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## FILTRATION

### LABORATORY AND PILOT PLANT FILTERS





## FILTRATION

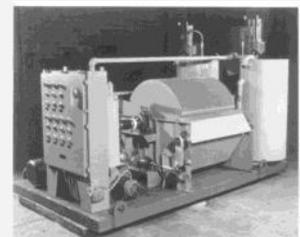
Basically, mechanical filters fall into two general categories, vacuum and pressure type filters. Since, 99% of the time, the greater the pressure applied, the greater the filtration rate. Generally, easier to filter material is filtered on vacuum filters, since they are lower cost to operate than pressure filters. When material to be filtered is fine, say -45 microns, it is usually filtered on one type of pressure filter, as pressures up to 150 psi or higher, can be applied, to dramatically increase the filtration rate, when compared to vacuum filters (14.7 psi, maximum).

There are many types of vacuum filters, disk, drum, pan, etc., and there are many types of pressure filters, tube, plate and frame, pressure leaf, etc.. The most widely utilized filters in industry are (Vacuum) filter disk and filter drum, and for (Pressure) are Plate and Frame Filters and Pressure Filter Leaf filters. Even among the various types of vacuum and pressure filters, there are many variations for more specific applications.



At left, Lab Batch Vacuum

At right, a Vacuum Pan Filter



Vacuum Drum Filter

For laboratory filters, the common types are batch vacuum filters, such as very small Buchner Funnels, to larger bench top (8" – 12" diameter) batch vacuum filters, and for larger samples, the vacuum pan filter. Also a lab size (6" x 3") vacuum drum filter exists, for conducting filtration tests, and the results from this can be directly scaled for production press sizing.



In the pressure category, the most common lab filter is a batch pressure filter, which can simulate most of the commercial pressure filters success on filtering material. There is also a lab size (8") plate and frame filter press for conducting filtration tests, and the results from this can be directly scaled for production press sizing.

Below, the small lab scale filters and a couple of pilot scale filters will be discussed in more detail.

#### Lab Vacuum Filters

This lab batch vacuum filter is 10" in diameter, and will hold a 2 gallon batch of slurry for dewatering. However, since the filtrate container supplied is 2 liters, a sample of no more than 2 liters should be used. Larger filtrate receivers are available as optional accessories.



3 Gallon Benchtop Pressure Filter





In the base, drainage channels are machined, and covered with rubber, to facilitate the quick removal of liquids to the filtrate container. On top of the machined drainage channels, a 10 mesh stainless steel screen is placed, to prevent filter paper or cloth from being pulled into the drainage channels and blinding them partially, or completely. These are a staple in most mining laboratories, where batch vacuum filtration of slurries is conducted. Generally, the CFM of vacuum for this type of flat, horizontal filter is 1 CFM per SqFt of filter area. Since the 10" filter has 1.3 SqFt of filter area, 1.5 CFM is minimally required, for each filter operated. Many labs use 3 CFM/filter, to increase the number of samples dewatered per hour, though.

The lab vacuum drum filter is occasionally used, to determine if vacuum filtration on a continuous production scale would be suitable and the size and number of filters that would be required. For this application, a 6 inch diameter by 3 inch wide vacuum drum filter is generally used. This filter has a 0/4 SqFt filter area, and the filtration rate is determined in lbs. of dry filter cake/SqFt of filter area per hour. From there it is relatively easy to determine the size and quantity of filters required for X tons per hour of dry solids, assuming the samples are truly representative of the material to be filtered. Factors of 1.2 to 1.3 are generally used, just in case solids vary during the life of the mine, which often do occur.



Lab 6" x 4" Vacuum Drum Filter

Vacuum drum filters are generally manufactured in two types, a scraper drum filter for high solids (10% - 30% solids by weight), and a precoat filter for very low solids content, of 2% or less. In between 2% and 10%, it depends upon the quantity of fines, the particle size distribution and the overall ease of filtration of the material, as to which would be suitable. Testing on a batch vacuum filter, such as the 10" could answer these questions, by adding precoat (diatomaceous earth) and filtering, then filtering with only the cloth or filter paper.



For larger samples and pilot plant studies, the vacuum pan filter is the vacuum filter of choice, as they can dewater slurries almost continuously, when dual pan models are utilized. One pan is filtering while the other is being filled, with a small amount of down time for emptying, cleaning the pans, and occasionally waiting for the filter process to complete, as filtering can occasionally take longer than filling the pan.

Vacuum pan filters are typically manufactured in sizes of 2 Ft x 2 Ft, 3 Ft x 3 Ft and 5 Ft x 5 Ft. A single 2 Ft x 2 Ft pan will hold 2 Cubic Feet of slurry. With 2.5 SG solids @ 20% solids by weight, that is 70 lbs of slurry. At 30% solids it is 76 lbs. of slurry per cycle. The largest size, a 5 Ft x 5 Ft pan will hold 886 lbs. of slurry per pan @ 20 % solids and 951 lbs./pan @30% solids. So, it is easy to see that the vacuum pan filters have application in pilot plant studies, for filtering suitable solids.



Single 5' x 5' Vacuum Pan Filter

### Lab Pressure Filters

Laboratory pressure filters are basically a plate (base) on the bottom, a tube forming the cylindrical body, and another plate on the top. Bench top pressure filters are very common, as they sit on a stand of lab bench. There are various methods of supporting the plates and body, however the simplest and most common, are two rods attached to the base which allow the top to be sealed and unsealed by means of a screw lever in the center.

The base has a machined drainage channel. On top of the machined drainage channels, a 10 mesh stainless steel screen is placed, to prevent filter paper or cloth from being pulled into the drainage channels and blinding them partially, or completely. On top of the screen, filter paper or filter cloth is placed, allowing it to extend past the cylinder. In the base, where the cylinder rests, is a machined gasket groove, with a neoprene or rubber gasket, to facilitate sealing and prevent blowouts. The cylinder is removed for emptying and cleaning,



When the cylinder is replaced, it is placed over the gasket, and when in place, the cylinder is filled with the slurry to be dewatered. The weight of the cylinder should seal in place and contain the slurry. Then, the top plate, which has a similar gasket in it, is placed over the cylinder, the screw mechanism is slowly tightened until a firm seal is achieved. Then, one may close the drainage valve in the base (some choose not to install a drainage valve in the base) and compressed air is administered to the filter. The pressure gauge will show the pressure increase and the pressure relief valve will automatically open at 75 PSI. When the desired pressure is reached, or the pressure relief valve opens, open the drainage valve (if used) and the liquid will begin to drain. Constant pressure can be achieved, by regulating the flow from the filter with the flow of compressed air into the filter, and this gives the most consistent filtering.



Another style of lab pressure filter is the batch pressure filter on a stand. These may be mounted directly on the floor, with a built in stand to hold them at work height. The top plate and bottom plate are generally attached, and are sealed and unsealed by turning a screw with a hand wheel or lever (bar). Some labs prefer this type, since the cylinder does not need to be removed and replaced. However, the time to filter a sample is generally the same, regardless of which type is used. The floor standing filters can be larger, 12 gallons or more, since the filter cylinder does not have to be removed



The 3 gallon batch pressure filter, at right is a floor standing filter, with swing away top and bottom plate.

They are utilized much the same way the bench top filter is. Turn the hand wheel on the bottom plate until it clears the filter body sufficiently. Then swing it 90 degrees. The base has a machined drainage channel. On top of the machined drainage channels, a 10 mesh stainless steel screen is placed, to prevent filter paper or cloth from being pulled into the drainage channels and blinding them partially, or completely. On top of the screen, filter paper or filter cloth is placed, allowing it to extend past the cylinder. In the base is a machined gasket groove, with a neoprene or rubber gasket, to facilitate sealing and prevent blow-outs. The top plate has a machined gasket groove with a gasket for maintaining a good seal. These filters are filled by turning the hand wheel on the top plate and rotating it 90 degrees, then pouring the slurry into the filter.



The top plate is then returned to its closed position and the hand wheel clamps the top plate against the filter body to make a good seal. Then, one may close the drainage valve in the base (some choose not to install a drainage valve in the base) and compressed air is administered to the filter. The pressure gauge will show the pressure increase and the pressure relief valve will automatically open at 75 PSI. When the desired pressure or the pressure is reached, or the pressure relief valve opens, open the drainage valve (if used) and the liquid will begin to drain. Constant pressure can be achieved, by regulating the flow from the filter with the flow of compressed air into the filter, and this gives the most consistent filtering.





## Lab Plate and Frame Pressure Filters

This little lab plate and frame filter has 8" square plates and frames, 1.7 SqFt of filter area, with a total filter cake volume of 0.19 CuFt. The feed rate depends upon the type of feed. For low solids, 2% and less, it is 0.8 GPM, while for higher solids feed it can be fed up to 1.7 GPM. Plate and frame filter presses require slurry pumps that can pump against high heads, in this case 60 PSI. The slurry enters the top of the plate and passes through ports in the top of the plates until it reaches the furthest plate, where it begins to flow through the filter cloth in order for the fluid to reach the bottom return ports for the filtrate. As the plates fill with solids, the pressure increases. When all chambers are full, or all filter cloth is full of solids, the pressure does not increase further, indicating that the press may be full. Feed is shut off, the plates are opened and the filter cake is discharged.



Results from this little lab plate and frame filter can be used to size process filters, and determine the number and quantity required to filter large volumes of slurry. Plate and frame filters can be coated with diatomaceous earth, and used to filter very low solids and or particle size slurries.

Below are some larger plate and frame filter presses, which can be used in pilot plant studies or small scale process systems. Capacities are indicated for the filters.

**75 to 150 GPM Feed Slurry**



**Model 470 Plate and Frame Filter Press**

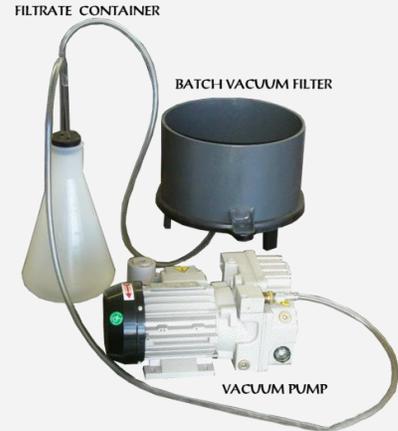
**25 to 50 GPM Feed Slurry**



**Filter Equipment Available  
From Sepor, Inc.**



Catalog Number	Batch Vacuum Filter Description
070C-001	Rubberized base, carbon steel body and drain
070C-002	Rubberized base, stainless steel body and drain
070C-006	2000 cc filtrate trap
030F-300	VUA vacuum pump, 0 to 5 CFM @29 In Hg



Catalog Number	Vacuum Pan Filter Description
070C-020	2' x 2' vacuum pan filter, simplex
070C-025	2' x 2' vacuum pan filter, duplex
070C-030	3' x 3' vacuum pan filter, simplex
070C-035	3' x 3' vacuum pan filter, duplex
070C-050	5' x 5' vacuum pan filter, simplex
070C-055	5' x 5' vacuum pan filter, duplex



Catalog Number	Benchtop Pressure Filter Description
070B-010	Benchtop batch pressure filter, carbon steel, 3 gal.
070B-020	Benchtop batch pressure filter, stainless steel, 3 gal.
070B-001	Floor Mtd. batch pressure filter, carbon steel, 11.5 gal.
070B-002	Floor Mtd. batch pressure filter, Neoprene lined 11.5 gal.
070B-003	Floor Mtd. batch pressure filter, stainless steel, 11.5 gal.
070B-055	Floor Mtd. batch pressure filter, carbon steel, 3 gal.
070B-056	Floor Mtd. batch pressure filter, stainless steel, 3 gal.

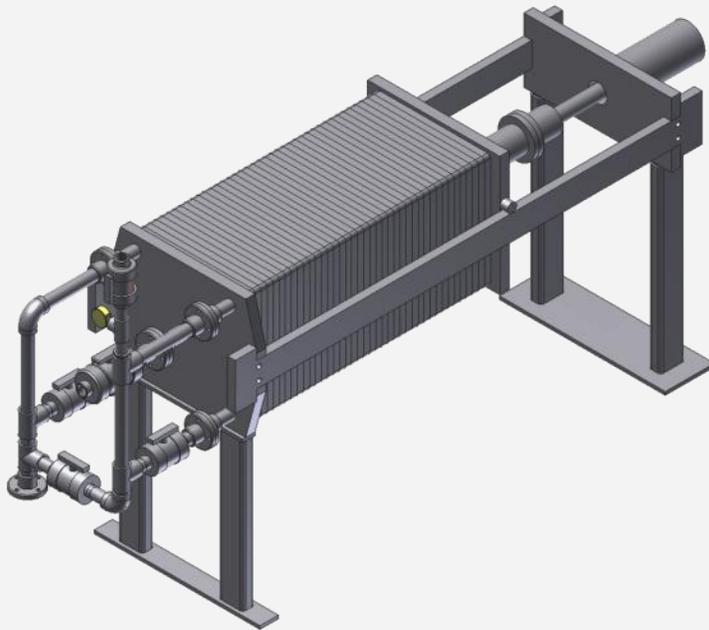


**Filter Equipment Available  
From Sepor, Inc.**



**Other Sizes of Plate & Frame  
Filter Presses Are Available**

Catalog Number	Benchtop Pressure Filter Description
070B-010	Benchtop batch pressure filter, carbon steel, 3 gal.
070B-020	Benchtop batch pressure filter, stainless steel, 3 gal.
070B-001	Floor Mtd. batch pressure filter, carbon steel, 11.5 gal.
070B-002	Floor Mtd. batch pressure filter, Neoprene lined 11.5 gal.
070B-003	Floor Mtd. batch pressure filter, stainless steel, 11.5 gal.
070B-055	Floor Mtd. batch pressure filter, carbon steel, 3 gal.
070B-056	Floor Mtd. batch pressure filter, stainless steel, 3 gal.



Catalog Number	Lab Plate & Frame Filter Description
070B-100	8" Lab Plate & Frame Filter Press
070B-130	24" Plate & Frame Filter Press, 50-100 GPM Feed
070B-140	31" Plate & Frame Filter Press, 150 - 300 GPM Feed

