High-Performance Filtering Centrifuges

from Western States

Fine Chemicals
Pharmaceuticals
Crystalline Suspensions
Artificial Sweeteners
Agricultural Chemicals
Organometallics
Advanced Ceramics
Flavor Extracts
Pigments
Polymers

Filtering Centrifuges are the ***most versatile and cost effective method for separating solids and liquids*** and offer many advantages over other types of solid/liquid separation methods. Filtering Centrifuges can process a wide range of viscosities and solids content, and are capable of removing most unbound moisture without thermal processing. Filtering centrifuges are compact, reliable and economical. Western States has over 90 years of experience providing separation solutions, process assistance and custom engineered designs.

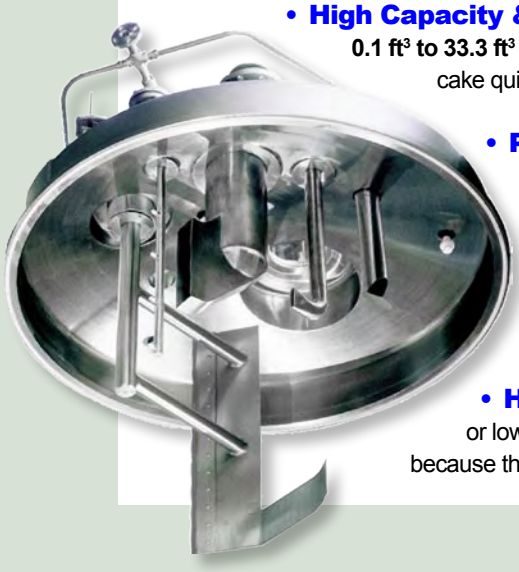
Filtering Centrifuge Overview:

- **High Separation Forces & Low Final Moisture -** Filtering Centrifuges can generate over **1,000 gravities** of separation force and can remove most, if not all, unbound moisture. No level of vacuum and pressure differential can come close to this level of centrifugal force separating liquids from solids.

- **Batch Integrity & Flexibility -** Filtering Centrifuges produce highly repeatable results. Because it is a batch operation, the time of purging, washing and drying can be varied independently and without affecting the other variables.

- **Low Cross-Contamination -** Clean design and access to all internal mechanisms make Filtering Centrifuges well suited for Clean-In-Place (CIP) design and easily adapted to meet cGMP requirements.

- **Efficient Cake Washing -** Because the wash spray is applied to the cake while the basket is spinning at between 50 and 500 rpm, washing is very efficient and uses less total wash fluid. In applications wherein the solids are soluble in the wash fluid, less wash fluid translates into less product dissolved and more solids retained.



- **High Capacity & Fast Cycle Time** - Solids retention capacity per batch ranges from **0.1 ft³ to 33.3 ft³** depending on centrifuge size. High separation forces drive liquids through the cake quickly providing cycles times as low as **3 minutes**.

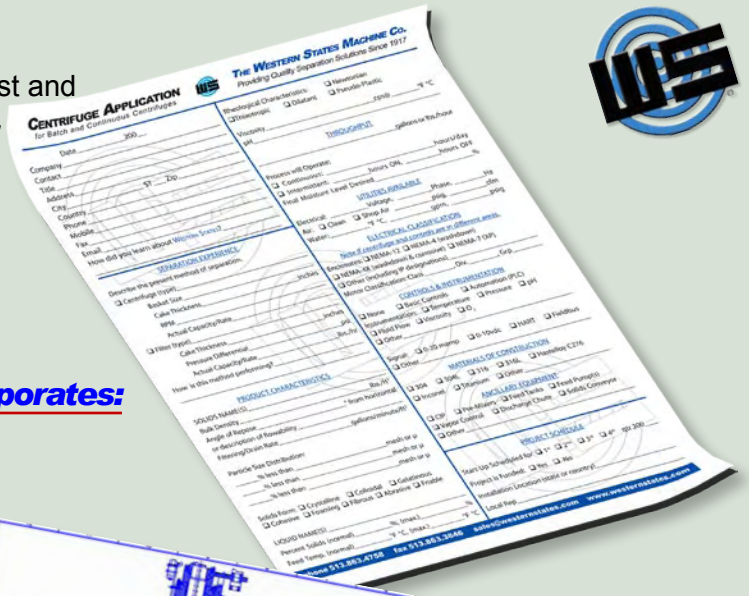
- **Particle Size** - Filtering Centrifuges are effective for separating solids as small as **2 microns**. For smaller particles or very low solids content (<1%) Western States has special Decanting Centrifuge designs available.

- **Wide Viscosity Range -** Liquids between 1 and 1,000,000 cps can be efficiently loaded and separated in filtering centrifuges. Non-flowable products can be diluted slightly to increase flowability and improve feeding.

- **High or Low Solids Content** - Filtering centrifuges can process high or low solids content products. Very low solids suspensions can be processed because the solids are filtered and collected as liquid is continuously discharged.

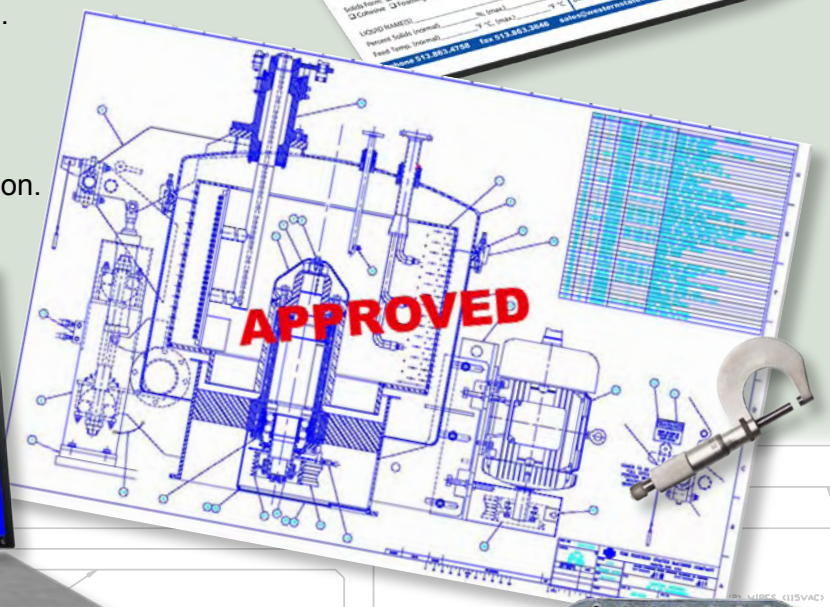
Comprehensive Design

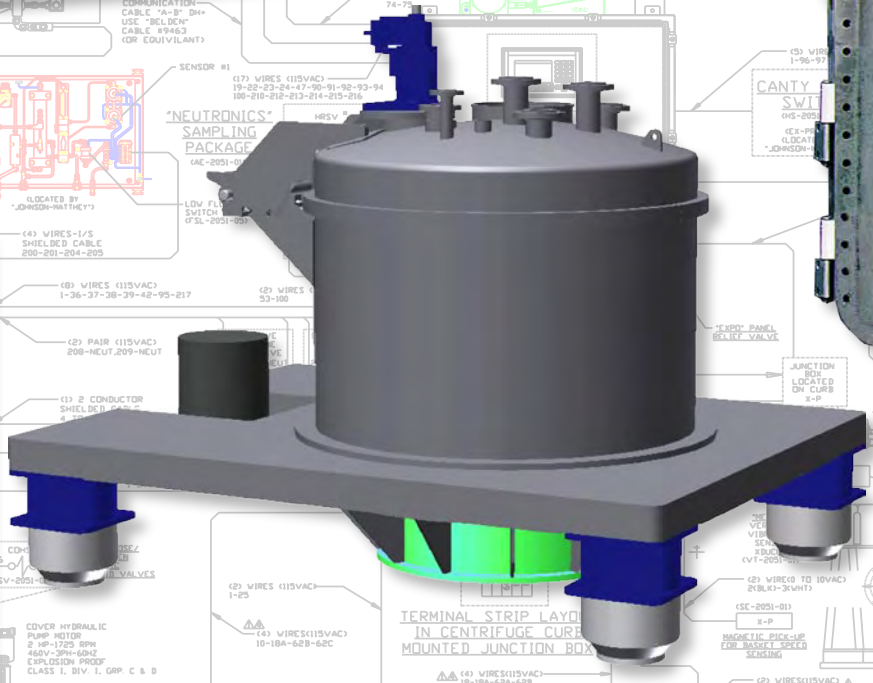
Western States Filtering Centrifuges are designed first and foremost to meet *customer process, operator, electrical, cleaning, maintenance and commercial requirements.* **Western States** offers a range of standard designs and features that have evolved over many years. *We recognize that most designs started as a solution to a unique process application, so we are always ready to develop special designs to meet your needs.*



Every Western States Centrifuge design incorporates:

- Customer process requirements.
- Electrical and instrumentation requirements.
- 90 years of solid/liquid separation experience.
- Empirical field testing.
- Advanced solid modeling.
- Finite element analysis.
- Quality manufacturing and component selection.





Standard and Custom Design Features

[A] CENTRIFUGE HOUSING - Standard housing is 316L stainless steel with optional Hastelloy, Inconel or other exotic alloys. Surface finish ranges from satin bead blast or mechanical polish to electroplished for sanitary or low cross-contamination applications. Standard housing includes a *fully opening top* which allows for visual inspection and changing the filter cloth. Housings are gas tight and can be designed for vacuum or pressure as required. HALAR and other fluorocarbon coatings are available as a cost-effective alternative for corrosive products. Vibration isolation is provided by a *buffered link suspension* or by an *integral inertia pad with viscous fluid dampers*.

[B] FULLY-MACHINED BASKET - The thick-walled (2.0 safety factor) filtering basket is fully machined inside and out to ensure geometric concentricity. Baskets are dynamically balanced for low vibration and long bearing life. The high open area increases purge rate and efficiency of liquid separation. A wide range of polymer and metallic filter cloths are available.

[C] BASKET SPINDLE AND BEARINGS - Through years of experience and analysis of mathematical models, our basket spindles and bearings are designed for high strength, stability and long life. Bearing assemblies are accessible from the top of the housing for ease of maintenance.

[D] FEED MANIFOLDS are designed for optimal flow and cleanability. Single-, Multiple- and Variable-Feed Manifolds are designed to accommodate variations in flow, viscosity and solids content.

[E] LOAD CONTROL *(see diagram on following page)* Accurate monitoring of the loading operation is critical to obtaining optimal separation. Our patented Ultrasonic Load Control utilizes time-of-flight pulse measurement to accurately measure cake depth. A 4-20 mA signal controls slurry feed rate and also signals when the basket has been fully discharged. Other types of load sensors include capacitance, optical and electromechanical sensors.

[F] WASH MANIFOLD – The Wash Manifold is fitted with a series of non-overlapping flat spray nozzles which provide consistent cake coverage. Because wash is applied at basket speeds of between 50 and 500 rpm, coverage is very consistent and wash fluid volume is minimized.

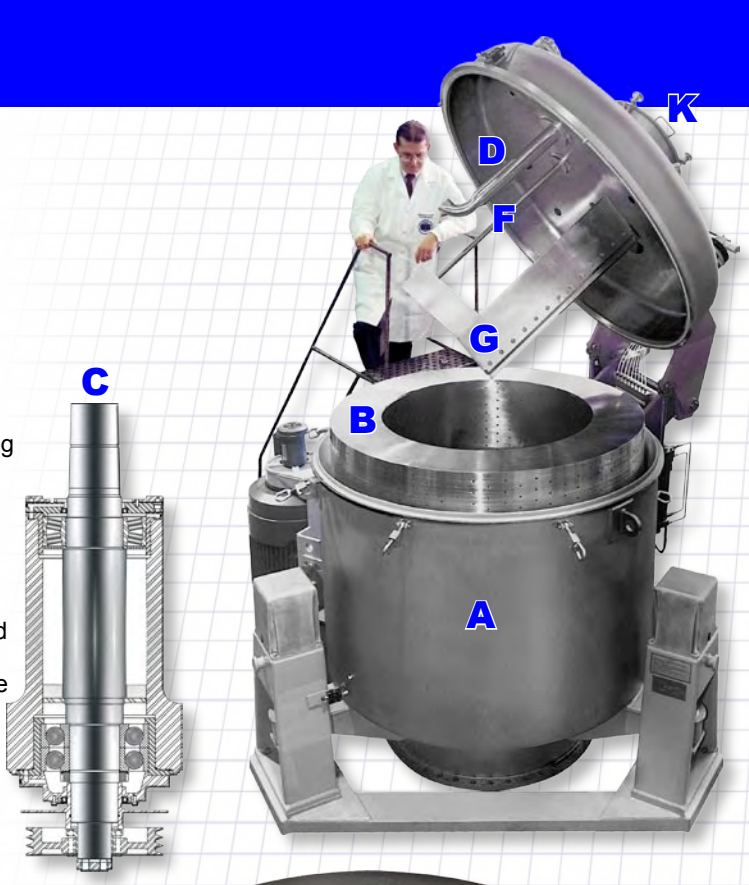
[G] MONOCUT® DISCHARGER - The single horizontal movement of the blade eliminates the need for any vertical movement which, in turn, eliminates the need for vertical movement seals or bellows which can be a source of contamination. The Air Knife on the reverse side of the blade is used to remove remaining heel.

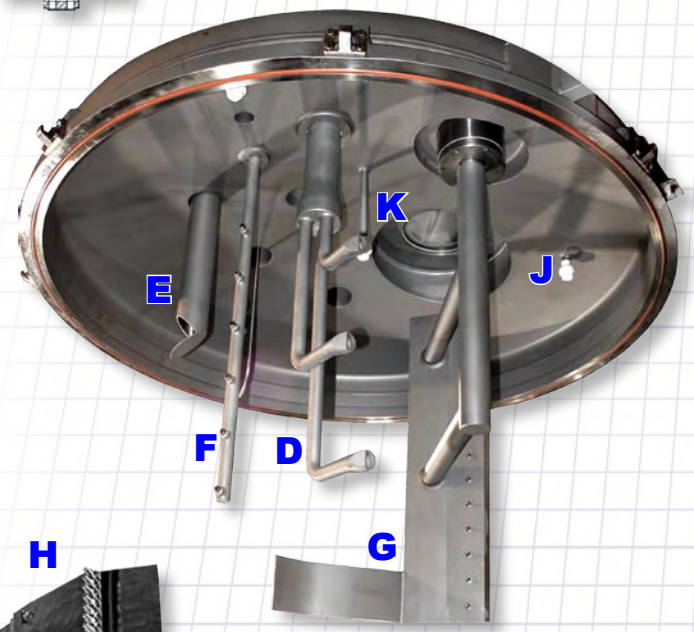
[H] AIR KNIFE - Discharging of the last 0.25" to 1" of cake is not normally performed with the discharge blade because it may damage the filter cloth. The discharger incorporates a series of air nozzles to focus high-pressure air or N_2 toward the filter to lift remaining cake from the filter cloth.

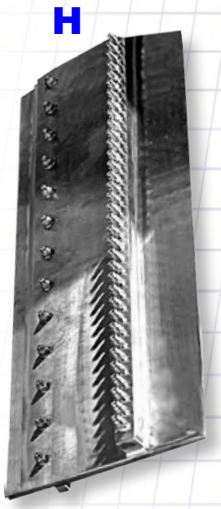
[I] RETRACTABLE BLOWBACK - In addition to the Air Knife, air or N_2 can be directed from the opposite side of the filter cloth to remove residual solids. The Blowback Manifold is positioned very close to the basket for maximum effectiveness and retracts away from the basket for high-speed operation.

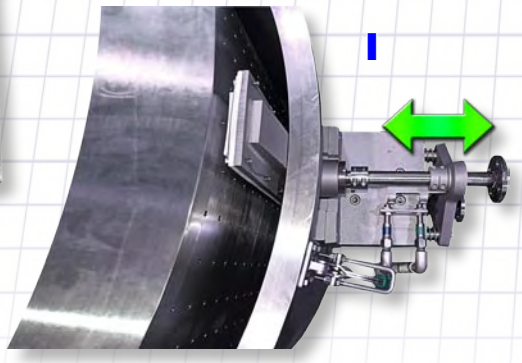
[J] CLEAN-IN-PLACE - Various spray balls and jets are available for cleaning interior surfaces for standard cleaning, sanitizing or validated CIP.

[K] SIGHT GLASS & LIGHT - A clear and illuminated view inside the centrifuge is important for monitoring the separation process. Single or multiple view ports and lights including "cold" and filtered lights for photosensitive products are available. Cameras are available for viewing the process and for analysis of particle size, color, reflectivity and effluent clarity.

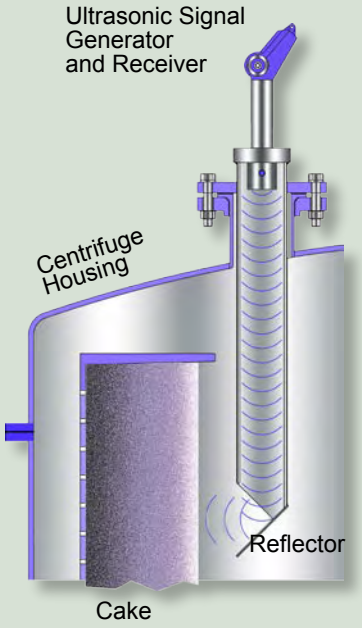








Special Design Feature



Load Control

Accurate monitoring of the loading of the slurry or suspension is a critical step in obtaining maximum separation performance. Our ***Ultrasonic Load Control*** utilizes time-of-flight high frequency pulses to measure solids or liquids depth in the centrifuge basket. Output is 4-20 mA signal which is used to control the following:

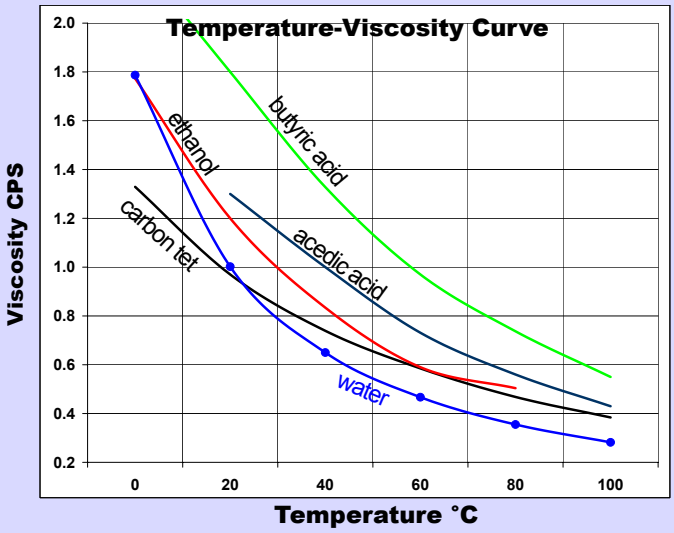
1. **Feed Rate**
2. **Fill Level**
3. **Monitor Solids/Liquid Separation** (by measuring the compression of solids during centrifugation)
4. **Completeness of Discharge**

Viscosity, Surface Tension & Drying

Viscosity and surface tension are controllable variables which can be altered to achieve a lower final cake moisture. Assuming basket RPM ("G" force) and spin time are held constant, lowering the viscosity and surface tension of the remaining unbound liquid will produce a dryer final cake. Water and common solvents can be reduced in viscosity two to four fold with an increase in temperature. For example, water at 10ºC has a viscosity of 1.4 cps; at 80ºC the viscosity of water drops to 0.4 cps. This temperature increase would reduce the final unbound moisture by approximately 50%. In general, higher viscosity liquids are reduced 2X in viscosity for every 10ºC rise in temperature.

Improved drying can be achieved by lowering viscosity or surface tension by the following methods:

1. Feed the slurry at an elevated temperature.
2. Apply heated wash fluid.
3. Apply dry steam to heat the liquid and flash off excess mother liquor. A small mass (a few pounds) of steam can be used to heat and drive off unbound moisture without significantly increasing solids temperature.
4. Use a wash fluid with a lower surface tension than the mother liquor in order to release additional liquid from the cake. For example, the surface tension of ethanol at 20ºC is 22.1 mN/m² compared to the surface tension of water which at 20ºC is 72.8 mN/m².

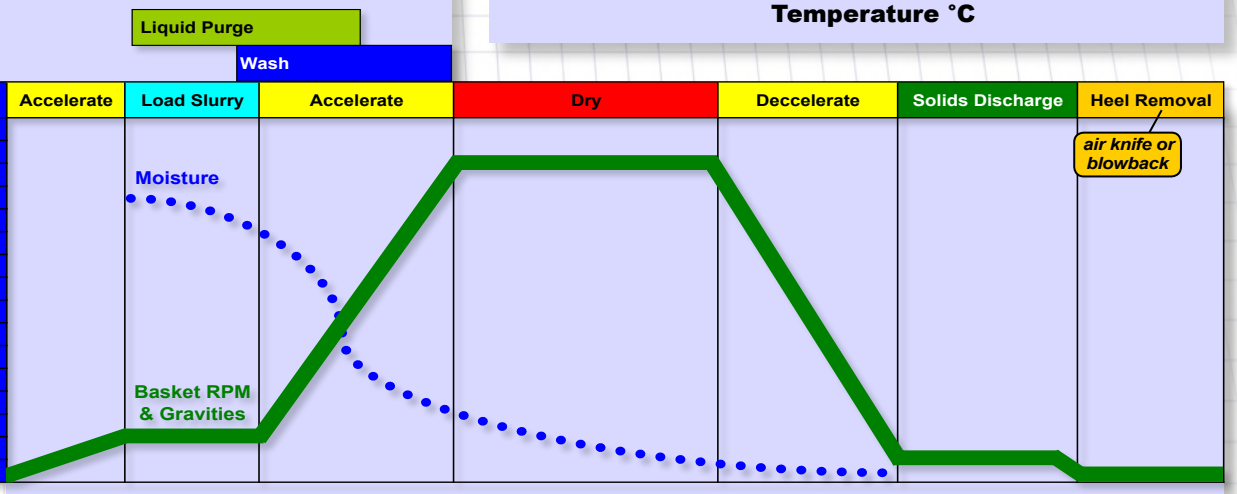


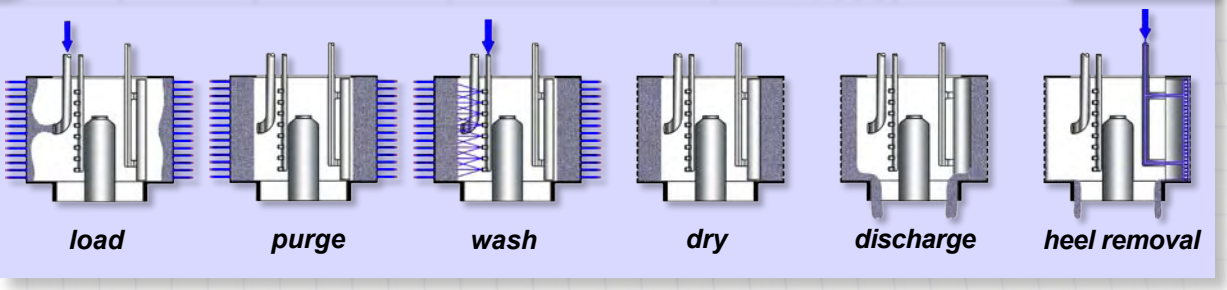
Optimizing the Cake Wash Stage

Filtering Centrifuges are highly effective at separating liquids from solids because they can generate over 1,000 gravities of force. Because wash is applied at between 50 and 500 rpm, the spray is dispersed evenly across the cake allowing the use of less fluid. In most cases, the wash fluid is added immediately after the slurry has been loaded and after most, but not all, of the mother liquor has been purged. Washing is generally done before high speed is reached and before any surface drying of the cake can occur.

(example is for 40" basket)

RPM	Gravities	Moisture
1,500	1,280	75%
1,400	1,110	70%
1,300	960	65%
1,200	820	60%
1,100	690	55%
1,000	570	50%
900	460	45%
800	360	40%
700	280	35%
600	200	30%
500	140	25%
400	90	20%
300	50	15%
200	20	10%
100	10	5%
0	0	0%



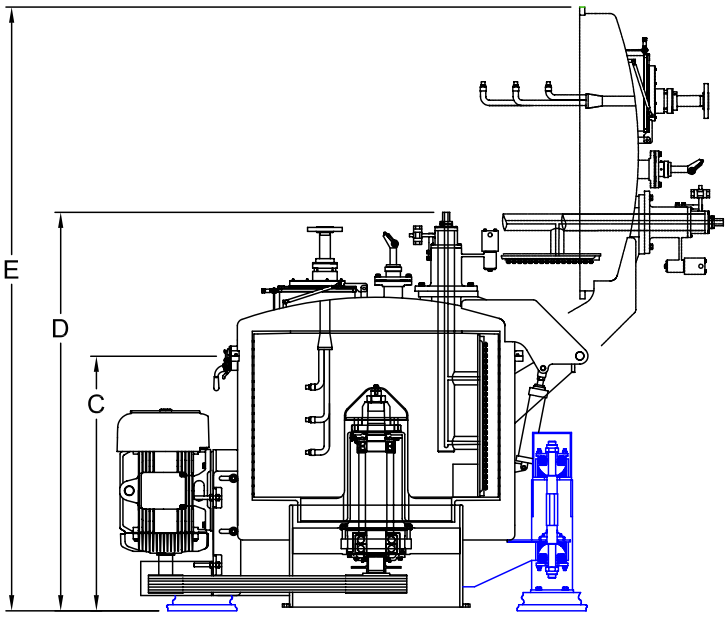


Capacities and Dimensions

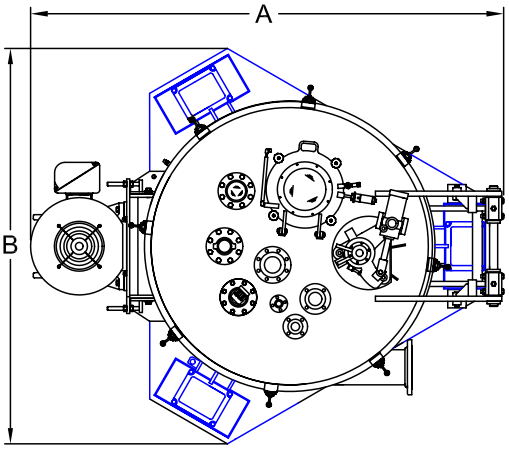
Model	Q-068	Q-120	Q-210	Q-250	Q-320	Q-520
Volumetric Capacity (ft^3)	1.9	3.5	8.9	12.5	15.7	33.3
Volumetric Capacity (liters)	54	99	252	354	445	943
Filter Surface Area (ft^2)	6.8	11.8	20.9	25.12	31.4	52
Basket RPM	1560	1450	1250	1150	1150	1000
Standard "G" Force	900	900	900	900	900	850
HP (minimum)	10	15	20	30	40	50
HP (maximum)	15	20	30	50	100	200

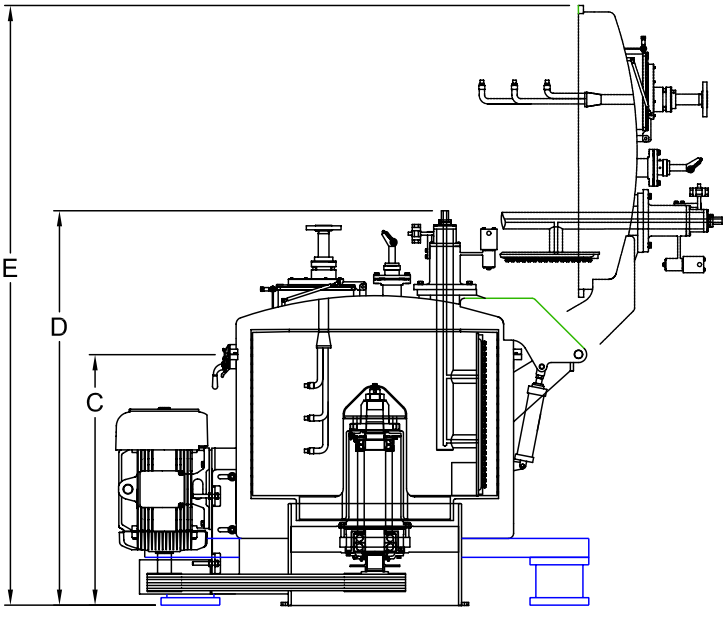
Approximate Dimensions	inches					
Basket Diameter	26	30	40	48	48	60
Basket Depth	12	18	24	24	30	40
Basket Cap Width	4	4	6	7	7	9
A (major width)	52	60	80	96	96	120
B (minor width)	47	54	72	86	86	108
C (height to curb top)	34	39	52	62	62	78
D (height to top of closed cover)	44	51	68	81	81	101
E (height to top of open cover)	68	78	104	125	125	156

Approximate Weights	pounds					
Link Suspension	2,000	5,000	7,000	8,000	9,000	16,000
Inertia Pad w/ Viscous Dampers	3,600	9,000	12,600	14,400	16,200	28,800

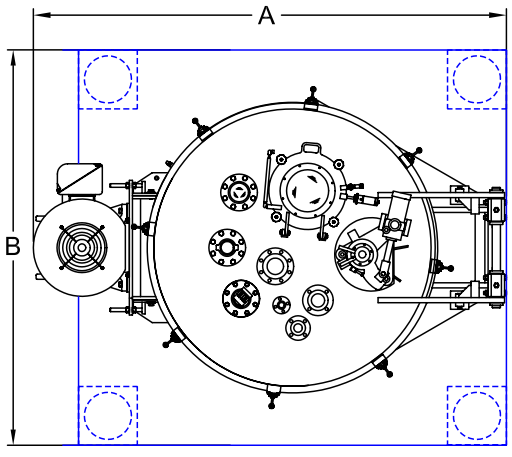


Dampened Link Suspension



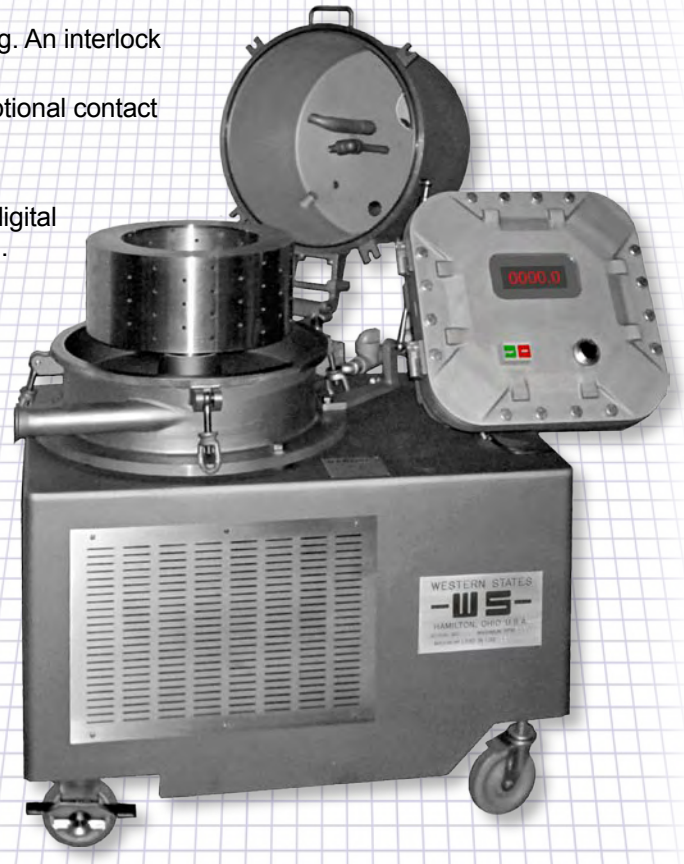


Inertia Pad with Viscous Dampers

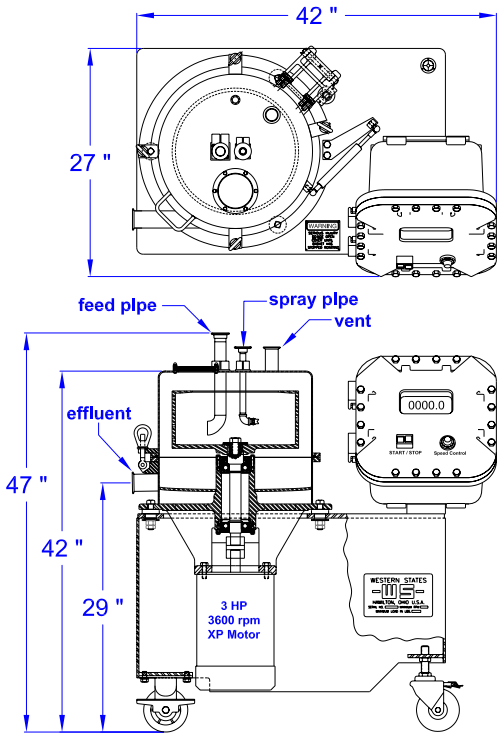


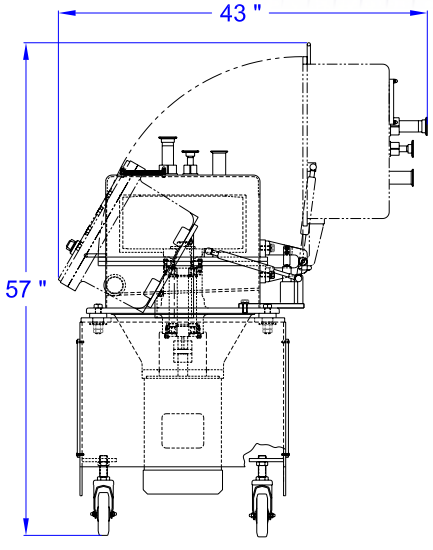
Laboratory/Pilot Scale Filtering Centrifuge
Model STM-2000

- **High-Performance Filtering Centrifuge with fully machined and dynamically balanced basket.**
  Optional: Non-Perforated Solid Bowl Decanting Centrifuge with Siphon Tube for capturing particles too small to filter or very low solids (<1%) suspensions.
- Three basket sizes available: 0.09 ft^3, 0.15 ft^3 and 0.26 ft^3 (solids retention).
- Vapor-tight, hinged housing opens for removal of solids, filter changes and inspection of internal surfaces.
- Sloped bottom and tangential fluid outlet ensure complete drainage.
- Sight glass, liquid feed, wash pipe and vent mounted in upper housing. An interlock prevents opening of the housing while the basket is rotating.
- 316 stainless steel contact surfaces with satin bead blasted finish. Optional contact materials include Hastelloy, HALAR and other fluorocarbon coatings.
- Fully-welded 304 stainless steel base on heavy-duty casters.
- Variable frequency drive, start/stop push buttons, speed control and digital RPM display mounted in an explosion proof NEMA-7&9 control panel.
- 3 HP, 3600 rpm, direct coupled, XP motor (Cls. 1, Div. I, Grps. C&D).
- Approximate weight 1,100 pounds.



Model STM-2000	Basket Size		
Basket Diameter	10"	12"	14"
Basket Depth	4"	4"	6"
Basket Cap	1.5"	2"	2"
Basket Capacity (ft^3)	0.09	0.15	0.26
Basket Capacity (liters)	2.5	4.2	7.4
Filter Area (ft^2)	0.9	1.05	1.83
Maximum Basket RPM	3600	3600	3600
Maximum "G" Force	1840	2200	2600





Contact Surfaces also available with **HALAR** or other **Fluorocarbon coatings,** solid **Hastelloy** or other alloys.

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