Dust Load (> 50 grains/ACF) | 3.0-4.5 : 1 | 0.91-1.37 |
| Hot Gas Applications (350°F-500°F) | 3.0-4.5 : 1 | 0.91-1.37 |

**Pulse Jet with Pleated Filters:**

| Nuisance Venting      | 3.0-3.5 : 1        | 0.91-1.07                    |
| Process Equipment     | 2.5-3.0 : 1        | 0.76-0.91                    |
| High Dust Load (> 50 grains/ACF) | 2.0-2.5 : 1 | 0.61-0.76 |
| Hot Gas Applications (350°F-500°F) | 2.5-3.0 : 1 | 0.76-0.91 |

**BLEEDTHROUGH** - Particulate migration completely through the interstices of the filter.

**BLINDING** - Fabric blockage by dust, fume, or liquid not being discharged by the cleaning mechanism, resulting in a reduced gas flow because of the increased pressure drop across the filter media.

**CAN VELOCITY** - The upward air stream speed in a collector below the filters, calculated at the horizontal cross-sectional plane of the collector housing below the bottom of the filters.

**CAPTURE VELOCITY** - The minimum hood-induced air velocity necessary to capture and convey a dust particle into the hood.
CELL PLATE (TUBESHEET) - A steel plate to which the open end of the filter bags is connected; separates the clean air and dirty air plenums of the baghouse.

CLOTH AREA - Diameter of the filter bag x height x π for each filter bag. For total cloth area of the baghouse, multiply the cloth area of each filter bag x total number of bags.

CONVEYING VELOCITY - The gas velocity required to keep a dust particle entrained in the gas stream. The conveying velocity varies based on the particulate in the gas stream.

DEPTH FILTRATION - Refers to particulate passing the surface of a filter and then being captured in the “depth” of the filter. Typically applies to felt filters.

DIFFERENTIAL PRESSURE (ΔP) - The pressure drop across a component or device located within the gas stream; the difference between static pressures measured at the inlet and outlet of a component, compartment or device (i.e., between the dirty and clean sides of filter bags and tubesheet).

DUST CAKE - Buildup on the filtration side of the fabric that is required to improve the filtration efficiency. (Filters with PTFE membrane do not require a dust cake to provide efficient filtration.)

FILTER DRAG - The ratio of differential pressure across the filters (in inches WC) to velocity through the filters. (FPM)

GRAIN LOADING - The amount of particulate by weight in a given volume of air, expressed in grains/ft3; 1 lb.; or 0.454 kg = 7,000 grains.

INCHES OF MERCURY - A measurement defined as the pressure exerted by a column of mercury of 1” in height at 32°F (0°C) at the standard acceleration of gravity.

INCHES OF WATER - A unit of pressure equal to the pressure exerted by a column of liquid water one inch high at standard conditions (70°F or 21°C at sea level); 27.7 inches of water (703 mm WC) = 1 PSA (69 mbar); usually expressed as INCHES WATER GAUGE (WG) or INCHES WATER COLUMN (WC).

INTERSTITIAL VELOCITY - The upward air stream speed passing between the filters in a dust collector with the filters suspended from the tubesheet, calculated at the horizontal cross-sectional plane of the collector housing at the bottom of the filters.

MAGNEHELIC GAUGE - An instrument used to measure the differential pressure drop in a baghouse.

MANOMETER - A U-shaped tube filled with a specific liquid, used to measure differential pressure. The difference in height between the liquid in each leg of the tube indicates the difference in pressure on each leg.

MICRON - A unit of length, 1/25,000 of an inch (1/1,000 of one millimeter). Typically used as a measurement of the diameter of particles in the inlet gas of a baghouse.

PHOTOHELIC GAUGE - An instrument used to measure differential pressure and control it with adjustable set points.

PULSE DURATION/ON TIME - The length of time a pulse lasts, generally described as the length of time the electrical signal holds the solenoid pilot valve open. However, due to mechanical losses, the time the diaphragm is actually open will vary.

PULSE FREQUENCY/OFF TIME - The time between pulses in a pulse-jet baghouse.

PSI - Pounds per square inch; a unit of pressure; 1 PSI equals 27.7 in. WG or 2.04 in. mercury (Hg); can be
actual or gauge pressure. In the metric system, this is measured as kg/cm². (The conversion is kg/cm² x 14.22 = PSI)

RE-ENTRAINMENT - The phenomenon whereby dust which has been removed from the gas stream is returned to the gas stream. It occurs as a result of excessive velocity or cleaning problems.

SCFM - Standard cubic feet per minute. The volume of dry gas flow per minute at standard temperature and pressure conditions (70°F at sea level). The metric equivalent is NORMAL VOLUME-Actual gas volume corrected to 0°C, 1 atmosphere; generally excludes moisture.

STATIC PRESSURE – The negative or positive pressure on the components of a system. Static pressure is generally stated in inches of water (or, in high pressure systems, inches of mercury). Sometimes these are referred to as the “suction” (negative) or “bursting” (positive) pressure.

SURFACE FILTRATION - Capturing particulate on the surface of the filter, such as with filters that have a PTFE membrane laminated to the filter surface.

TOTAL PRESSURE - The sum of the static pressure and the velocity pressure at the same point in a system.

VELOCITY PRESSURE- The pressure required to accelerate air or gas from zero velocity to a given velocity.

VENTURI - A cone-shaped device located at the top of each filter in pulse-jet dust collectors into which compressed air is blown. A negative pressure at the top of the venturi is created during pulsing to help pull additional air volume into the filter element.

9.0 How to Troubleshoot Pulse-Jet Baghouse Equipment and Filter Bags Performance and Filtration Problems

9.1 At start-up most Pulse-Jet fabric filters perform as expected because they are completely new equipment. However, over time these fabric filter’s performances start to decline. A well thought-out preventative maintenance program can extend baghouse performance and filter life five-fold. (Refer to IAC’s Recommended Maintenance Schedule and Failed Bag Location chart at the end of Section 9.0.)

9.2 Baghouse performance decline causes plant production problems; allows dust emissions; and costs your facility money.

Answer: Filter bags cleaning energy transfer is not as robust as it one was during baghouse start-up.

Why:
- Compressed air capacity is in short supply
- Air Pressure Regulator has been turned down
- Failed Pulse Valves are not pulsing entire bag rows
- Failed Pulse Valves are bleeding off compressed air
- Solenoid dwell time is too low or too high
- Cleaning interval between pulses has been extended unknowingly
- Moisture in compressed air system
- Automatic cleaning thru high DP signal is malfunctioning due to clogged pressure tap ports
- Blow pipes have been removed and now are misaligned after reinstallation

Answer: Filter bags are no longer able to supports originally designed airflow as previously, even at a higher DP across the filters.

Why:
• Incoming dust load has increased
• Dust is moisture-laden
• Process changes have caused dust to become sticky / tacky
• Time of year; high humidity and/or cold weather affect condition of dust
• Bags have stopped reliable cleaning due to upstream equipment malfunction
• Bags have become impregnated with fine dust particles after seeing high DP across their surfaces
• Bags are encrusted with solid particulate matter
• Bags have suffered thru hydrolysis and have shrunk onto the cages
• Leaking bags have caused remaining good bags to fill up partially with dust
• High temperature surges have caused bag fibers to melt, shrink, or deteriorate
• PTFE membrane has cracked or partially delaminated
• Original equipment design was marginal to being with in air to cloth ratio, can velocity, and interstitial velocity, but was not recognized at start-up because bags were new and highly permeable. Current marginal equipment design causes more pronounced operational problems once the filter bag starts to become less permeable at normal DP across the bags. The higher “DP” causes accelerated fine particulate bleed-thru the media resulting in even higher DP. This cycle continues leading to self-destruction of the filter in terms of systems balance between the baghouse operation, upstream dust capture and collection, stack emissions and the fan’s static / air volume balance.
• Material is being stored in the hopper leading to flow problems and re-entrainment of stored dust back up onto the filter bags.
• Dust is bridging and rat holing in the hopper. Material flow has become restricted.
• Replacement bags have been purchased and installed using an incorrect filter bag specification.
• Inferior foreign / off-shore filter media is being utilized in plants new replacement filter bags.

**Summation:**
Eventually even a well-maintained baghouse will start to lose efficiency in terms of dust filtration and DP stabilization after cleaning. Real-world wear and tear will eventually catch up with the filter bags and pulse cleaning equipment. Inevitably, events leading to failure can be extended — but not totally corrected — by a consistent maintenance schedule which is used to detect filter bag failures due to the following conditions:

• Abrasive
• Chemical
• Moisture
• Thermal
• Loss of compressed air
• Poor product flow in hopper
• Operator control error
• Material handling equipment wear / failures

**Solution:**
Besides IAC’s recommended preventative maintenance program, IAC has developed an Automated Baghouse Control and Cleaning Optimization Analyzer including alarms and operator touchscreen.

The Baghouse Control Analyzer works as follows:

**Baghouse Monitoring Controls**
1. Baghouse Measured Variables
   1.1. Inlet Temperature
   1.2. Differential Pressure w/ self-cleaning Dirty Tap Port
   1.3. Air Header Pressure
   1.4. Outlet Particulate Monitoring
1.5. Outlet Temperature
1.6. Pulse Valve Operation
   1.6.1. Optional External Inputs / Outputs
      1.6.1.1. Hopper Level
      1.6.1.2. Explosion Vent Rupture (if required)
      1.6.1.3. Material Discharge Control
      1.6.1.4. ID Fan Control
2. Baghouse Calculated Variables
   2.1. Differential Temperature, Inlet to Outlet
   2.2. Compressed Air Usage Pulse Optimization
   2.3. Differential Pressure Pulse Efficiency
   2.4. Air Header Pulse Volume
   2.5. Compressed Air Usage
   2.6. Outlet Particulate versus Pulse Valves location
   2.7. Broken Bag Location Detection
3. Baghouse Control Variables
   3.1. Compressed Air Usage Pulse Optimization
      3.1.1. Pulse Duration
      3.1.2. Pulse Interval
      3.1.3. Differential Pressure Pulse Efficiency
      3.1.4. Pulse Air Consumption
4. Data Logs
   4.1. Inlet Temperature
   4.2. Differential Pressure
   4.3. Air Header Pressure
   4.4. Outlet Particle Monitoring
   4.5. Outlet Temperature

**Summation:** The IAC Baghouse Analyzer Control System makes baghouse control management and maintenance planning EASY.

**10.0 Proper Filter Bag Selection Tips, including Industry Favorites**

IAC is a major Pulse-Jet fabric filter baghouse Original Equipment Manufacturer (OEM). When IAC designs and builds a baghouse pulse-jet dust collector, we have to be sure that the baghouse will perform according to our customer’s expectation. An IAC baghouse must meet or exceed the both the state, and federal government dust emission permit requirements.

As a baghouse OEM, one of the most important Baghouse Equipment IAC design criteria considerations is the proper selection of both the bag’s filter media and the bag’s size / tailoring. To select a proper bag filter media as a baghouse OEM and as baghouse owner in the market to purchase bag replacements, you need to determine the following information:

1. Compare baghouse application / process to filter media application selection chart by temperature and chemical resistance.
2. Evaluate previous IAC job dust handling experience to select suitable internal can and interstitial velocity ranges.
3. Once internal velocities ranges are agreed upon, then final air to cloth ratio and filter bag length can be calculated.
4. Filtration efficiency selection in terms of outlet dust emission requirements to meet air permit is revisited based on actual internal velocities, air to cloth ratio, and bag length. This final analysis and review is used to determine if special media surface treatments or PTFE membrane is required to insure success in meeting filtration efficiency and maintaining a DP range of between 2.5” WC to 4.5” WC.
5. Determine special application design requirements for ground wire, bottom wear guards, and special sewing / needle hole close-offs. At this point in your developing final filter bag selection and specifications you will have determined the following bag design criteria:
   A. Fabric Selection
   B. Bag Length
   C. Bag Tailoring
   D. Surface Treatments
   E. PTFE Membrane option

6. Next, here are some helpful tips to ensure you receive the filter bag you have specified and have placed on order
   • Specify only filter media produced in the USA
   • Specify specific fiber suppliers; example: Nomex – E.I. DuPont
   • Your PO should state no off-shore media or membrane allowed
   • If a PTFE membrane is being used, state the vendor’s membrane you want to use clearly on your PO, plus add made in USA only. These are all reputable membrane suppliers:
     o Tetratec
     o BHA
     o WL Gore
     o TTG
   • If you are ordering a fiberglass media, be sure to specify that only Burlington, Menardi, or JP Stevens media and finishes are acceptable.

11.0 Baghouse Design and Accessories That Affect Filter Bag Performance and Useful Life
All successful baghouse performances share common design, accessories, and attention to quality details. Below is a list of equipment, components, and quality control specifications that when specified by the baghouse OEM and end user as mandated / necessary design / supply requirements will insure a successful baghouse performance and extended filter bag life.

1. Cleaning System Design / Components
   1.1. 1 ½” Double Diaphragm Pulse Valves
   1.2. Min. 100 psig of available Compressed Air Cleaning Energy
   1.3. Demand Cleaning based on Dual Set-point DP Switch or DP Transmitter
   1.4. Air Header Pressure Transmitter
   1.5. Not more than 17 bags in one row to be cleaned
   1.6. Pulse / Solenoid Valve Setting: between 90 to 120 milliseconds
   1.7. Cleaning Interval: max. 15 seconds when cleaning
   1.8. Smart Timer Panel: to start cleaning next row from last row cleaned on prior cleaning cycle
   1.9. ¼” Air Tubing Distance form Solenoid Valve to Diaphragm Valve; NTE 8 ft.
   1.10. 6” dia. Air Header
   1.11. Timer Board’s terminal strip positions will have only (1) solenoid valve landed per each (1) position on terminal. Timer will fire only (1) solenoid per position.

2. Material Handling Design / Equipment
   2.1. Min. 60° Slope Hopper
   2.2. Min. 8” Discharge Opening
   2.3. Ladder Vane Inlet Baffles (min. 3)
   2.4. Hopper Hi-Level Indicator
   2.5. Hopper Vibrator Mounting Channel
   2.6. Hopper Poke Holes
   2.7. Hopper Rapper Plate
   2.8. Hopper Inspection Clean-out Door
   2.9. Continuous Material Discharge
3. **Bag / Cage / Tubesheet Assembly Design**
   3.1. Snapband top bag to Tubesheet attachment design
   3.2. Laser cut Tubesheet Holes
   3.3. Min. 3/16" thick Tubesheet
   3.4. 3" Bag Bottom Wearguard
   3.5. PTFE Membrane Filter Media
   3.6. Min. 12 wire cage for 5.25" to 6" dia. 10 wire 4.5" to 5.0"
   3.7. Bag Pinch: min. ½”; max. 5/8”
   3.8. Steel Cages to be specified no burrs; sharp edges and ring spot welds to be positioned against a vertical stringer wire
   3.9. Venturis are required
   3.10. Blow Pipe Holes; 1/16” tolerance to center of bag; radial holes NTE 5% off of staright vertical
   3.11. 100% Galvanized Cages