



# Vacuum Pump Liquid Separator-Silencers

## Convenient Drop-in Design

- Dimensionally equivalent to most existing units.

## High-performance Liquid Separation and Silencing

- High-performance liquid removal efficiencies, 90% to 99%, to suit your application.
- Choice of high or moderate acoustic performance.
- Choose from two inlet models (RWVS and RWSI) designed for full vacuum or two discharge models (RVCS and RVRS) designed for discharge to atmosphere.

## Built to Suit Your Application

- Designed to application requirements, including easy installation and low maintenance.
- Optional design features for special production and assembly conditions are available.
- ASME Code construction and special materials available.

## Outstanding Construction

- Carbon steel construction with a high-quality shop coat primer finish.
- Special materials such as stainless steel are available.
- Optional leak test available upon request.

## Immediate Availability

- Off-the-shelf delivery for most sizes.

**U**niversal Silencer separator-silencers separate liquid particles from gas flow, while attenuating noise at the inlet and discharge ports of blowers and liquid ring vacuum pumps. These separator-silencers support better working conditions, lower operating costs, and a quieter environment.

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## Vacuum Pump Systems

**S**eparator-silencers are used to remove liquid from gas flow vacuum systems using either liquid-sealed rotary positive blowers or liquid ring vacuum pumps (Fig. 1).

Separator-silencers may be required for both the inlet (vacuum) and the discharge (atmospheric) of a vacuum system. Only the most stringent acoustical environments require significant inlet silencing. An inlet separator provides corrosion protection for the pump by removing most, if not all, of the process liquid before it enters the vacuum pump.

The vacuum pump or blower discharge is normally extremely noisy and requires a high-performance separator-silencer.

### Operation and Capacity

When a vacuum pump first starts operating at normal atmospheric pressure, system pressure drop and power requirements are at their maximum. As the vacuum pump continues to evacuate the system, the inlet pressure decreases so the system pressure losses and power requirements decrease. The inlet volume flow in actual cubic feet per minute (ACFM) stays essentially constant throughout system operation, but because of decreasing inlet pressure, the discharge volume decreases until normal operating conditions are reached.

Vacuum pump capacities at operating conditions are expressed by the inlet volume flow of air and the amount that the inlet pressure has been reduced below atmospheric pressure. Thus, vacuum pump capacities are stated in inlet ACFM at a relative vacuum, usually measured in inches of mercury (Hg).

### Liquid Separation Performance

Separator-silencers meet their rated liquid separation efficiency at a nozzle velocity of 5500 fpm. At lower velocities their performance improves. At higher velocities their efficiency decreases. The nozzle velocity is the air velocity in the inlet or discharge nozzle and is equal to the actual volume flow rate (ACFM) divided by the nozzle area.

Since the *inlet volume flow rate* is nearly constant during normal vacuum pump operation, the inlet separator-silencer should be sized so the velocity does not exceed 5500 fpm during all phases of operation (Table 1).

The *discharge flow rate* decreases from startup to normal operation, and in some applications it may be acceptable to exceed a velocity of 5500 fpm during startup. If it is not acceptable to discharge liquid during startup, the velocity must be reduced (Table 1). If some liquid bypass is allowed during startup, the selection of the discharge separator-silencer should be based on pressure drop.

Inlet and discharge separator-silencers require drain systems to remove the liquid. These systems (both inlet and discharge) must provide an adequate drain sealing system or liquid level to offset the vacuum on the inlet side and prevent blowout on the discharge side. See Tables 2 and 3 for liquid removal data.

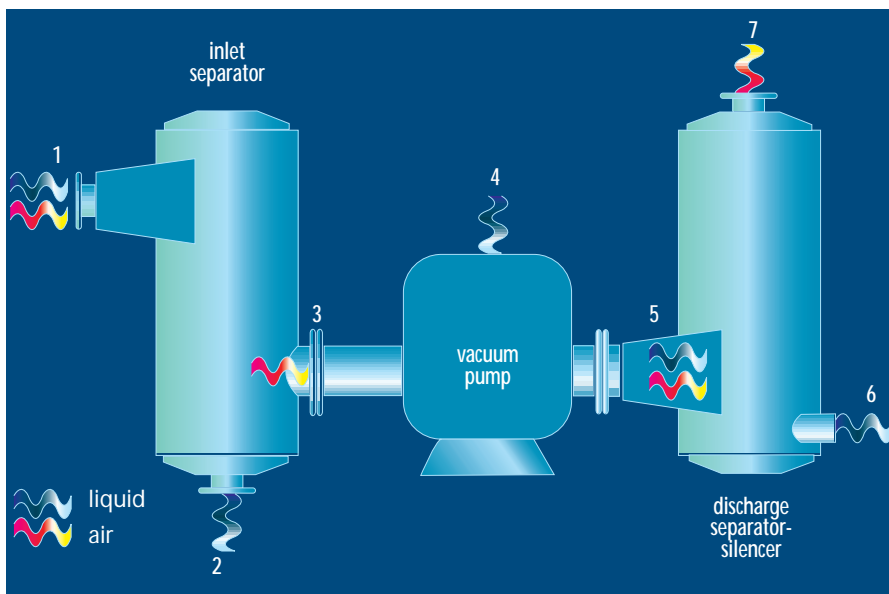


FIGURE 1.

This is an example of a vacuum pump and liquid removal system. Air and liquid enter the inlet separator-silencer during processing (1). Process liquid is removed (2), and air enters the vacuum pump (3). The pump takes in seal liquid (4). Air and seal liquid are pumped into the discharge separator-silencer (5), which removes the liquid (6) and sends the air into the atmosphere (7).

## Technical Details

Separator-silencer pressure drop depends on velocity and pressure. In a vacuum system, pressure drop is at a maximum during startup. Under normal atmospheric conditions, the pressure drop at startup, for either an inlet or discharge separator-silencer, is calculated from the following equation:

$$\Delta P = \frac{C}{477} \left( \frac{ACFM}{p} \right)^2$$

$$= C \left( \frac{V}{4005} \right)^2$$

where  $ACFM$  = inlet volume flow rate  
 $C$  = separator-silencer  $\Delta P$  coefficient (Table 3)  
 $\Delta P$  = pressure drop in inches of water  
 $p$  = separator-silencer size (nozzle diameter) in inches  
 $V$  = velocity in feet per minute

If the startup pressure drop is too great, use the flow given for a lower relative vacuum, or calculate a separator-silencer size from this equation:

$$p = 0.214 \sqrt{ACFM} \sqrt{\frac{C}{\Delta P}}$$

where  $C$  = separator-silencer  $\Delta P$  coefficient  
 $\Delta P$  = desired pressure drop in inches of water  
 $p$  = separator-silencer size (nozzle diameter)

**TABLE 1. Maximum capacity (inlet ACFM) for full liquid separation efficiency at operating vacuum.**

Nominal Size	Operating Vacuum, inches of Hg						
	0*	5	10	15	18	20	25**
1	30	36	45	60	75	90	98
1½	70	81	101	135	169	204	221
2	120	144	180	241	301	362	393
2½	190	225	282	376	471	565	614
3	270	324	406	541	678	814	884
3½	370	441	552	737	922	1110	1200
4	480	576	721	963	1200	1450	1570
5	750	900	1130	1500	1880	2260	2450
6	1080	1300	1620	2170	2710	3260	3530
8	1920	2310	2880	3850	4820	5790	6280
10	3000	3600	4510	6020	7530	9050	9800
12	4300	5190	6490	8660	10800	13000	14100
14	5900	7060	8830	11800	14800	17700	19200
16	7700	9220	11500	15400	19300	23200	25100
18	9700	11670	14600	19500	24400	29300	31800
20	12000	14410	18000	24100	30100	36200	39300
22	14500	17430	21800	29100	36400	43800	47500
24	17300	20750	26000	34700	43400	52100	56500
26	20300	24350	30500	40700	50900	61200	66400
28	23500	28240	35300	47200	59000	70900	77000
30	27000	32420	40600	54100	67800	81400	88400

\* This column is used for inlet separator-silencers and discharge separator-silencers with no liquid bypass during startup.

\*\* Capacity at operating vacuum greater than 20" Hg is limited by startup conditions.

## Easy to Specify and Order

When you work with Universal Silencer, you can simply provide the flow conditions and the pump manufacturers' information, and we can recommend a separator-silencer best suited for your application. We use the following operating conditions for system analysis and separator-silencer selection:

1. Pressure
2. Temperature
3. Molecular weight or specific gravity
4. Flow rate in SCFM at 14.7 PSIA and 70° F
5. Liquid flow rate in GPM
6. Maximum allowable pressure drop (inches of water) for the separator-silencer
7. Pump manufacturer's name, and equipment model number, if available
8. Unsilenced noise levels from the system, if available
9. Silenced noise level required at a specified distance from the source
10. Required liquid removal efficiency

Using your information, we can prepare a comprehensive technical proposal and price quotation.

### Comparative Dimensional Equivalents

Performance is equal to or greater than Burgess-Manning products.

Universal Silencer	Burgess-Manning
RWVS	WSVT
RWSI	WVKT
RVCS	WSS
RVRS	WSDA

**TABLE 2. Maximum liquid flow in GPM for various drain sizes.\***

Drain Size (O)	RWVS and RWSI	RVCS and RVRS
1	15	10
1½	30	20
2	50	35
2½	75	60
3	120	100
3½	150	125
4	200	160
5	300	260
6	450	400
8	800	650
10	1200	1000

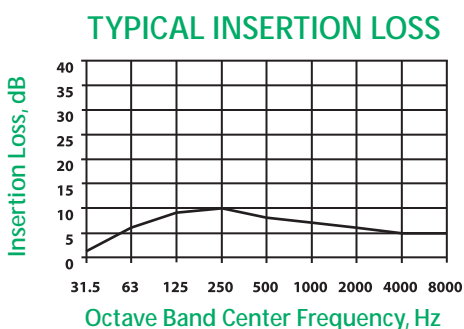
\* Values are based on gravity drain and may be larger with a positive drainage system.

**TABLE 3. Pressure drop coefficients and separation efficiency.**

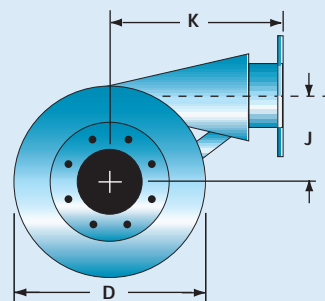
Model	Pressure Drop Coefficient (C)	Separation Efficiency
RWVS	4.0	99 %
RWSI	3.0	90 %
RVCS	4.0	99 %
RVRS	4.5	>99 %

## RWVS SERIES Inlet Liquid Separator-Silencers

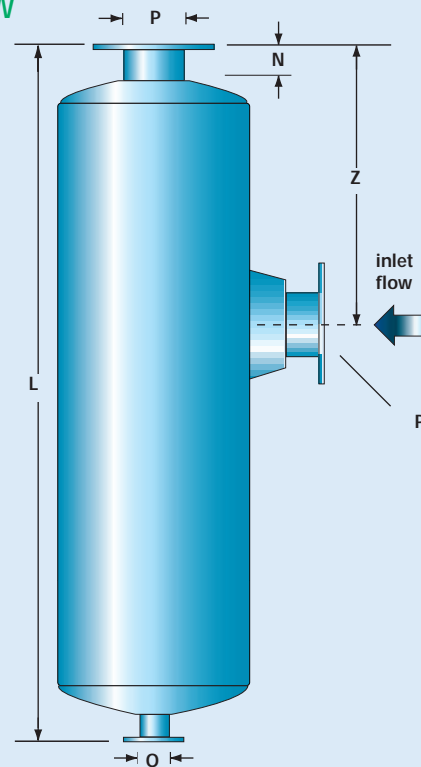
**T**he RWVS inlet liquid separator-silencers provide corrosion protection for vacuum pumps by removing most of the process liquid before it enters the vacuum pump. These separators are best suited for full vacuum conditions under critical applications, which require inlet silencing.



TOP VIEW



SIDE VIEW



### DIMENSIONS, WEIGHTS, AND RATED CAPACITIES

MODEL	P (nom.)	D	N	L	K	Z	J	O (nom.)	WEIGHT	RATED CAPACITY*	
										MAX. ACFM AT VACUUM (BLOWER INLET)	LIQUID GPM**
RWVS-4	4	12 <sup>3</sup> / <sub>4</sub>	3	52	13 <sup>1</sup> / <sub>2</sub>	19 <sup>1</sup> / <sub>2</sub>	5 <sup>5</sup> / <sub>8</sub>	2	76	530	35
RWVS-5	5	16	3	58	14 <sup>1</sup> / <sub>2</sub>	23 <sup>1</sup> / <sub>2</sub>	7 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>2</sub>	144	830	55
RWVS-6	6	18	3	66	18	30	8	3	189	1200	80
RWVS-8	8	22	3 <sup>1</sup> / <sub>2</sub>	78	21 <sup>1</sup> / <sub>2</sub>	36	9 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>2</sub>	355	2100	150
RWVS-10	10	24	3 <sup>1</sup> / <sub>2</sub>	85	26	37	10 <sup>1</sup> / <sub>2</sub>	4	442	3300	200
RWVS-12	12	30	3 <sup>1</sup> / <sub>2</sub>	97	31 <sup>1</sup> / <sub>2</sub>	45	13 <sup>1</sup> / <sub>4</sub>	5	630	4700	300
RWVS-14	14	36	3 <sup>1</sup> / <sub>2</sub>	105	36 <sup>1</sup> / <sub>2</sub>	47	16	6	1029	6000	400
RWVS-16	16	42	3 <sup>1</sup> / <sub>2</sub>	114	41 <sup>1</sup> / <sub>2</sub>	50	18 <sup>9</sup> / <sub>16</sub>	6	1401	7800	500
RWVS-18	18	42	3 <sup>1</sup> / <sub>2</sub>	135	47	68	18 <sup>7</sup> / <sub>16</sub>	8	1645	10000	600
RWVS-20	20	48	4 <sup>1</sup> / <sub>2</sub>	138	52	66	21 <sup>1</sup> / <sub>8</sub>	8	2925	12000	800
RWVS-22	22	54	4 <sup>1</sup> / <sub>2</sub>	149	57	70	23 <sup>7</sup> / <sub>8</sub>	10	2384	15000	1000
RWVS-24	24	60	4 <sup>1</sup> / <sub>2</sub>	158	62	74	26 <sup>5</sup> / <sub>8</sub>	10	3502	18000	1200

\* Capacities for larger sizes available on request.

\*\* If maximum gas flow is not exceeded for a given separator size, liquid GPM may exceed nominal capacity shown, up to the capacity of the next larger separator.

## RWSI SERIES

### Inlet Liquid Separator-Silencers

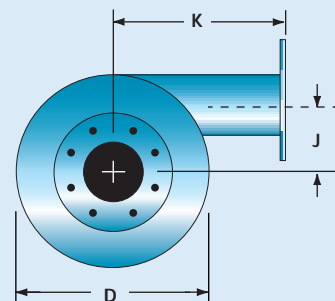
**T**he RWSI inlet liquid separator-silencers provide corrosion protection for vacuum pumps by removing most of the process liquid before it enters the vacuum pump. These separators are best suited for full vacuum conditions under critical applications, which require inlet silencing. The RWSI models include larger pipe sizes than the RWVS and have a different profile.

#### TYPICAL INSERTION LOSS

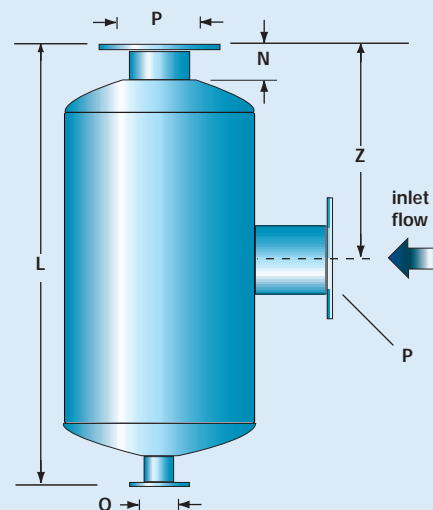
Insertion Loss, dB

Octave Band Center Frequency, Hz

TOP VIEW



SIDE VIEW



#### DIMENSIONS, WEIGHTS, AND RATED CAPACITIES

MODEL	P (nom.)	D	N	L	K	Z	J	O (nom.)	WEIGHT	RATED CAPACITY*	
										MAX. ACFM AT VACUUM (BLOWER INLET)	LIQUID GPM**
RWSI-4	4	12	3	26	11	15	3 <sup>3</sup> / <sub>4</sub>	2	40	530	35
RWSI-5	5	16	3	31	14 <sup>1</sup> / <sub>4</sub>	18	5 <sup>3</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>2</sub>	82	830	55
RWSI-6	6	18	3	36	15 <sup>1</sup> / <sub>2</sub>	21	5 <sup>11</sup> / <sub>16</sub>	3	108	1200	80
RWSI-8	8	22	3 <sup>1</sup> / <sub>2</sub>	46	18	27	6 <sup>11</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>2</sub>	202	2100	150
RWSI-10	10	24	3 <sup>1</sup> / <sub>2</sub>	58	23	34	6 <sup>5</sup> / <sub>8</sub>	4	276	3300	200
RWSI-12	12	30	3 <sup>1</sup> / <sub>2</sub>	68	25 <sup>1</sup> / <sub>2</sub>	40	8 <sup>5</sup> / <sub>8</sub>	5	403	4700	300
RWSI-14	14	36	3 <sup>1</sup> / <sub>2</sub>	78	28	46	11	6	708	6000	400
RWSI-16	16	42	3 <sup>1</sup> / <sub>2</sub>	88	28	52	13	6	950	7800	500
RWSI-18	18	42	3 <sup>1</sup> / <sub>2</sub>	98	30 <sup>1</sup> / <sub>2</sub>	58	12	8	1050	10000	600
RWSI-20	20	48	4 <sup>1</sup> / <sub>2</sub>	108	33	64	14	8	1308	12000	800
RWSI-22	22	54	4 <sup>1</sup> / <sub>2</sub>	120	35	71	16	8	1619	15000	1000
RWSI-24	24	60	4 <sup>1</sup> / <sub>2</sub>	130	38	77	18	10	2481	18000	1200
RWSI-26	26	66	4 <sup>1</sup> / <sub>2</sub>	140	40 <sup>1</sup> / <sub>2</sub>	83	20	10	2986	21000	1400
RWSI-28	28	72	4 <sup>1</sup> / <sub>2</sub>	150	43	89	22	10	3554	24000	1600
RWSI-30	30	78	4 <sup>1</sup> / <sub>2</sub>	160	45 <sup>1</sup> / <sub>2</sub>	95	24	10	4959	28000	1800

\* Capacities for larger sizes available on request.

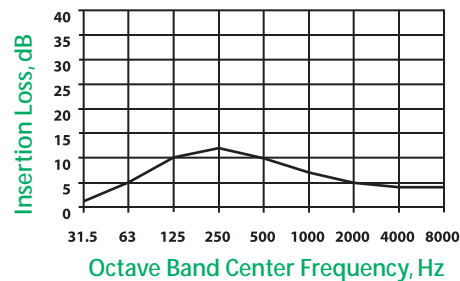
\*\* If maximum gas flow is not exceeded for a given separator size, liquid GPM may exceed nominal capacity shown, up to the capacity of the next larger separator.

## RVCS SERIES

### Discharge Liquid Separator-Silencers

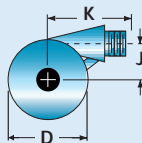
The RVCS models provide high-performance liquid separation and noise attenuation. When an inlet separator is not installed, the discharge separator might need to be over-sized.

#### TYPICAL INSERTION LOSS



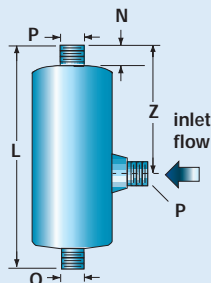
#### TOP VIEW

Pipe sizes 1 in. through 3½ in.



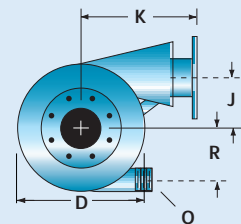
#### SIDE VIEW

Pipe sizes 1 in. through 3½ in.



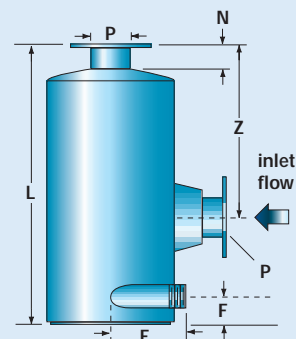
#### TOP VIEW

Pipe sizes 4 in. through 16 in.



#### SIDE VIEW

Pipe sizes 4 in. through 16 in.



### DIMENSIONS AND WEIGHTS

MODEL	P (nom.)	D	N	L	K	E	F	Z	R	J	O (nom.)	WEIGHT
RVCS-1	1	4½	2	14	6	—	—	8¾	—	2¾/32	1	4
RVCS-1¼	1¼	4½	2	14	6	—	—	8	—	2¼/16	1	5
RVCS-1½	1½	6	2	17	7	—	—	10	—	2¾/4	1½	10
RVCS-2	2	8	3	22	9	—	—	13	—	3¼/16	2	15
RVCS-2½	2½	10	3	24	10	—	—	14	—	4⅝/8	2	20
RVCS-3	3	10	3	27	11	—	—	16	—	4⅞/16	2½	25
RVCS-3½	3½	12	3	30	12	—	—	18	—	5½/2	2½	35
RVCS-4	4	12	3	29	13½	8	3	18½	4¼	5⅞/16	3	50
RVCS-5	5	16	3	35	14½	9	3½	21½	6¼	7⅝/16	3	95
RVCS-6	6	18	3	42	18	10	3½	27	7¼	8¾/16	3	130
RVCS-8	8	22	3½	52	21½	12	4	32	9¼	9⅝/16	3	240
RVCS-10	10	24	3½	56	26	14	4½	32	10¼	10⅞/16	3	300
RVCS-12	12	30	3½	69	31½	16	5	40½	12¾	13⅞/16	4	445
RVCS-14	14	36	3½	75	36½	16	5	43	15¾	16¼	4	620
RVCS-16	16	42	3½	88	41½	19	6½	52	18¾	18⅞	4	1035

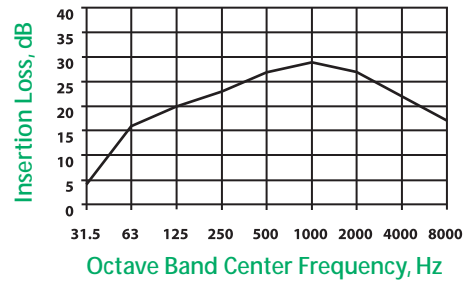
- All models use a pipe thread connection (MNPT) for the liquid outlet (O).
- Sizes 1 in. through 3½ in. are standard with male pipe thread connection (MNPT).
- Sizes 4 in. through 16 in. are standard with 150# ANSI drilled plate flanges.

## RVRS SERIES

### Discharge Liquid Separator-Silencers

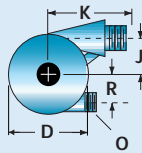
The RVRS models are similar to the RVCS models. For pipe sizes 1 in. through 3 in., the RVRS has a side liquid outlet, while the RVCS has a vertical liquid outlet.

#### TYPICAL INSERTION LOSS



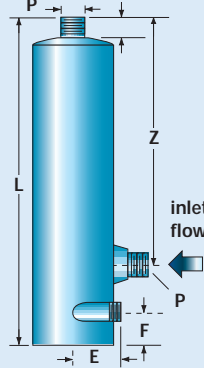
#### TOP VIEW

Pipe sizes 1 in. through 3 in.



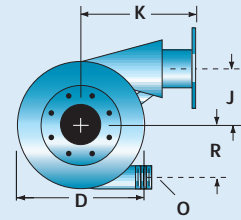
#### SIDE VIEW

Pipe sizes 1 in. through 3 in.



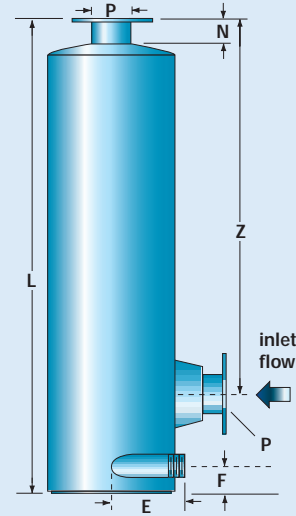
#### TOP VIEW

Pipe sizes 3 1/2 in. through 16 in.



#### SIDE VIEW

Pipe sizes 3 1/2 in. through 16 in.



### DIMENSIONS AND WEIGHTS

MODEL	P (nom.)	D	N	L	K	E	F	Z	R	J	O (nom.)	WEIGHT
RVRS-1	1	4 1/2	2	20 3/4	6	3 1/2	1 1/4	15 1/2	1 9/32	2 3/32	1	10
RVRS-1 1/4	1 1/4	4 1/2	2	20 3/4	6	3 1/2	1 1/4	14 3/4	1 9/32	2 1/16	1	10
RVRS-1 1/2	1 1/2	6	2	25	7	4	1 3/4	19	2 3/64	2 3/4	1 1/2	15
RVRS-2	2	8	2	32 7/8	9	5	2	25	2 13/16	3 11/16	2	30
RVRS-2 1/2	2 1/2	10	3	35 1/2	10	6	3	26	3 13/16	4 5/8	2	40
RVRS-3	3	10	3	41	11	6	3	31	3 9/16	4 3/16	2 1/2	45
RVRS-3 1/2	3 1/2	12	3	44 3/8	13	7	3	33	4 9/16	5 1/2	2 1/2	55
RVRS-4	4	12	3	47	13 1/2	8	3	36 1/2	4 1/4	5 7/16	3	70
RVRS-5	5	16	3	59 1/2	14 1/2	9	3 1/2	47	6 1/4	7 5/16	3	140
RVRS-6	6	18	3	71 3/4	18	10	3 1/2	57	7 1/4	8 3/16	3	244
RVRS-8	8	22	3 1/2	90 1/4	21 1/2	12	4	71	9 1/4	9 15/16	3	355
RVRS-10	10	24	3 1/2	103 1/4	26	14	4 1/2	80	10 1/4	10 11/16	3	460
RVRS-12	12	30	3 1/2	128 1/2	31 1/2	16	5	101	12 3/4	13 7/16	4	1092
RVRS-14	14	36	3 1/2	141 1/4	36 1/2	16	5	109 1/4	15 3/4	16 1/4	4	1678
RVRS-16	16	42	3 1/2	154 1/4	41 1/2	19	6 1/2	118 1/4	18 3/4	18 7/8	4	2212

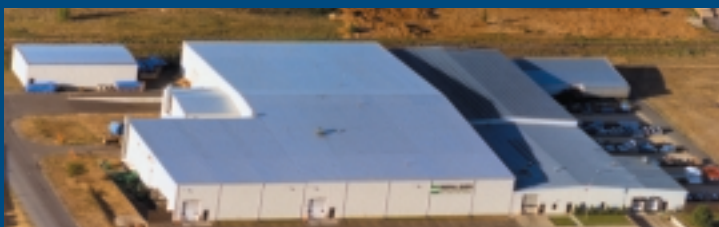
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- Sizes 1 in. through 3 in. are standard with male pipe thread connection (MNPT).
- Sizes 3 1/2 in. through 16 in. are standard with 150# ANSI drilled plate flanges.



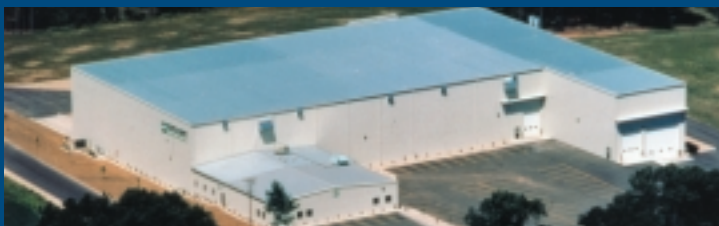
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Our corporate headquarters are located in Stoughton, Wisconsin, just southeast of Madison, the state capital. This new building houses administration, sales, and engineering departments.



Manufacturing facilities are in Muscoda (above), 75 miles west of Stoughton, and Montello (below), 70 miles north.



## Quality You Can Count On

Our products have been used to protect, quiet, and optimize the performance of industrial equipment for 50 years. We maintain a fully equipped testing facility to qualify filters and silencers. We are an ISO 9001 registered firm and ASME Code certified.

Our extensive in-house engineering, manufacturing, and testing capabilities ensure optimized process, mechanical, and acoustic performance for your application.

*Keeping  
industrial equipment  
clean and quiet.*

# RWVS, RWSI, RVCS, AND RVRS SERIES Vacuum Pump Liquid Separator-Silencers

Contact us for more information about our complete line of industrial filter-silencers, air filters, and silencers:

- Universal Silencer guide to industrial products, catalog 278
- Vacuum pump low-profile liquid separator-silencers, catalog 285-A
- Rotary positive blower silencers, catalog 244-D
- Acousti-Tube® and Acousti-Ring® vent silencers, catalog 243-C
- Acousti-Tube® and Acousti-Ring® vent silencer specification sheet, form 88-0063
- Air filters and filter silencers, catalog 241-B
- Cartridge air filters and filter silencers, catalog 242-C
- CB compact blower silencers, catalog 255-A
- CBF/CBFI compact blower filter-silencers, catalog 261-A
- Reciprocating engine silencers and filters, catalog 246-A
- Compressor silencers and filters, information provided by application
- Industrial fan silencers, catalog 249-A
- Steam ejectors, pressure reduction valves, and other special applications
- Universal Silencer guide to gas turbine products, catalog 265
- Gas turbine filters and silencers, catalog B-249-A



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