Varian, Inc.
Vacuum Technologies

Diffusion Pumps

Inspiring Excellence

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VIEW OUR INVENTORY

Diffusion Pumps

Varian's high performance Diffusion Pumps offer:

- High pumping speeds
- High throughput
- High forepressure tolerance
- Low ultimate pressure
- Excellent backstreaming characteristics
- Long-term reliability

The full fractioning design of all Varian diffusion pumps allows vaporized fluid to be fractionated in the boiler and jet assembly. Contamination and decomposition products are pumped away, and only the purest vapor reaches the top jet, assuring highest speed and lowest backstreaming. The unique boiler design of Varian pumps provides a high degree of insensitivity to normal variations in voltage and type of pumping fluid. The design also minimizes pumping fluid breakdown by achieving full operation with a low boiler temperature (below 240 °C).

The foreline ejector stage provides high tolerable forepressure and a large surface area for efficient degassing of compressed fluid, while the foreline baffle minimizes fluid loss, even under high throughput conditions.

Most Varian diffusion pumps also feature full thermal protection** ac
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cold cap or a dense baffle. The pump includes a sight glass for immedi

M-Series Diffusion Pumps
Available in 2 in. through 6 in. sizes, the M-Series pumps have the lowest backstreaming rate of all unbaffled diffusion pumps on the market – ten times better than that of other pumps. As a result of this superior performance, it is often possible to use the M-Series pumps without traps or baffles. (When these components are added, however, the degree of cleanliness at the inlet of the topmost component is greater than that possible with many other pumping systems.)

The standard cold cap, which intercepts over 99% of backstreaming vapor, has been designed to stay colder by more efficient heat transfer, and it is easy to install and maintain. All M-series pumps have full thermal protection** against inadequate cooling water, low pumping fluid, and high system pressure. Finned boilers increase surface area, prolonging fluid life.

VHS-Series Diffusion Pumps
Available in 4 in., 6 in., 250 mm, 10 in., and 400 mm sizes, the VHS-Series pumps are the fastest and cleanest diffusion pumps of their size available today. The VHS-Series patented bulge contour*** doubles gas capture and maintains lower pressure for your process. All VHS-Series pumps have sight glass/fill and drain assemblies for continuous monitoring and easy maintenance of pump fluid. Finned boilers increase surface area prolonging fluid life. Full thermal protection and quick cool coils are also standard. The 4 in., 6 in., and 10 in. pumps can be ordered with ASA or ISO flanges, standard or extended cold caps, and a variety of voltages.

HS-Series Diffusion Pumps
Available in 2 in. and 16 in. through 35 in. sizes, high speed, low ultimate pressure, high throughput, high tolerable forepressure, and low backstreaming combine with low cost to make the HS-Series pumps ideal diffusion pumps. These pumps come with full thermal protection and optional quick cool coils.† HS-16 through 35 come with sight glass/fill and drain assemblies and are available with ASA or ISO flanges.

Should you not find a diffusion pump within this catalog to meet your requirements, please contact us. We are committed to providing diffusion pump solutions.

* For an explanation of terms such as pumping speed, maximum throughput, maximum forepressure, and backstreaming rate, see Technical Notes, page 52.

** U.S. Patent No. 3282330

*** U.S. Patent No. 3363830

† HS-2 includes the quick cool coil as a standard feature

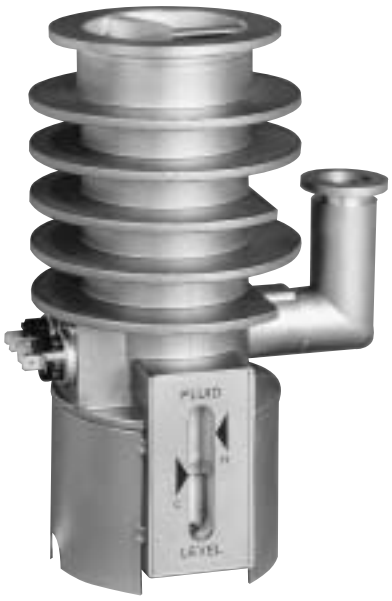
Diffusion Pumps

Model	AX-65	HS-2	M-2	M-4	VHS-4	M-6
Previous Model Number	**–**	**0160**	**–**	**0187**	**0183**	**0188**
Speed, *l*/s (operating range) Air –	65	285	175	800	1,200	1,500
Hydrogen –	–	340	210	1,000	1,600	1,800
Helium –	90	340	210	1,000	1,500	1,800
Maximum forepressure, Torr (mbar)						
No load	0.75 (1.00)	0.55 (0.72)	0.55 (0.72)	0.65 (.86)	0.65 (.86)	0.70 (.91)
Full load	0.60 (0.78)	0.40 (0.52)	0.40 (0.52)	0.45 (.59)	0.55 (.73)	0.60 (.78)
Maximum throughput, T-*l*/s (mbar-*l*/s)						
In operating range	0.19 (0.25)	0.45 (0.60)	0.35 (0.47)	0.80 (1.1)	1.2 (1.6)	1.5 (2.0)
@ 1 x 10^{-2} Torr (1.3 x 10^{-2} mbar)	0.30 (0.40)	0.70 (0.93)	0.65 (0.84)	1.5 (2.0)	2.5 (3.2)	2.4 (3.1)
Minimum recommended backing pump for maximum throughput, cfm (m^3/hr)	1.5 (2.5)	5.0 (8.5)	5.0 (8.5)	10 (17)	10 (17)	11 (19)
Backstreaming rate at inlet flange mg/cm^2/min (standard cold cap)*	2 x 10^{-4}	1 x 10^{-3}	1 x 10^{-3}	1 x 10^{-4}	5 x 10^{-4}	1 x 10^{-4}
Warmup time, minutes	7	15	10	12	10	12
Cooldown time, minutes						
With quick cool coil, where applicable		10	30	30	20	10 20
Fluid charge	30 cc	100 cc	100 cc	250 cc	300 cc	400 cc
Electrical requirements	1 ph 50/60 Hz 90/115/165/220 V	1 ph 50/60 Hz 120/240 V	1 ph 50/60 Hz 120/240 V	1 ph 50/60 Hz 120/208/240 V	1 ph 50/60 Hz 120/208/240 V	1 ph 50/60 Hz 120/208/240 V
Power, Watts	200/250	450	450	1190	1450	1785
Cooling water, U.S. gpm (*l*/hr)						
at 60-80° F (15-26 °C)	NA	0.1 (20)	0.1 (20)	0.15 (30)	0.15 (30)	0.2 (40)
Page Number	4	6	8	10	12	14

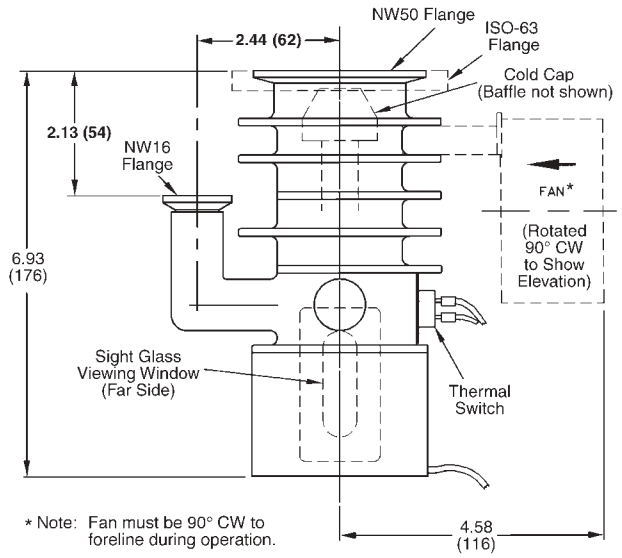
* Refer to page 50 for a description of test methods.
Refer to page 46 for discussion of pump performance with halo baffles.

VHS-6	VHS-250	VHS-10	VHS-400	HS-16	HS-20	HS-32	NHS-35
0184	**–**	**0185**	**–**	**0164**	**0165**	**0167**	**0169**
2,400 3,200 3,000	3,700 4,100 4,600	5,300 7,000 6,600	8,000 9,600 10,000	10,000 12,500 12,500	17,500 22,000 22,000	32,000 40,000 40,000	50,000 62,500 62,500
0.65 (0.85) 0.55 (0.72)	0.65 (.85) 0.55 (0.72)	0.65 (.85) 0.55 (0.72)	0.65 (.85) 0.55 (0.72)	0.65 (.85) 0.55 (.72)	0.65 (.85) 0.55 (.72)	0.50 (.65) 0.35 (.45)	0.55 (.71) 0.40 (.52)
2.4 (3.2) 3.5 (4.5)	2.6 (3.5) 3.5 (4.5)	5.3 (7.1) at 4400 W 7.7 (10.2) at 4400 W	5.6 (7.5) at 4400 W 8.0 (10.6) at 4400 W	8.5 (11) at 8100 W 12.5 (16.6) at 8100 W	14 (19) 18 (23.4)	23 (31) 35 (45.5)	25 (33) 35 (45.5)
17.0 (28.9)	17.0 (28.9)	30 (51)	30 (51)	80 (136)	100 (170)	300 (510)	300 (510)
5×10^{-4}	5×10^{-4}	5×10^{-4}	1×10^{-3}	1.5×10^{-3}	1.5×10^{-3}	7×10^{-4}	5×10^{-4}
10	10	15	15	30	45	60	60
10	10	25	25	48	85	180	180
500 cc	500 cc	1,000 cc	1,000 cc	3 U.S. qts. (2.8 liters)	5 U.S. qts. (4.7 liters)	3 U.S. gal. (11.3 liters)	3 U.S. gal. (11.3 liters)
1 ph 50/60 Hz 120/208/240 V	1 ph 50/60 Hz 120/208/240 V	3 ph 50/60 Hz 208/240/380/480 V	3 ph 50/60 Hz 208/240/380/480 V	3 ph 50/60 Hz 240/415/480 V	3 ph 50/60 Hz 240/415/480 V	3 ph 50/60 Hz 240/415/480 V	3 ph 50/60 Hz 240/415/480 V
2200	2200	4400/5100	4400/5100	8100/9600	12,000	24,000	24,000
0.25 (50)	0.25 (50)	0.40 (80)	0.40 (80)	1.5 (300)	1.5 (300)	4.0 (800)	4.0 (800)
16	18	20	22	24	26	28	30

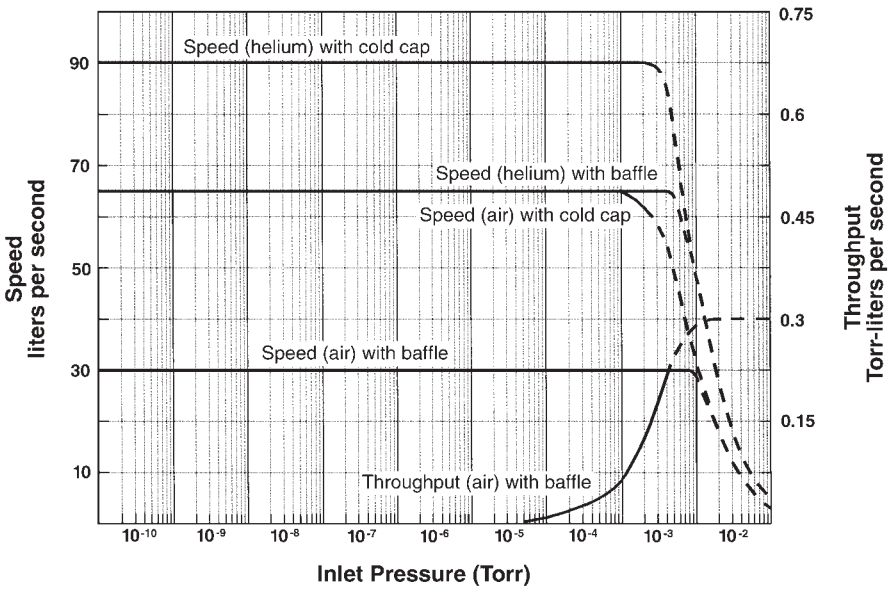
AX-65 Diffusion Pump



Outline Drawing — inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test

Features

- Hi
- Fl
- O
- Compact design
- Full thermal protection
- Pump ready thermal switch
- Finned, vertical boiler
- Three stage fractionating jet with ejector stage

Benefits

- roduces higher, cleaner vacuum levels
- nmediate fluid level indication
-)ptimized performance and fit for your application
- Integration into space limited equipment
- Protects against all overtemperature conditions
- Can be used to send signal when pump is operational
- Promotes stable pumping, especially of light gases
- Purifies fluid, gives higher forepressure tolerance

Technical Specifications

Pumping Speed*, Operating Range
65 *l*/sec Air, 90 *l*/s He and H_2

Maximum Throughput
0.19T-*l*/s (0.25 mbar-*l*/s) in operating range
0.30 torr-*l*/s (0.40 mbar-*l*/s) @ 0.01 torr

Compression Ratio
4 x 10^7 (Air), 2 x 10^6 (helium)

Operating Range
3 x 10^{-3} to <5 x 10^{-8} torr
(3.9 x 10^{-3} to 6.5 x 10^{-8} mbar)

Maximum Forepressure
No load 0.75 torr (1.00 mbar)
Full Load 0.60 torr (0.78 mbar)

Backstreaming Rate*
With cold cap: < 2 x 10^{-4} mg/cm^2/min
With baffle: < 2 x 10^{-5} mg/cm^2/min

Recommended Backing Pump
≥1.5 cfm (2.5 m^3/hr)

Warmup Time
7 minutes

Cooldown Time
10 minutes

Fluid Charge
30 cc

Electrical Requirements
1 ph, 50/60 Hz, 90/115/165/220 VAC

Pump Power
200/250 watts

Air Cooling
30 cfm

* Refer to page 50 for a description of speed and backstreaming tests.

Ordering Information

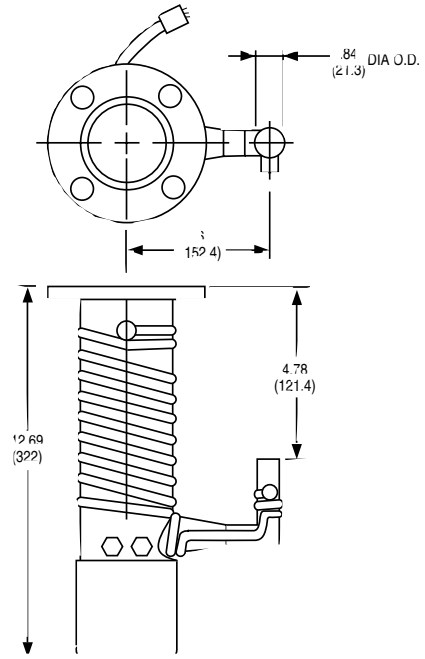
Description	Voltage	Part Number		Weight lbs. (kg)
		Inlet Flange Type		
AX-65 Pump		**KF-50**	**ISO-63K**	
AX-65 with standard cold cap	115 V, 250 W	L9670301	L9707301	8.0 (3.6)
AX-65 with internal baffle	115 V, 250 W	L9670311	L9707311	8.0 (3.6)
AX-65 with standard cold cap	220 V, 250 W	L9670302	L9707302	8.0 (3.6)
AX-65 with internal baffle	220 V, 250 W	L9670312	L9707312	8.0 (3.6)
AX-65 with standard cold cap	115 V, 200 W	L9670303	L9707303	8.0 (3.6)
AX-65 with internal baffle	115 V, 200 W	L9670313	L9707313	8.0 (3.6)
AX-65 with standard cold cap	220 V, 200 W	L9670304	L9707304	8.0 (3.6)
AX-65 with internal baffle	220 V, 200 W	L9670314	L9707314	8.0 (3.6)
AX-65 with standard cold cap	90 V, 250 W	L9670305	L9707305	8.0 (3.6)
AX-65 with internal baffle	90 V, 250 W	L9670315	L9707315	8.0 (3.6)
AX-65 with standard cold cap	165 V, 250 W	L9670306	L9707306	8.0 (3.6)
AX-65 with internal baffle	165 V, 250 W	L9670316	L9707316	8.0 (3.6)

Description	Part Number	Page	Weight lbs. (kg)
Accessories			
Santovac 5 diffusion pump fluid, 40 cc	695405001	33	1.0 (0.5)
Santovac 5 diffusion dump fluid, 65 cc	695405002	33	2.0 (0.9)
DC-704 diffusion pump fluid, 500 cc	695474005	33	3.0 (1.4)
DC-705 diffusion pump fluid, 500 cc	695475005	33	3.0 (1.4)
Internal baffle kit	R1160065		2.0 (0.9)
(	KC50SB		0.5 (0.2)
(	IC063SV		1.0 (0.5)
(	KC16SB		0.5 (0.2)
I	699901062		
R			
2	L9994307		1.0 (0.5)
2	L9994303		1.0 (0.5)
200 W, 220 V heater harness (for use with DC-704 and DC-702)	L9994308		1.0 (0.5)
250 W, 220 V heater harness (for use with DC-705 and Santovac 5)	L9994304		1.0 (0.5)
250 W, 90 V heater harness (for use with DC-705 and Santovac 5)	L9994301		1.0 (0.5)
250 W, 165 V heater harness (for use with DC-705 and Santovac 5)	L9994302		1.0 (0.5)
Overtemperature thermal switch (included with each heater harness)	L9964001		1.0 (0.5)
Pump ready thermal switch (optional)	L9964002		1.0 (0.5)

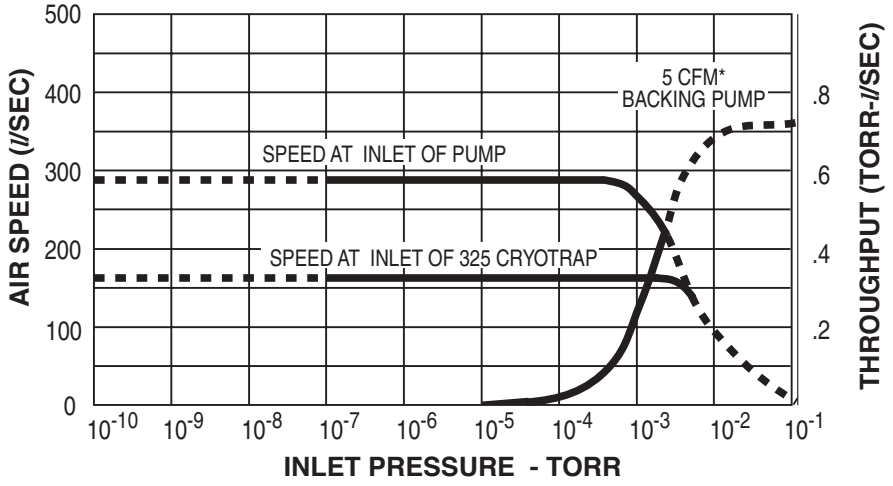
NOTE
- All pumps have NW-16 foreline
- Mounted cooling fan included with each pump (P/N 661300138)
- Overtemperature thermal switch set to open at 365° F (182 °C)
- Use 250W heater with polyphenyl ether fluids (such as DC-705 and Santovac 5). Use 200W heater for other fluids.

HS-2 Diffusion Pump

Outline Drawing inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Fe

- Hi
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- Hi
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- Standard quick cool coil
- Finned baffle increases surface area providing fluid life
- Foreline baffle prevents loss of fluid to backing system

Technical Specifications

Pumping Speed*, Operating Range
285 l/s Air, 340 l/s He and H_2

Maximum Throughput
0.45 T-l/s (0.60 mbar-l/s) in operating range
0.70 T-l/s (0.93 mbar-l/s) @ 0.01 torr

Operating Range
2×10^{-3} to $< 5 \times 10^{-8}$ torr
(2.6×10^{-3} to $< 6.5\ 10^{-8}$ mbar)

Maximum Forepressure
No Load 0.55 torr (0.71 mbar)
Full Load 0.40 torr (0.52 mbar)

Recommended Backing Pump
≥ 5 cfm (8.5 m^3/hr)

Backstreaming Rate*, Standard Cold Cap
$< 1 \times 10^{-3}$ mg/cm^2/min

Warmup Time
15 minutes

Cooldown Time
10 minutes (with quick cool coil)

Fluid Charge
100 cc

Electrical Requirements
1 ph, 50/60 Hz, 120/240 VAC

Pump Power
450 watts

Cooling Water Requirements
0.1 gpm (20 l/hr) at 60-80° F (15-26 °C)

Water Connections
⅛ in. FPT

* Refer to page 50 for a description of speed and backstreaming tests.

Ordering Information

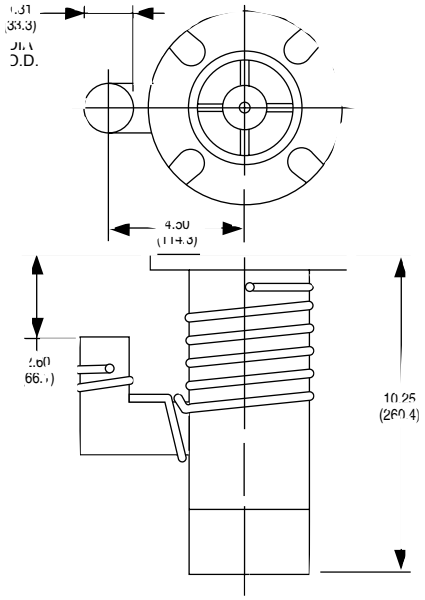
Description	Voltage	Part Number Flange Type ASA		Weight lbs. (kg)
HS-2 Pump				
With standard cold cap	120 V	82906301		20.0 (9.0)
With standard cold cap	240 V	82906302		20.0 (9.0)
Description		**Part Number**	**Page**	**Weight lbs. (kg)**
Accessories				
332 Water-cooled baffle with ASA		F9453302	35	10.0 (4.5)
325 Cryotrap with ASA		86132302	36	15.0 (7.0)
Nominal 2 in. ASA blank mating flanges		ASA06000000N		5.0 (2.3)
2 in. ASA bored mating flanges		ASA06000353N		5.0 (2.3)
Santovac 5 diffusion pump fluid, 500 cc		695405005	33	2.5 (1.1)
DC-702 diffusion pump fluid, 500 cc		695472005	33	3.0 (1.4)
DC-704 diffusion pump fluid, 500 cc		695474005	33	3.0 (1.4)
DC-705 diffusion pump fluid, 500 cc		695475005	33	3.0 (1.4)
Instruction manual		699901150		
Replacement Parts (one heater required per pump)				
450 W, 120 V heater		647302125		1.0 (0.5)
450 W, 240 V heater		647302150		1.0 (0.5)
Heater block (one required per pump)		82920001		21.0(10.0)
Heater platen (one required per pump)		82918301		1.0 (0.5)
[illegible]		K0377159		1.0 (0.5)

N

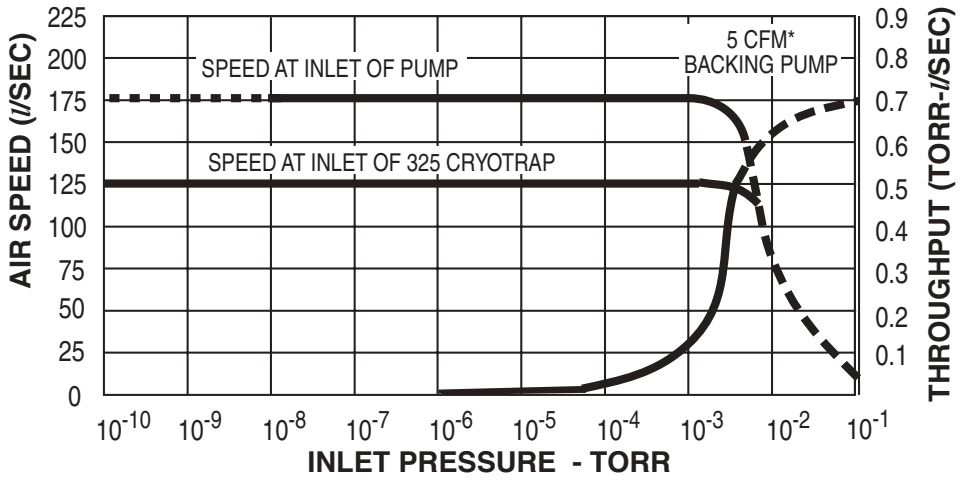
M-2 Diffusion Pump

Outline Drawing

inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Features

- Hi
- Fr
- Hi
- St
- Fu
- Finned boiler increases surface area prolonging fluid life
- Rotatable inlet flange
- Corrosion resistant copper/nickel alloy water lines
- Foreline baffle prevents fluid loss to backing system

Technical Specifications

Pumping Speed*, Operating Range
175 *l*/s Air, 210 *l*/s He and H_2

Maximum Throughput
0.35 T-*l*/s (0.47 mbar-*l*/s) in operating range
0.65 T-*l*/s (0.84 mbar-*l*/s) @ 0.01 torr

Operating Range
2×10^{-3} to $< 5 \times 10^{-8}$ torr
(2.6×10^{-3} to 6.5×10^{-8} mbar)

Maximum Forepressure
No Load 0.55 torr (0.72 mbar)
Full Load 0.40 torr (0.52 mbar)

Backstreaming Rate*, Standard Cold Cap
$< 1 \times 10^{-3}$ mg/cm^2/min

Recommended Backing Pump
≥ 5 cfm (8.5 m^3/hr)

Warmup Time
10 minutes

Cooldown Time
30 minutes

Fluid Charge
100 cc

Electrical Requirements
1 ph, 50/60 Hz, 120/240 VAC

Pump Power
450 watts

Cooling Water Requirements
0.1 gpm (20 *l*/hr) at 60-80° F (15-26 °C)

Water Connections
⅛ in. FPT

* Refer to page 50 for a description of speed and backstreaming tests.

Ordering Information

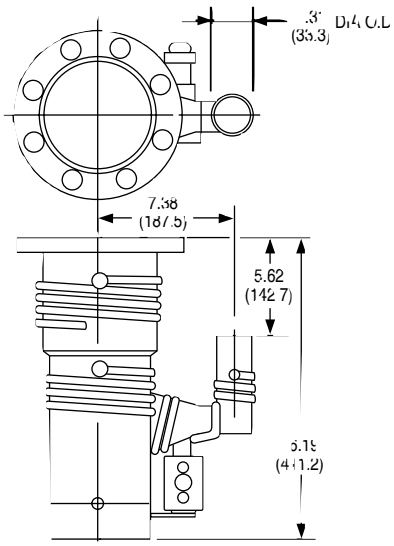
Description	Voltage	Part Number Flange Type ASA	Weight lbs. (kg)
M-2 Pump			
With standard cold cap	120 V	L6298301	15.0 (6.8)
With standard cold cap	240 V	L6298302	15.0 (6.8)

Description	Part Number	Page	Weight lbs. (kg)
Accessories			
332 Water-cooled baffle with ASA flanges	F9453302	35	10.0 (4.5)
325 Cryotrap with ASA flanges	86132302	36	10.0 (4.5)
Nominal 2 in. ASA blank mating flanges	ASA06000000N		5.0 (2.3)
Nominal 2 in. ASA bored mating flanges	ASA06000353N		5.0 (2.3)
Santovac 5 diffusion pump fluid, 500 cc	695405005	33	2.5 (1.1)
DC-702 diffusion pump fluid, 500 cc	695472005	33	3.0 (1.4)
DC-704 diffusion pump fluid, 500 cc	695474005	33	3.0 (1.4)
DC-705 diffusion pump fluid, 500 cc	695475005	33	3.0 (1.4)
Instruction manual	699901070		
Replacement Parts (one heater required per pump)			
450 W, 120V heater	647203120		1.0 (0.5)
450 W, 240V heater	647203240		1.0 (0.5)
Heater clamp (one required per pump)	L6951001		1.0 (0.5)
Replacement o-ring kit, (5 inlet flange o-rings (butyl, 2-238))	K0377159		1.0 (0.5)
W	K4111301		
N			

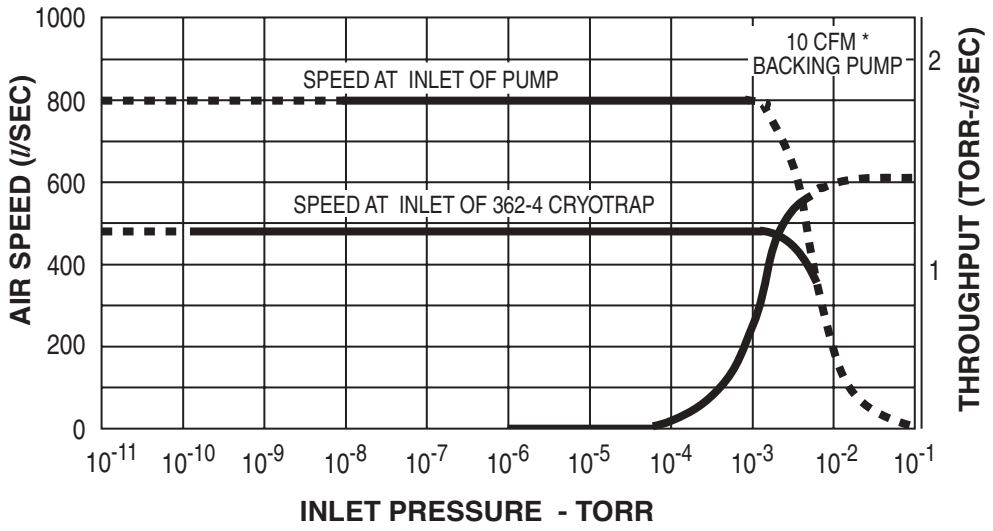
M-4 Diffusion Pump

Outline Drawing

inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Features

- Hi
- Fr
- Fu
- Hi
- St
- Fin
- Foreline baffle prevents fluid loss to backing system

Technical Specifications

Pumping Speed*, Operating Range
800 l/s air, 1,000 l/s He and H_2

Maximum Throughput
0.8 T-l/s (1.1 mbar-l/s) in operating range
1.5 T-l/s (2.0 mbar-l/s) @ 0.01 torr

Operating Range
1 x 10^{-3} to < 5 x 10^{-9} torr
(1.3 x 10^{-3} to < 6.5 x 10^{-9} mbar)

Maximum Forepressure
No Load 0.65 torr (0.86 mbar)
Full Load 0.45 torr (0.59 mbar)

Recommended Backing Pump
≥ 10 cfm (17 m^3/hr)

Backstreaming Rate,* Standard Cold Cap
< 1 x 10^{-4} mg/cm^2/min

Warmup Time
12 minutes

Cooldown Time
20 minutes

Fluid Charge
250 cc

Electrical Requirements
1 ph, 50/60 Hz,120/208/240 VAC

Pump Power
1190 watts

Cooling Water Requirements
0.15 gpm (30 l/hr) at 60-80° F (15-26 °C)

Water Connections
⅛ in. FPT

* Refer to page 50 for a description of speed and backstreaming tests.

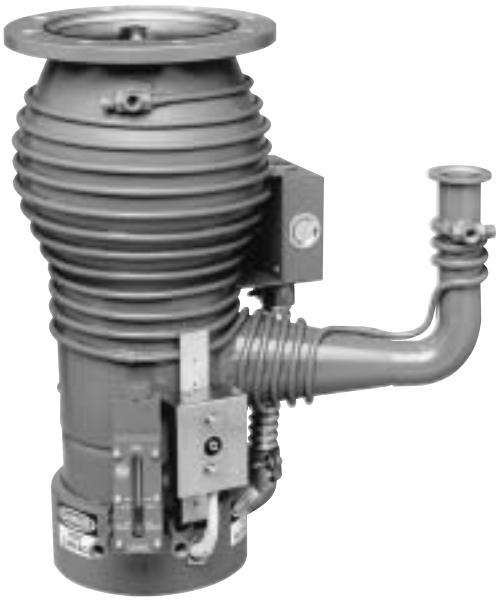
Ordering Information

Description	Voltage	Part Number Flange Type ASA	Weight lbs. (kg)
M-4 Pump			
With standard cold cap	120 V	F8265301	45.0(21.0)
With standard cold cap	208 V	F8265306	45.0(21.0)
With standard cold cap	240 V	F8265302	45.0(21.0)

Description	Part Number	Page	Weight lbs. (kg)
Accessories			
334 Water-cooled baffle with ASA flanges	F8286304	37	10.0 (4.5)
362-4 Cryotrap with ASA flanges	K2653304	38	35.0(16.0)
Nominal 4 in. ASA blank mating flange	ASA09000000N		8.0 (3.6)
Nominal 4 in. ASA bored mating flange	ASA09000553N		6.0 (2.7)
Santovac 5 diffusion pump fluid, 500 cc	695405005	33	2.5 (1.1)
DC-702 diffusion pump fluid, 500 cc	695472005	33	3.0 (1.4)
DC-704 diffusion pump fluid, 500 cc	695474005	33	3.0 (1.4)
DC-705 diffusion pump fluid, 500 cc	695475005	33	3.0 (1.4)
Instruction manual	699901050		
Replacement Parts (one heater required per pump)			
1190 W, 120 V heater	647304100		1.0 (0.5)
1190 W, 208 V heater	647304150		1.0 (0.5)
1190 W, 240 V heater	647304200		1.0 (0.5)
H	86642301		
	642906015		
I	86085001		1.0 (0.5)
I	86084001		1.0 (0.5)
I	86083301		2.0 (1.0)
I	656179100		0.5 (0.2)
I			
(butyl, 2-236)/10 fill and drain O-rings (Viton, 2-111))	K0377187		1.0 (0.5)

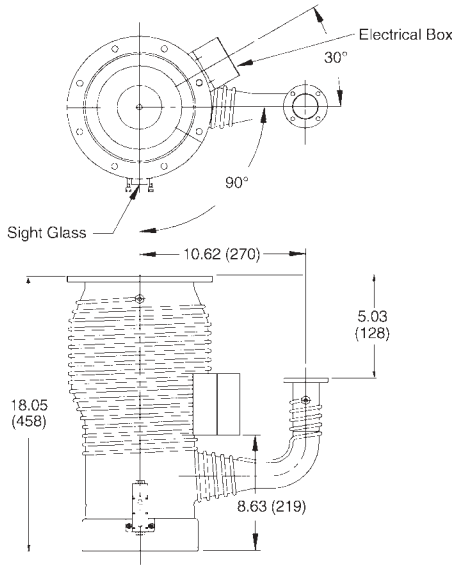
NOTE Inlet flange: nominal 4 in. ASA flange with 9 in. OD
For inline flange 4.31 in. diameter tube

VHS-4 Diffusion Pump

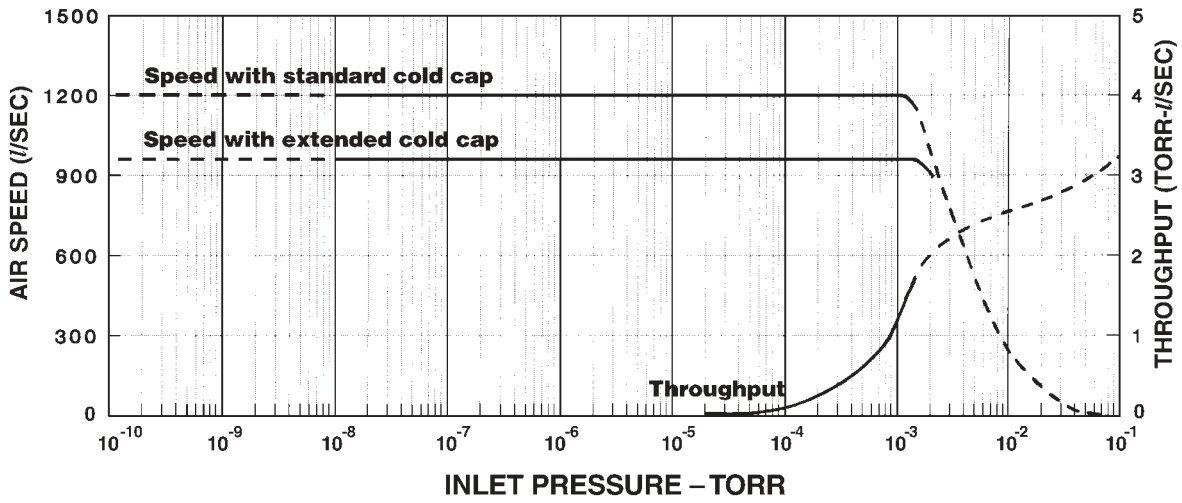


Outline Drawing

inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Features

- Hi
- Si
- Fr
- Hi
- Fu
- All
- Finned boiler increases surface area prolonging fluid life
- Standard quick cool
- Optional extended cold cap increased where cleanliness is desired
- Foreline baffle prevents fluid loss to backing system
- Tee water connections for ease of cleaning cooling coils

Technical Specifications

Pumping Speed*, Operating Range
1,200 l/s air, 1,500 l/s He, 1,600 H_2

Maximum Throughput
1.2 T-l/s (1.6 mbar-l/s) in operating range
2.5 T-l/s (3.2 mbar-l/s) @ 0.01 torr

Operating Range
1 x 10^{-3} to < 5 x 10^{-9} torr
(1.3 x 10^{-3} to < 6.5 x 10^{-9} mbar)

Maximum Forepressure
No Load 0.65 torr (0.86 mbar)
Full Load 0.55 torr (0.73 mbar)

Recommended Backing Pump
≥ 10 cfm (17 m^3/hr)

Backstreaming Rate*, Standard Cold Cap
< 5 x 10^{-4} mg/cm^2/min

Warmup Time
10 minutes

Cooldown Time
10 minutes (with quick cool coil)

Fluid Charge
300 cc

Electrical Requirements
1 ph, 50/60 Hz, 120/208/240 VAC

Pump Power
1450 watts

Cooling Water Requirements
0.15 gpm (30 l/hr) at 60-80° F (15-26 °C)

Water Connections
⅛ in. FPT Tee

* Refer to page 50 for a description of speed and backstreaming tests.

Ordering Information

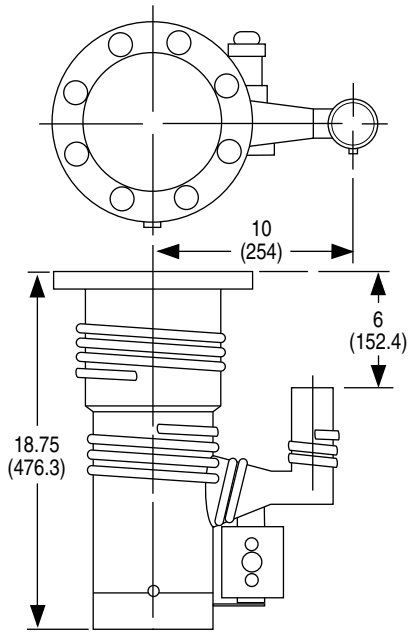
Description	Voltage	Part Number			Weight lbs. (kg)
		Flange Type			
VHS-4 Pump		**ASA**	**ISO**	**ConFlat**	
VHS-4 with standard cold cap	120 V	86460301	L6256301	L6188301	55.0 (25.0)
VHS-4 with extended cold cap	120 V	86460311	L6256311	L6188311	55.0 (25.0)
VHS-4 with standard cold cap	208 V	86460306	L6256306	L6188306	55.0 (25.0)
VHS-4 with extended cold cap	208 V	86460316	L6256316	L6188316	55.0 (25.0)
VHS-4 with standard cold cap	240 V	86460302	L6256302	L6188302	55.0 (25.0)
VHS-4 with extended cold cap	240 V	86460312	L6256312	L6188312	55.0 (25.0)

Accessories	Part Number	Page	Weight lbs. (kg)
334 Water-cooled baffle with ASA flanges	F8286304	37	10.0 (4.5)
334 Water-cooled baffle with ISO flanges	F8286305	37	10.0 (4.5)
334 Water-cooled baffle with ConFlat flanges	F8286306	37	10.0 (4.5)
362-4 Cryotrap with ASA flanges	K2653304	38	35.0 (16.0)
362-4 Cryotrap with ISO flanges	K2653305	38	35.0 (16.0)
362-4 Cryotrap with ConFlat flanges	K2653306	38	35.0 (16.0)
Centering ring for ISO inlet flange, 160K	IC160SV		1.0 (0.5)
Centering ring for ISO foreline flange, KF40	KC40SV		0.5 (0.2)
Santovac 5 diffusion pump fluid, 500 cc	695405005	33	2.5 (1.1)
DC-702 diffusion pump fluid, 500 cc	695472005	33	3.0 (1.4)
DC-704 diffusion pump fluid, 500 cc	695474005	33	3.0 (1.4)
DC-705 diffusion pump fluid, 500 cc	695475005	33	3.0 (1.4)
Instruction manual	699901021		
R			
	647304205		1.0 (0.5)
	647304210		1.0 (0.5)
	647304250		1.0 (0.5)
I	88164301		2.0 (1.0)
I	656179100		0.5 (0.2)
R			
(butyl, 2-258)/10 fill and drain o-rings (Viton, 2-113))	K0377183		1.0 (0.5)
Therma Switch (set at 500° F / 260 °C)	642906025		1.0 (0.5)
Extended cold cap	F6898301	87	1.0 (0.5)
Sight glass repair kit	L8908301		
Basic sight glass cooling kit	R1523301		
Extended sight glass cooling kit	R1208301		

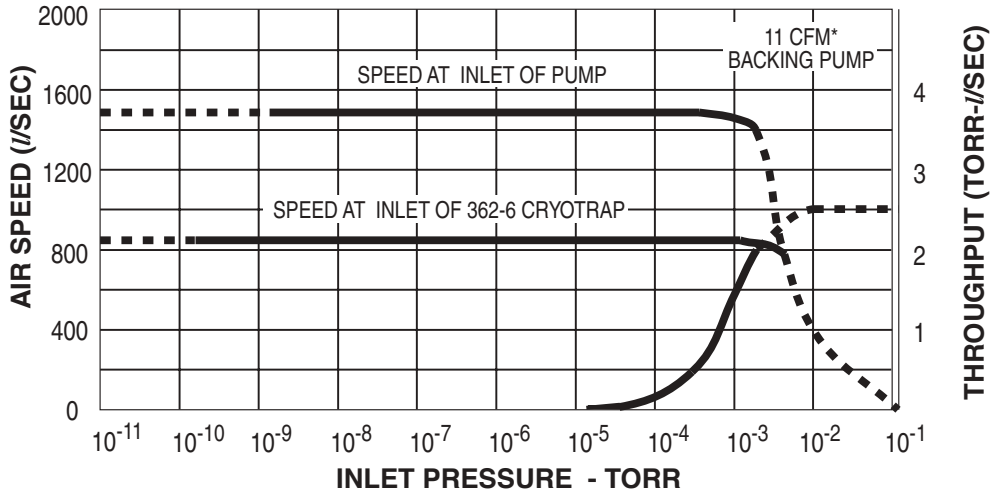
NOTE
- Inlet flange 4 in. ASA , foreline flange KF40
- Inlet flange ISO 160K, foreline flange ISO KF40
- Inlet flange 8 in. CFF, foreline flange 2¾ in. CFF
- Pumps with ISO flanges do not include required centering rings

M-6 Diffusion Pump

Outline Drawing inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Fe

- Hi
- Fr
- Fu
- Hi
- Stainless steel body
- Finned b[illegible] increases surface area, prolonging fluid life
- Foreline baffle prevents fluid loss to backing system

Technical Specifications

Pumping Speed*, Operating Range
1,500 *l*/s Air, 1,800 *l*/s He and H_2

Maximum Throughput
1.5 T-*l*/s (2.0 mbar-*l*/s) in operating range
2.4 T-*l*/s (3.1 mbar-*l*/s) @ 0.01 torr

Operating Range
1 x 10^{-3} to < 5 x 10^{-9} torr
(1.3 x 10^{-3} to < 6.5 x 10^{-9} mbar)

Maximum Forepressure
No Load 0.70 torr (0.91 mbar)
Full Load 0.60 torr (0.78 mbar)

Recommended Backing Pump
≥ 11 cfm (19 m^3/hr)

Backstreaming Rate*, Standard Cold Cap
< 1 x 10^{-4} mg/cm^2/min

Warmup Time
12 minutes

Cooldown Time
20 minutes

Fluid Charge
400 cc

Electrical Requirements
1ph, 50/60 Hz, 120/208/240 VAC

Pump Power
1785 watts @ 120 V/240 V
1500 watts @ 208 V

Cooling Water Requirements
0.2 gpm (40 *l*/hr) at 60-80° F (15-26 °C)

Water Connections
⅛ in. FPT

* Refer to page 50 for a description of speed and backstreaming tests.

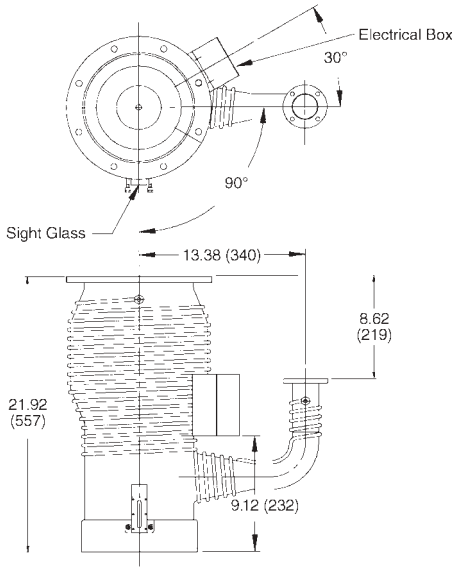
Ordering Information

Description	Voltage	Part Number	Reference Page	Shipping Weight lbs. (kg)
M-6 Pump				
with ASA 6 in. inlet	120 V	F8170301		65.0 (30.0)
with ASA 6 in. inlet	208 V	F8170306		65.0 (30.0)
with ASA 6 in. inlet	240 V	F8170302		65.0 (30.0)
Accessories				
336 Water-cooled baffle with ASA flanges		F8277306	39	15.0 (7.0)
362-6 Cryotrap with ASA flanges		K1531306	40	50.0 (23.0)
Nominal 6 in. ASA blank mating flange		ASA11000000N		10.0 (4.5)
Nominal 6 in. ASA bored mating flange		ASA11000753N		8.0 (3.6)
Santovac 5 diffusion pump fluid, 500 cc		695405005	33	2.5 (1.1)
DC-702 diffusion pump fluid, 500 cc		695472005	33	3.0 (1.4)
DC-704 diffusion pump fluid, 500 cc		695474005	33	3.0 (1.4)
DC-705 diffusion pump fluid, 500 cc		695475005	33	3.0 (1.4)
Instruction manual		699901050		
Replacement Parts (one heater required per pump)				
1785 W, 120 V heater		647306100		1.0 (0.5)
1500 W, 208 V heater		647306150		1.0 (0.5)
1785 W, 240 V heater		647306200		1.0 (0.5)
Heater clamping assembly (includes clamping plate, cover plate insulator)		86643301		
Heater cover plate (one required per pump)		86088001		2.0 (1.0)
		86087001		0.5 (0.2)
		86086301		1.0 (0.5)
		656179100		1.0 (0.5)
		K0377188		1.0 (0.5)
		642906015		1.0 (0.5)

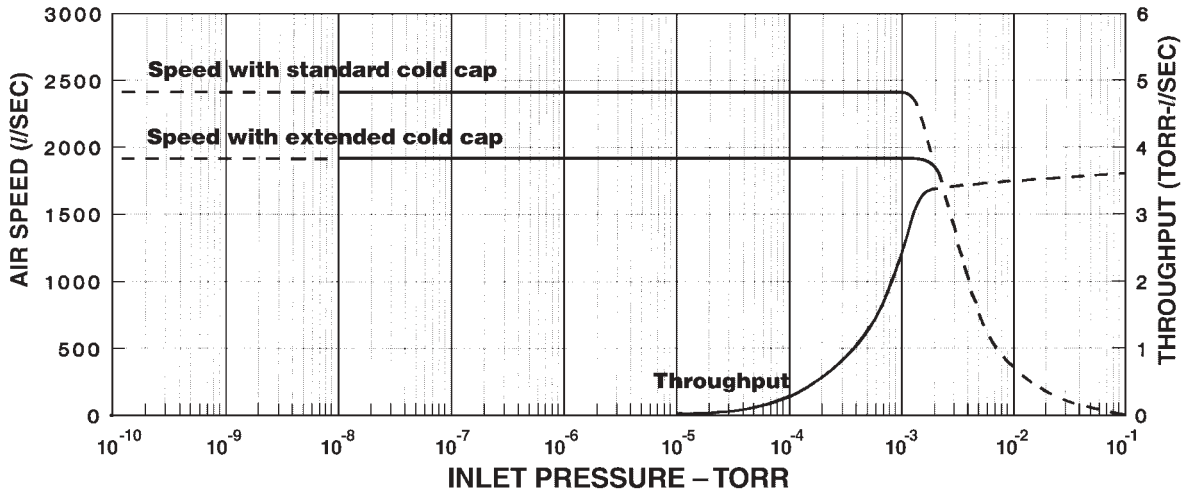
- Foreline flange: 1.31 in. diameter tube

VHS-6 Diffusion Pump

Outline Drawing — inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Features

- Hi
- Si
- Fr
- Hi
- Fu
- All
- Finned boiler increases surface area prolonging fluid life
- Standard quick cool
- Optional extended cold cap where increased cleanliness is desired
- Foreline baffle prevents fluid loss to backing system
- Tee water connections for ease of cleaning cooling coils

Technical Specifications

Pumping Speed*, Operating Range
2,400 l/s Air, 3,000 l/s He, 3,200 H_2
Maximum Throughput
2.4 T-l/s (3.2 mbar-l/s) in operating range
3.5 T-l/s (4.5 mbar-l/s) @ 0.01 torr
Operating Range
1 x 10^{-3} to < 5 x 10^{-9} torr
(1.3 x 10^{-3} to < 6.5 x 10^{-9} mbar)
Maximum Forepressure
No Load 0.65 torr (0.85 mbar)
Full Load 0.55 torr (0.72 mbar)
Recommended Backing Pump
≥ 17 cfm (29 m^3/hr)
Backstreaming Rate,* Standard Cold Cap
< 5 x 10^{-4} mg/cm^2/min

Warmup Time
10 minutes
Cooldown Time
10 minutes (with quick cool coil)
Fluid Charge
500 cc – exact fluid charge available
Electrical Requirements
1 ph, 50/60 Hz, 120/208/240 VAC
Pump Power
2200 watts
Cooling Water Requirements
0.25 gpm (50 l/hr) at 60-80° F (15-26 °C)
Water Connections
⅛ in. FPT Tee

* Refer to page 50 for a description of speed and backstreaming tests.

Ordering Information

Description	Voltage	Part Number			Weight lbs. (kg)
		Flange Type			
VHS-6 Pump		**ASA**	**ISO**	**ConFlat**	
VHS-6 with standard cold cap	120 V	85826301	L6193301	L6200301	75.0 (34.0)
VHS-6 with extended cold cap	120 V	85826311	L6193311	L6200311	75.0 (34.0)
VHS-6 with standard cold cap	208 V	85826306	L6193306	L6200306	75.0 (34.0)
VHS-6 with extended cold cap	208 V	85826316	L6193316	L6200316	75.0 (34.0)
VHS-6 with standard cold cap	240 V	85826302	L6193302	L6200302	75.0 (34.0)
VHS-6 with extended cold cap	240 V	85826312	L6193312	L6200312	75.0 (34.0)

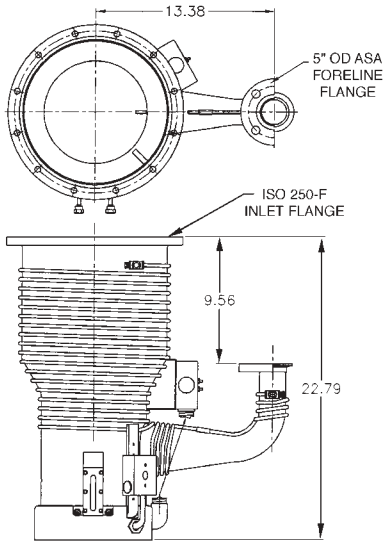
Accessories	Part Number	Page	Weight lbs. (kg)
336 Water-cooled baffle with ASA flanges	F8277306	39	15.0 (7.0)
336 Water-cooled baffle with ISO flanges	F8277307	39	15.0 (7.0)
336 Water-cooled baffle with ConFlat flanges	F8277308	39	15.0 (7.0)
362-6 Cryotrap with ASA flanges	K1531306	40	50.0 (23.0)
362-6 Cryotrap with ISO flanges	K1531307	40	50.0 (23.0)
362-6 Cryotrap with ConFlat flanges	K1531308	40	50.0 (23.0)
Santovac 5 diffusion pump fluid, 500 cc (exact pump charge)	695405005	33	2.5 (1.1)
DC-702 diffusion pump fluid, 500 cc (exact pump charge)	695472005	33	3.0 (1.4)
DC-704 diffusion pump fluid, 500 cc (exact pump charge)	695474005	33	3.0 (1.4)
DC-705 diffusion pump fluid, 500 cc (exact pump charge)	695475005	33	3.0 (1.4)
Centering ring for ISO inlet flange, 200K	IC200SV	33	1.0 (0.5)
Centering ring for ISO foreline flange, KF50	KC50SV	33	0.5 (0.2)
Instruction manual	699901022		
R			
2	647306125		1.0 (0.5)
2	647306175		1.0 (0.5)
2	647306225		1.0 (0.5)
I	86643301		
I	86088001		2.0 (1.0)
I	86087001		0.5 (0.2)
Heater clamping plate (one required per pump)	86086301		1.0 (0.5)
Replacement nickel heater wire	656179100		1.0 (0.5)
Replacement o-ring kit: 3 inlet flange o-rings (butyl, 2-267)/3 foreline flange o-rings (butyl/2-332), 10 fill and drain o-rings (Viton, 2-113)	K0377184		1.0 (0.5)
Thermal switch (set at 300° F – 147 °C)	642906025		1.0 (0.5)
Extended cold cap	F6455001	47	1.0 (0.5)

NOTES
- Inlet flange 6 in. ASA , foreline flange 1.5 in. ASA
- Inlet flange ISO 200K, foreline flange ISO KF50
- Inlet flange 10 in. CFF, foreline flange 3⅜ in. CFF
- Pumps with ISO flanges do not include required centering rings

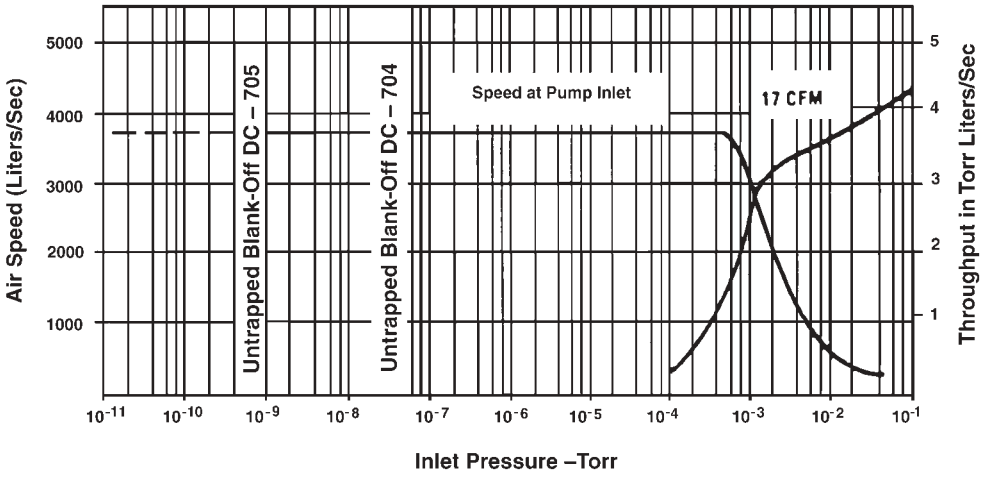
VHS-250 Diffusion Pump

Outline Drawing

inches



Speed Curve



* Refer to page 50 for a description of speed test.

Features

- High
- Si
- Fr
- Hi
- Fu
- All
- Finned boiler increases surface area prolonging fluid life
- Standard quick-cool
- Foreline baffle prevents fluid loss to backing system
- Tee water connections for ease of cleaning cooling coils

Technical Specifications

Pumping Speed*, Operating Range
3,700 l/s Air, 4,600 l/s He, 4,100 l/s H_2

Maximum Throughput
2.6 T-l/s (3.5 mbar-l/s) in operating range
3.5 T-l/s (4.5 mbar l/s) @ 0.01 torr

Operating Range
7×10^{-4} to $< 5 \times 10^{-9}$ torr
(1.3×10^{-3} to $< 6.5 \times 10^{-9}$ mbar)

Maximum Forepressure
No Load 0.65 torr (0.85 mbar)
Full Load 0.55 torr (0.72 mbar)

Recommended Backing Pump
≥17 cfm (29 m^3/hr)

Backstreaming Rate*, Standard Cold Cap
$< 5.0 \times 10^{-4}$ mg/cm^2/min

Warmup Time
10 minutes

Cooldown Time
10 minutes (with quick cool coil)

Fluid Charge
500 cc – exact fluid charge available

Electrical Requirements
1 ph, 50/60 Hz, 120/208/240 VAC

Pump Power
2200 watts

Cooling Water Requirements
0.25 gpm (50 l/hr)

Water Connections
⅛ in. FPT Tee

* Refer to page 50 for a description of speed and backstreaming tests.

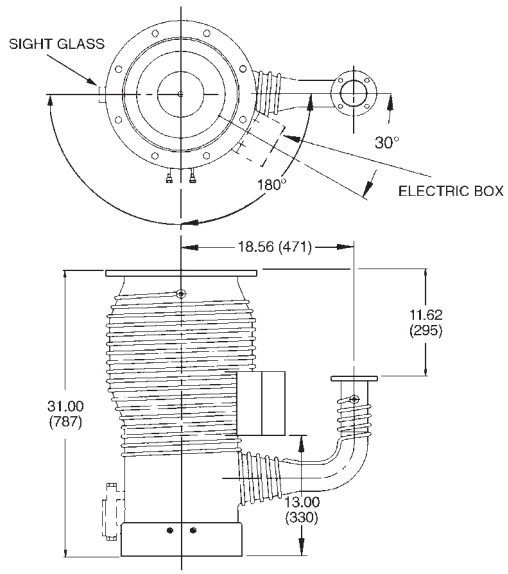
Ordering Information

Description	Voltage	Part Number	Shipping Weight lbs. (kg)
VHS-250 Pump			
VHS-250 with standard cold cap	120V	K0543301	75.0 (34.0)
VHS-250 with standard cold cap	208V	K0543306	75.0 (34.0)
VHS-250 with standard cold cap	240V	K0543302	75.0 (34.0)
Accessories			
Santovac 5 diffusion pump fluid, 500 cc (exact pump charge)		695405005	2.5 (1.1)
DC-702 diffusion pump fluid, 500 cc (exact pump charge)		695472005	3.0 (1.4)
DC-704 diffusion pump fluid, 500 cc (exact pump charge)		695474005	3.0 (1.4)
DC-705 diffusion pump fluid, 500 cc (exact pump charge)		695475005	3.0 (1.4)
Instruction manual		699901020	
Replacement Parts (one heater required per pump)			
2200 W, 120 V heater		647306125	1.0 (0.5)
2200 W, 208 V heater		647306175	1.0 (0.5)
2200 W, 240 V heater		647306225	1.0 (0.5)
Heater cover plate (one required per pump)		86088001	2.0 (1.0)
Heater insulator (one required per pump)		86087001	0.5 (0.2)
Heater clamping plate (one required per pump)		86086301	1.0 (0.5)
Replacement nickel heater wire		656179100	1.0 (0.5)
Replacement o-ring kit: 3 inlet flange o-rings (butyl, 2-379),			
		K0377178	1.0 (0.5)
		642906025	1.0 (0.5)

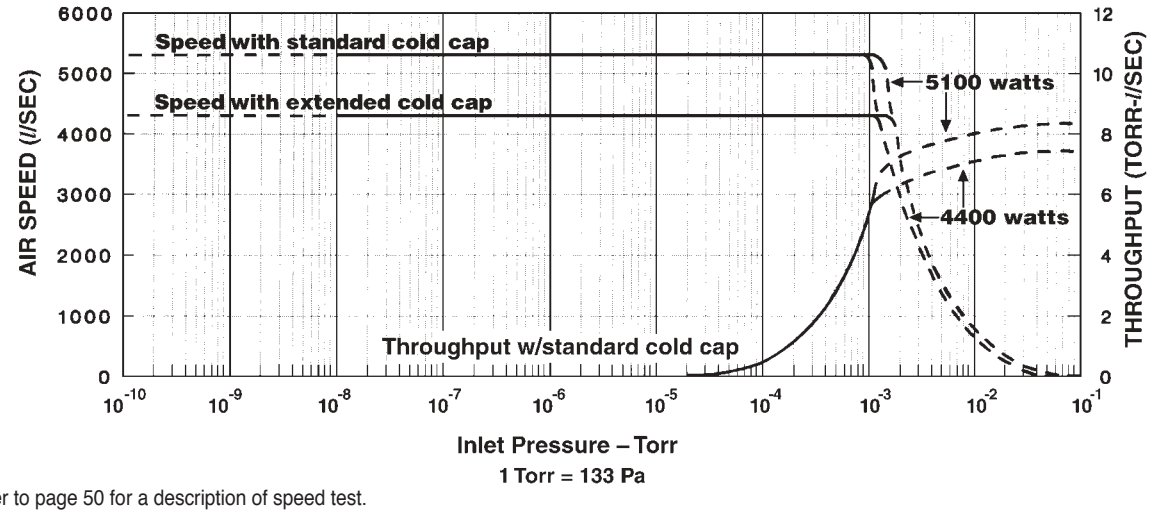
VHS-10 Diffusion Pump

Outline Drawing

inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Features

- High[illegible] pumping speed
- Si[illegible]
- Hi[illegible]
- Fr[illegible]
- Hi[illegible]
- Fu[illegible]
- All [illegible] construction
- Finned boiler increases surface area prolonging fluid life
- Standard quick cool
- Optional extended cold cap where increased cleanliness is desired
- Foreline baffle prevents fluid loss to backing system
- Tee water connections for ease of cleaning cooling coils

Technical Specifications

Pumping Speed*, Operating Range	5,300 l/s Air, 6,600 l/s He, 7,000 H_2
Maximum Throughput	5.3 T-l/s (7.1 mbar l/s) in operating range, 4400 W 6.9 T-l/s (9.2 mbar l/s) in operating range, 5100 W 7.7 T-l/s (10.2 mbar l/s) @ 0.01 torr, 4400 W 8.1 T-l/s (10.8 mbar l/s) @ 0.01 torr, 5100 W
Operating Range	1 x 10^{-3} to < 5 x 10^{-9} torr at 4400 W (1.3 x 10^{-3} to < 6.5 x 10^{-9} mbar)
Maximum Forepressure	No Load 0.65 torr (0.85 mbar) Full Load 0.55 torr (0.72 mbar)
Recommended Backing Pump	≥ 30 cfm (51 m^3/hr)
Backstreaming Rate*, Standard Cold Cap	<5.0 x 10^{-4} mg/cm^2/min
Warmup Time	15 minutes
Cooldown Time	25 minutes
Fluid Charge	1,000 cc
Electrical Requirements	3 ph, 50/60 Hz, 208/240/380/415/480 VAC
Pump Power	4400/5100 watts
Cooling Water Requirements	0.40 gpm (80 l/hr)
Water Connections	⅛ in. FPT Tee

* Refer to page 50 for a description of speed and backstreaming tests.

Ordering Information

Description	Voltage	Part Number			Weight lbs. (kg)
		Flange Type			
VHS-10 Pump		ASA	ISO	ConFlat	
VHS-10 with standard cold cap	208 V	F0426307	L5920307	L6176307	150.0 (68.0)
VHS-10 with extended cold cap	208 V	F0426317	L5920317	L6176317	150.0 (68.0)
VHS-10 with standard cold cap	240 V	F0426308	L5920308	L6176308	150.0 (68.0)
VHS-10 with extended cold cap	240 V	F0426318	L5920318	L6176318	150.0 (68.0)
VHS-10 with standard cold cap	380 V	F0426326	L5920326	L6176326	150.0 (68.0)
VHS-10 with extended cold cap	380 V	F0426336	L5920336	L6176336	150.0 (68.0)
VHS-10 with standard cold cap	480 V	F0426309	L5920309	L6176309	150.0 (68.0)
VHS-10 with extended cold cap	480 V	F0426319	L5920319	L6176319	150.0 (68.0)

NOTE • The VHS-10 can be ordered with 5100 W heaters by increasing the middle number of the 3-digit suffix by two; eg F042632**7**

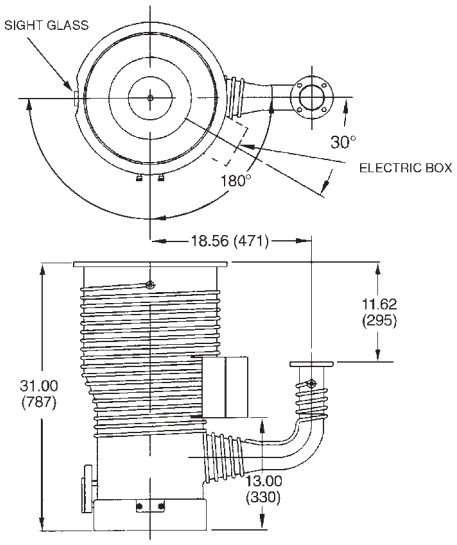
Description	Part Number	Page	Weight lbs. (kg)
Accessories			
330 Water-cooled baffle with ASA flanges	F8600310	41	20.0 (9.0)
330 Water-cooled baffle with ISO flanges	F8600311	41	20.0 (9.0)
330 Water-cooled baffle with ConFlat flanges	F8600312	41	20.0 (9.0)
316-10 Cryotrap with ASA flanges	F0844310	42	90.0 (41.0)
316-10 Cryotrap with ISO flanges	F0844311	42	90.0 (41.0)
316-10 Cryotrap with ConFlat flanges	F0844312	42	90.0 (41.0)
DC-702 diffusion pump fluid, 500 cc (two required)	695472005	33	6.0 (2.8)
DC-704 diffusion pump fluid, 500 cc (two required)	695474005	33	6.0 (2.8)
DC-705 diffusion pump fluid, 500 cc (two required)	695475005	33	6.0 (2.8)
Centering ring for ISO foreline flange, 63K	IC063SV		1.0 (0.5)
Instruction manual	699901023		
Replacement Parts (two heaters required per pump)			
2[illegible]	647310140		1.0 (0.5)
2[illegible]	647310150		1.0 (0.5)
2[illegible]	647310160		1.0 (0.5)
2[illegible]	647310170		1.0 (0.5)
2[illegible]	647310145		1.0 (0.5)
2[illegible]	647310155		1.0 (0.5)
2[illegible]	647310165		1.0 (0.5)
2550 W, 480 V heater	647310175		1.0 (0.5)
Heater crush plate (replace one with each new heater)	K7667001		2.0 (1.0)
Heater clamping plate (one required per pump)	K4928001		1.0 (0.5)
Replacement nickel heater wire	656179100		1.0 (0.5)
Replacement o-ring kit, (1 Inlet flange o-ring, (butyl, F0430001)/1 foreline flange o-ring, (butyl, 2-338)/10 fill and drain o-rings, (Viton, 2-113))	K0377185		1.0 (0.5)
Thermal switch (set at 300° F – 147 °C)	642906025		1.0 (0.5)
Extended cold cap	L8917301	47	2.0 (0.9)

NOTE • Inlet flange 10 in. ASA , foreline flange 2 in. ASA • Inlet flange 16½ in. CFF, foreline flange 4⅝ in. CFF
• Inlet flange ISO 320K, foreline ISO 63K

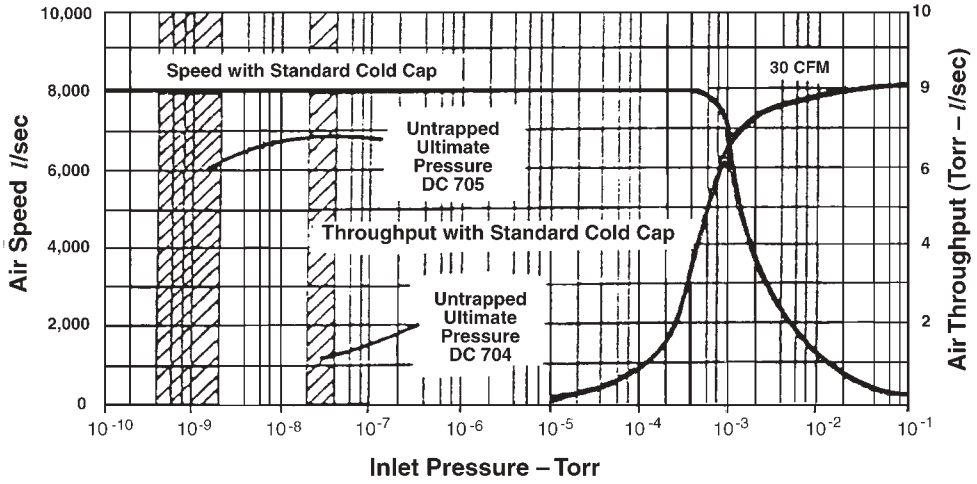
VHS-400 Diffusion Pump

Outline Drawing

inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Features

- High
- Si
- Hi
- Fc
- Hi
- Fu
- Stainless steel construction
- Finned boiler increases surface area prolonging fluid life
- Standard quick cool
- Foreline baffle prevents fluid loss to backing system
- Tee water connections for ease of cleaning cooling coils

Technical Specifications

Pumping Speed*, Operating Range

8,000 *l*/s Air, 10,000 *l*/s He, 9,600 H_2

Maximum Throughput

5.6 T-*l*/s (7.5 mbar *l*/s) in operating range, 4400 W
8 T-*l*/s (10.6 mbar *l*/s) @ 0.01 torr, 4400 W
8.4 T-*l*/s (11.2 mbar *l*/s) @ 0.01 torr, 5100 W

Operating Range

7.5×10^{-4} to $< 5 \times 10^{-9}$ torr, at 4400 W

(1.3×10^{-3} to $< 6.5 \times 10^{-9}$ mbar)

Maximum Forepressure

No Load 0.65 torr (0.85 mbar)
Full Load 0.55 torr (0.72 mbar)

Recommended Backing Pump

≥ 30 cfm (51 m^3/hr)

Backstreaming Rate*, Standard Cold Cap

$<1.0 \times 10^{-3}$ mg/cm^2/min

Warmup Time

15 minutes

Cooldown Time

25 minutes

Fluid Charge

1,000 cc

Electrical Requirements

3 ph, 50/60 Hz, 208/380/480 VAC

Pump Power

4400 watts/5100 watts

Cooling Water Requirements

0.40 gpm (80 *l*/hr)

Water Connections

⅛ in. FPT Tee

* Refer to page 50 for a description of speed and backstreaming tests.

Ordering Information

Description	Voltage	Part Number Flange Type ASA	Part Number Flange Type ISO	Weight lbs. (kg)
VHS-400 Pump				
VHS-400 with standard cold cap	208 V	K4816307	L9767307	180.0(75.0)
VHS-400 with standard cold cap	380 V	K4816326	L9767326	180.0(75.0)
VHS-400 with standard cold cap	480 V	K4816309	L9767309	180.0(75.0)
VHS-400 with standard cold cap	240 V	K4816308	L9767308	180.0(75.0)

NOTE • The VHS-400 can be ordered with 5100 W heaters by increasing the middle number of the 3-digit suffix by two; eg K48163**2**7

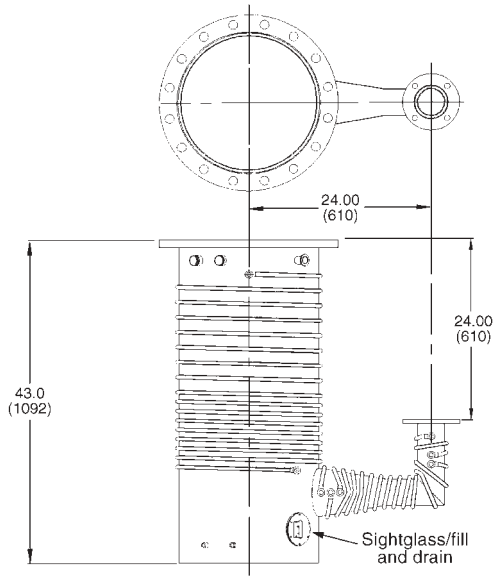
Description	Part Number	Page	Weight lbs. (kg)
Accessories			
DC-702 diffusion pump fluid, 500 cc (two required)	695472005	33	6.0 (2.8)
DC-704 diffusion pump fluid, 500 cc (two required)	695474005	33	6.0 (2.8)
DC-705 diffusion pump fluid, 500 cc (two required)	695475005	33	6.0. (2.8)
Centering ring for ISO Inlet flange, 400K	IC400SV		1.0 (0.5)
Centering ring for ISO foreline flange, 63K	IC063SV		1.0 (0.5)
Instruction manual	699901023		
Replacement Parts (two heaters required per pump)			
2200 W, 208 V heater	647310140		1.0 (0.5)
2200 W, 240 V heater	647310150		1.0 (0.5)
2200 W, 380/415 V heater	647310160		1.0 (0.5)
2	647310170		1.0 (0.5)
2	647310145		1.0 (0.5)
2	647310155		1.0 (0.5)
2	647310165		1.0 (0.5)
2	647310175		1.0 (0.5)
I	K7667001		2.0 (1.0)
H	K4928001		1.0 (0.5)
Replacement nickel heater wire	656179100		1.0 (0.5)
Replacement O-ring kit, 1 inlet flange O-ring (butyl, 2-365), 1 foreline flange o-ring (butyl, 2-338), 10 fill and drain o-rings (Viton, 2-113)	K0377189		1.0 (0.5)
Thermal switch (set at 300° F – 147 °C)	642906025		1.0 (0.5)

NOTE
- Inlet flange ISO 400K, foreline flange ISO 63-K.
- Inlet flange non-standard ASA, foreline flange 2 in. ASA.
- Pumps with ASA flanges include O-Rings for inlet and foreline flanges
- Pumps with ISO flanges do not include centering rings required for inlet and foreline flanges.

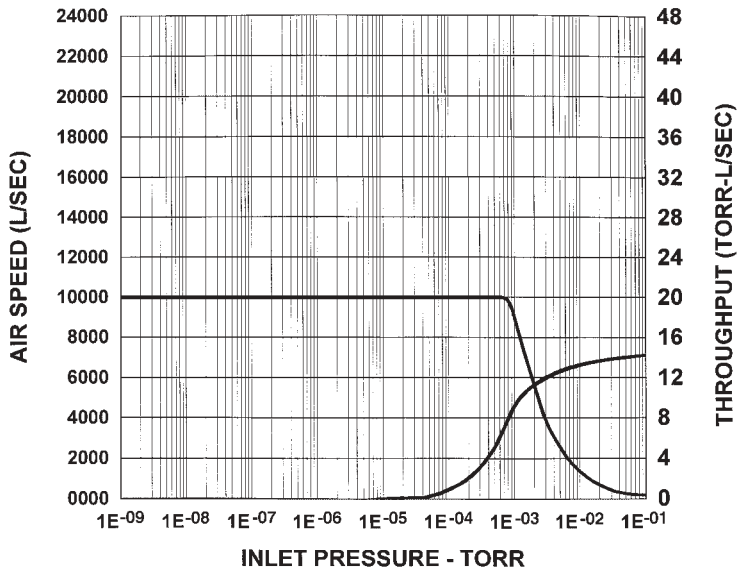
HS-16 Diffusion Pump

Outline Drawing

inches (mm)



Speed Curve



* Refer to page 50 for a description of speed test.

Fe

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- Hi
- Fu
- Sight glass/fill and drain assembly
- Standard gauge port (NW-25 shown). Not flange included
- Foreline baffle prevents loss of fluid to backing pump system
- Optional halo baffle reduces backstreaming without adding height
- Tee water connections for ease of cleaning cooling coils
- Optional quick cool

Technical Specifications

Pumping Speed*, Operating Range	10,000 l/s air, 12,500 l/s He and H_2
Maximum Throughput	8.5 T-l/s (11.0 mbar l/s) in operating range 8,100 W 10.0 T-l/s (13 mbar l/s) in operating range 9,600 W 12.5 T-l/s (16.6 mbar-l/s) @ 0.01 torr, 8,100 W 13.5 T-l/s (18.0 mbar-l/s) @ 0.01 torr, 9,600 W
Operating Range	1 x 10^{-3} to < 5 x 10^{-8} torr at 9,600 W (1.3 x 10^{-3} to < 6.5 x 10^{-8} mbar)
Maximum Forepressure	No Load 0.65 torr (0.85 mbar) Full Load 0.55 torr (0.72 mbar)
Pump Power	8100/9600 watts
Recommended Backing Pump	≥ 80 cfm (136 m^3/hr)
Backstreaming Rate*, Standard Cold Cap	< 1.5 x 10^{-3} mg/cm^2/min
Warmup Time	30 minutes
Cooldown Time	48 minutes (30 minutes with optional quick cool coil)
Fluid Charge	3 quarts (2.8 liters)
Electrical Requirements	3 ph, 50/60 Hz, 240/380/415/480 VAC
Cooling Water Requirements	1.5 gpm (300 l/hr) at 60-80° F (15-26 °C)
Water Connections	¼ in. FPT Tee
Recommended Fluid	DC-704 (see page 33)

* Refer to page 50 for a description of speed and backstreaming tests. Refer to page 46 for pump performance with halo baffle.

Ordering Information

Description	Voltage	Part Number		Weight lbs. (kg)
		Flange Type		
HS-16 Pump		**ASA**	**ISO**	
HS-16 with standard cold cap	240 V	79292308	L5921308	500.0(227.0)
HS-16 with halo baffle	240 V	79292318	L5921318	500.0(227.0)
HS-16 with standard cold cap	380/415 V	79292326	L5921326	500.0(227.0)
HS-16 with halo baffle	380/415 V	79292336	L5921336	500.0(227.0)
HS-16 with standard cold cap	480 V	79292309	L5921309	500.0(227.0)
HS-16 with halo baffle	480 V	79292319	L5921319	500.0(227.0)

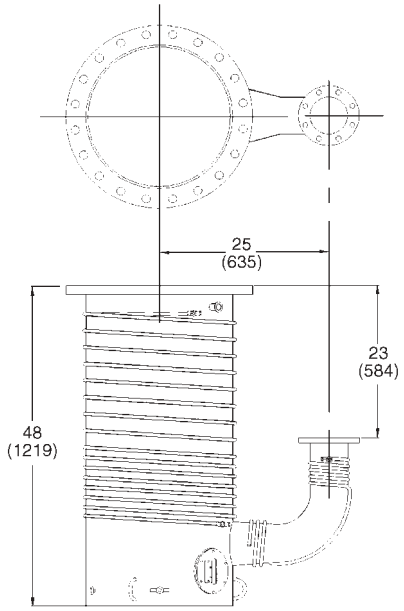
NOTE
- The HS-16 can be ordered with 9600 W heaters by increasing the middle number of the 3-digit suffix by two; eg 7929232**8**
- Maximum throughput @ 0.01 Torr approximately 10 T-l/s at 84% power (380 V)

Accessories	Part Number	Page	Weight lbs. (kg)
Water-cooled halo baffle	K0143316	46	20.0 (9.0)
Water-cooled baffle with ASA flanges	R1152301	45	180.0(80.0)
Water-cooled baffle with ISO flanges	R1153301	45	130.0(60.0)
315-16 Cryotrap	F7514316	43	120.0(55.0)
Quick cool coil – must be installed in the factory, can not ship separately	L6167301		
Centering ring for ISO inlet flange, 500K	IC500SV		1.0 (0.5)
Centering ring for ISO foreline flange, 100K	IC100SV		1.0 (0.5)
Instruction manual	699901140		
Replacement Parts (three heaters required per pump)			
2700 W, 240 V/380 V/415 V with leads	647316020		1.0 (0.5)
2700 W, 480 V with leads	647316030		1.0 (0.5)
2700 W, 240 V/380 V/415 V no leads – used on pumps built before May 1990	647316035		1.0 (0.5)
2700 W, 480 V no leads – used on pumps built before May 1990	647316045		1.0 (0.5)
[illegible]	647316023		1.0 (0.5)
[illegible]	647316033		1.0 (0.5)
[illegible]	K4919001		1.0 (0.5)
[illegible]	79309001		1.0 (0.5)
[illegible]	K4917001		8.0 (4.0)
[illegible]	K0377164		1.0 (0.5)
Upper thermal switch (set at 185° F/85 °C)	K9050001		1.0 (0.5)
Lower thermal switch (set at 300 F/149 C)	K9050002		1.0 (0.5)
Heater Retrofit Kit (for pumps built before May 1990)			
HS-16, 240	L6526308		25.0(11.35)
HS-16, 380/415	L6526326		25.0(11.35)
HS-16, 480	L6526309		25.0(11.35)

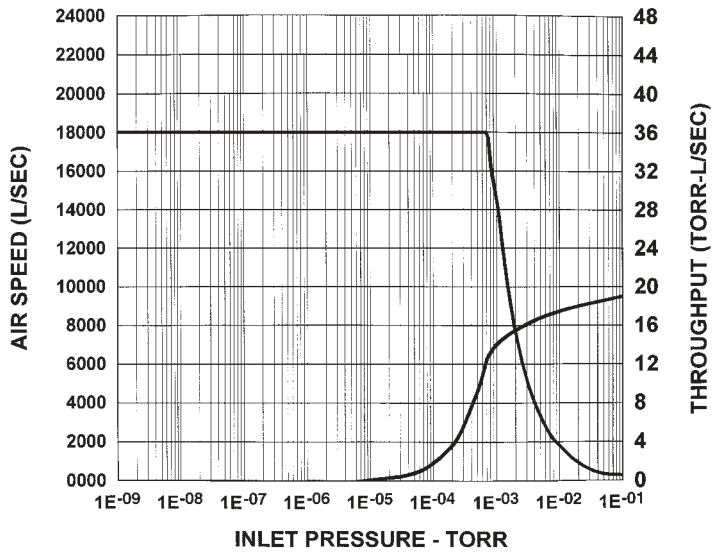
NOTE
- Inlet flange 16 in. ASA, foreline flange 3 in. ASA
- Inlet flange ISO 500K, foreline flange ISO 100K
- Not recommended for use with Santovac 5
- Pumps with ASA flanges include o-rings for inlet and foreline flanges
- Pumps with ISO flanges do not include centering rings required for foreline and inlet flanges

HS-20 Diffusion Pump

Outline Drawing inches (mm)



Speed Curve



Fe

- Fi
  ba
- Hi
- Full thermal protection
- Sight glass fill and drain assembly
- Standard gauge port (NW-25) below inlet flange included
- Foreline baffle prevents loss of fluid to backing pump system
- Optional halo baffle reduces backstreaming without adding height
- Tee water connections for ease of cleaning cooling coils
- Optional quick cool

Technical Specifications

Pumping Speed*, Operating Range	17,500 l/s air, 22,000 l/s He and H_2
Maximum Throughput	14 T-l/s (19.0 mbar l/s) in operating range 18 T-l/s (23 mbar-l/s) @ 0.01 torr
Operating Range	8 x 10^{-4} to 5 x 10^{-8} torr (1 x 10^{-3} to 6.5 x 10^{-8} mbar)
Maximum Forepressure	No Load 0.65 torr (0.85 mbar) Full Load 0.55 torr (0.72 mbar)
Recommended Backing Pump	≥ 100 cfm (170 m^3/hr)
Backstreaming Rate*, Standard Cold Cap	< 1.5 x 10^{-3} mg/cm^2/min
Warmup Time	45 minutes
Cooldown Time	85 minutes
Fluid Charge	5 quarts (4.7 liters)
Electrical Requirements	3 ph, 50/60 Hz, 240/380/415/480 VAC
Pump Power	12,000 watts
Cooling Water Requirements	1.5 gpm (300 l/hr) at 60-80° F (15-26 °C)
Water Connections	¼ in. FPT Tee
Recommended Fluid	DC-704 (see page 33)

* Refer to page 50 for a description of speed and backstreaming tests. Refer to page 46 for pump performance with halo baffle.

Ordering Information

Description	Voltage	Part Number		Weight lbs. (kg)
		Flange Type		
HS-20 Pump		ASA	ISO	
HS-20 with standard cold cap	240 V	84341308	L5922308	580.0(264.0)
HS-20 with halo baffle	240 V	84341318	L5922318	580.0(264.0)
HS-20 with standard cold cap	380 V/415 V	84341326	L5922326	580.0(264.0)
HS-20 with halo baffle	380 V/415 V	84341336	L5922336	580.0(264.0)
HS-20 with standard cold cap	480 V	84341309	L5922309	580.0(264.0)
HS-20 with halo baffle	480 V	84341319	L5922319	580.0(264.0)

NOTE • Maximum throughput @ 0.01 Torr approximately 14 T-l/s at 84% power (380 V)

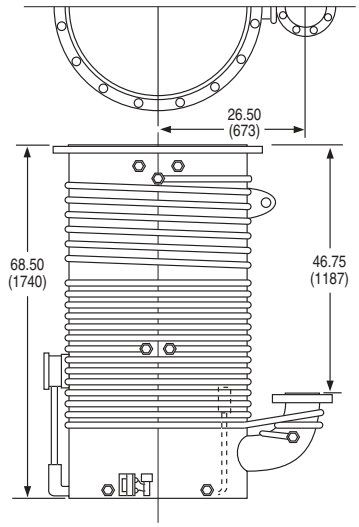
Accessories	Part Number	Page	Weight lbs. (kg)
Water-cooled halo baffle	K1855320	46	25.0 (11.0)
Water-cooled baffle with ASA flanges	R1154301	45	215.0 (100.0)
Water-cooled baffle with ISO flanges	R1155301	45	160.0 (70.0)
315-20 Cryotrap	87866320	44	130.0 (59.0)
Quick cool coil – must be installed in the factory, can not ship separately	84884001		
Centering ring for ISO foreline flange, 160K	IC160SV		1.0 (0.5)
Instruction manual	699901140		
Replacement Parts (six heaters required per pump)			
Heater, 2000 W, 240 V/380 V/415 V with leads	647320020		1.0 (0.5)
Heater, 2000 W, 480 V with leads	647320030		1.0 (0.5)
Heater, 2000 W, 240 V/380 V/415 V no leads – used on pumps built before May 1990	647320060		1.0 (0.5)
Heater, 2000 W, 480 V no leads – used on pumps built before May 1990	647320070		1.0 (0.5)
Heater crush plate (replace one with each new heater)	K7108001		1.0 (0.5)
Heater clamping plate (six required per pump)	K7107001		8.0 (4.0)
Heater insulator (one required per pump)	L6514001		1.0 (0.5)
[illegible]	K0377165		1.0 (0.5)
[illegible]	K9050001		1.0 (0.5)
[illegible]	K9050002		1.0 (0.5)
H[illegible]	L6392308		30.0 (13.62)
H[illegible]	L6392326		30.0 (13.62)
HS-20, 480	L6392309		30.0 (13.62)

NOTE • Inlet flange 20 in. ASA, foreline flange 8 in. ASA • ASA version pumps include o-rings for both inlet to foreline flanges.
• Inlet flange ISO 630K, foreline flange ISO 160K • Centering rings for ISO version pumps must be ordered separately.
• Not recommended for use with Santovac 5

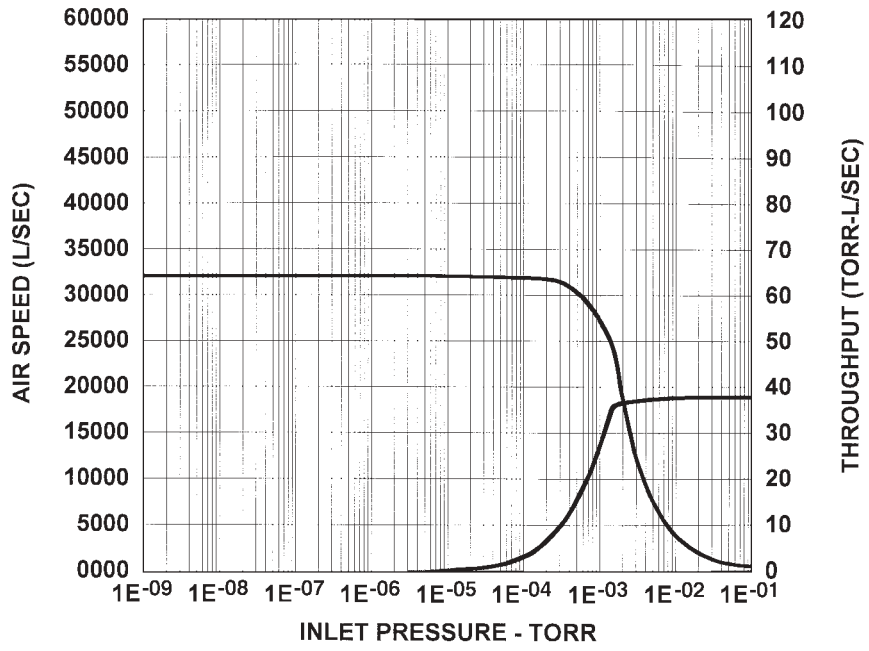
Please note that this item is controlled for export by the Nuclear Suppliers Group. Accordingly, you may be required to obtain an export license from the U.S. Department of Commerce prior to exporting this diffusion pump from the United States. Please consult the U.S. Export Administration Regulations, ECCN 2B2341, for further guidance.

HS-32 Diffusion Pump

Outline Drawing inches (mm)



Speed Curve



Fe

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- Optional halo baffle cold cap reduces backstreaming without adding a[illegible]
- Standard gauge port (NW-25) below inlet flange included
- Tee water connections for ease of cleaning cooling coils
- Optional quick cool

Technical Specifications

Pumping Speed*, Operating Range	32,000 *l*/s Air, 40,000 *l*/s He and H_2
Maximum Throughput	23 T-*l*/s (31 mbar *l*/s) in operating range 35 T-*l*/s (45 mbar-*l*/s) @ 0.01 torr
Operating Range	8×10^{-4} to $< 5 \times 10^{-8}$ torr (1×10^{-3} to $< 6.5 \times 10^{-8}$ mbar)
Maximum Forepressure	No Load 0.50 torr (0.65 mbar) Full Load 0.35 torr (0.45 mbar)
Recommended Backing Pump	≥ 300 cfm (510 m^3/hr)
Backstreaming Rate*, Standard Cold Cap	$< 7 \times 10^{-4}$ mg/ cm^2/min
Warmup Time	60 minutes
Cooldown Time	180 minutes
Fluid Charge	3 U.S. gallons (11.3 liters)
Electrical Requirements	3 ph, 50/60 Hz, 240/380/415/480 VAC
Pump Power	24,000 watts
Cooling Water Requirements	4 gpm (800 *l*/hr) at 60-80° F (15-26 °C)
Water Connections	⅜ in. FPT Tee
Recommended Fluid	DC-704 (see page 33)

* Refer to page 50 for a description of speed and backstreaming tests. Refer to page 46 for pump performance with halo baffle.

Ordering Information

Description	Voltage	Part Number Flange Type ASA	ISO	Weight lbs. (kg)
HS-32 Pump				
HS-32 with standard cold cap	240 V	76134308	L5923308	1,550.0 (705.0)
HS-32 with halo baffle	240 V	76134318	L5923318	1,565.0 (711.0)
HS-32 with standard cold cap	380 V/415 V	76134326	L5923326	1,550.0 (705.0)
HS-32 with halo baffle	380 V/415 V	76134336	L5923336	1,565.0 (711.0)
HS-32 with standard cold cap	480 V	76134309	L5923309	1,550.0 (705.0)
HS-32 with halo baffle	480 V	76134319	L5923319	1,565.0 (711.0)

NOTE • Maximum throughput @ 0.01 Torr approximately 31 T-*l*/s at 84% power (380 V)

Accessories	Part Number	Page	Weight lbs. (kg)
Water-cooled halo baffle	K1856332	46	35.0 (16.0)
Water-cooled baffle with ASA flanges	R1156301	45	350.0 (160.0)
Water-cooled baffle with ISO flanges	R1157301	45	300.0 (135.0)
Quick cool coil – must be installed in the factory, can not ship separately	K6175001		
Centering ring for ISO foreline flange, 200K	IC200SV		1.0 (0.5)
Instruction manual	699901140		
Replacement Parts (six heaters required per pump)			
Heater, 4000 W, 240 V/380 V/480 V with leads	647332010		1.0 (0.5)
Heater, 4000 W, 240 V/380 V/480 V no leads – used on pumps built before May 1990	647332075		1.0 (0.5)
Heater, 4000 W, 200 V	647335020		1.0 (0.5)
Heater, 4000 W, 400 V	L6383010		1.0 (0.5)
Heater, 4000 W, 440 V	L6383011		1.0 (0.5)
Heater, 4000 W, 240 V/380 V/480 V no leads – used on pumps built before May 1990	647332075		1.0 (0.5)
Heater crush plate (replace one with each new heater)	K7246001		1.0 (0.5)
H	75792001		1.0 (0.5)
I	K7247001		8.0 (4.0)
I	01)/		
	3) K0377167		1.0 (0.5)
I	78536002		1.0 (0.5)
I	K9050004		1.0 (0.5)
H			
H	L6517308		40.0 (18.16)
HS-32, 380/415	L6517326		40.0 (18.16)
HS-32, 480	L6517309		40.0 (18.16)

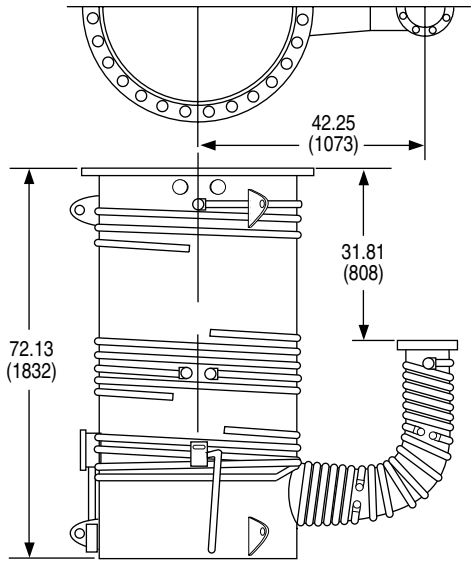
NOTE
- Inlet flange 32 in. ASA, foreline flange 6 in. ASA
- Inlet flange ISO 800F (bolted), foreline flange ISO 200K (clamped)
- Not recommended for use with Santovac 5
- ASA pump versions include o-rings for both inlet and foreline flanges
- ISO pump versions include inlet flange o-ring, but does not include foreline flange centering ring

Please note that this item is controlled for export by the Nuclear Suppliers Group. Accordingly, you may be required to obtain an export license from the U.S. Department of Commerce prior to exporting this diffusion pump from the United States. Please consult the U.S. Export Administration Regulations, ECCN 2B2341, for further guidance.

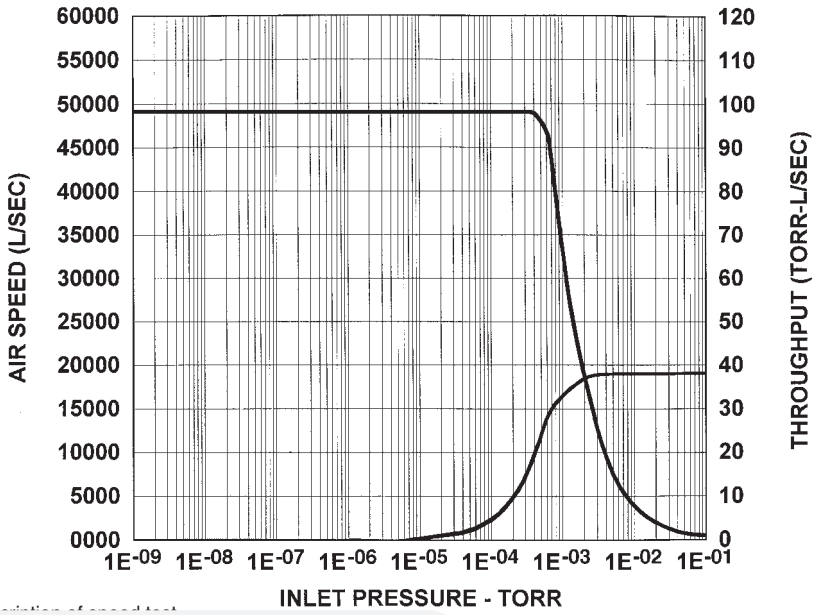
NHS-35 Diffusion Pump

Outline Drawing

inches (mm)



Speed Curve



Fe

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- Sight glass/fill and drain assembly
- Foreline baffle prevents loss of fluid to backing pump system
- Optional halo baffle cold cap reduces backstreaming without adding height
- Tee water connections for ease of cleaning cooling coils
- Standard gauge port (NW-25) below inlet flange included
- Optional quick cool

Technical Specifications

Pumping Speed*, Operating Range
50,000 *l*/s air, 62,500 *l*/s He and H_2

Maximum Throughput
25 T-*l*/s (33 mbar *l*/s) in operating range
35 T-*l*/s (45 mbar-*l*/s) @ 0.01 torr

Operating Range
5 x 10^{-4} to < 5 x 10^{-8} torr
(6.5 x 10^{-4} < 6.5 x 10^{-8} mbar)

Maximum Forepressure
No Load 0.55 torr (0.71 mbar) Full Load 0.40 torr (0.52 mbar)

Recommended Backing Pump
≥ 300 cfm (510 m^3/hr)

Backstreaming Rate*, Standard Cold Cap
<5 x 10^{-4} mg/cm^2/min

Warmup Time
60 minutes

Cooldown Time
180 minutes

Fluid Charge
3 U.S. gallons (11.3 liters)

Electrical Requirements
3 ph, 50/60 Hz, 240/380/415/480 VAC

Pump Power
24,000 watts

Cooling Water Requirements
4 gpm (800 *l*/hr) at 60-80° F (15-26 °C)

Recommended Fluid
DC-704 (see page 33)

* Refer to page 50 for a description of speed and backstreaming tests. Refer to page 46 for pump performance with halo baffle.

Ordering Information

Description	Voltage	Part Number		Weight lbs. (kg)
		Flange Type		
NHS-35 Pump		**ASA**	**ISO**	
NHS-35 with standard cold cap	240 V	F1730308	L5924308	2,000.0 (909.0)
NHS-35 with halo baffle	240 V	F1730318	L5924318	2,045.0 (930.0)
NHS-35 with standard cold cap	380/415 V	F1730326	L5924326	2,000.0 (909.0)
NHS-35 with halo baffle	380/415 V	F1730336	L5924336	2,045.0 (930.0)
NHS-35 with standard cold cap	480 V	F1730309	L5924309	2,000.0 (909.0)
NHS-35 with halo baffle	480 V	F1730319	L5924319	2,045.0 (930.0)

NOTE • Maximum throughput @ 0.01 Torr approximately 31 T-*l*/s at 84% power (380 V)

Accessories	Part Number	Page	Weight lbs. (kg)
Water-cooled halo baffle	K1857335	46	45.0 (20.0)
Water-cooled baffle with ASA flanges	R1158301	45	495.0 (225.0)
Water-cooled baffle with ISO flanges	R1159301	45	375.0 (170.0)
Quick cool coil – must be installed in the factory, can not ship separately	F1739001		
Centering ring for ISO foreline flange, 200K	IC200SV		1.0 (0.5)
O-ring, ISO Inlet flange	78536002		1.0 (0.5)
Instruction manual	699901140		
Replacement Parts (six heaters required per pump)			
Heater 4000 W, 240 V/380 V/480 V with leads	647335010		1.0 (0.5)
Heater 4000 W, 240 V/380 V/480 V no leads – used on pumps built before May 1990	647235248		1.0 (0.5)
Heat shield (reusable)	L6370001		1.0 (0.5)
Heater clamping plate (six required per pump)	F1749001		8.0 (4.0)
H	F4536001		1.0 (0.5)
I	001)/		
	K0377169		1.0 (0.5)
S	F6097301		3.0 (1.5)
I	K9050005		1.0 (0.5)
I	K9050006		1.0 (0.5)
H			
N	L6391308		40.0 (18.16)
NHS-35 380/415	L6391326		40.0 (18.16)
NHS-35 4(0	L6391309		40.0 (18.16)

NOTE
- Inlet flange 35 in. ASA, foreline flange 6 in. ASA
- Inlet flange ISO 1000F (bolted), foreline flange ISO 200K (clamped)
- Not recommended for use with Santovac 5
- ASA pump versions include o-rings for both inlet and foreline flanges
- ISO pump versions include inlet flange o-ring, but does not include foreline flange centering ring

Please note that this item is controlled for export by the Nuclear Suppliers Group. Accordingly, you may be required to obtain an export license from the U.S. Department of Commerce prior to exporting this diffusion pump from the United States. Please consult the U.S. Export Administration Regulations, ECCN 2B2341, for further guidance.

Diffusion Pump Fluids

Varian offers a wide range of diffusion pump fluid types and containers sizes. We have just the right fluid type and container size to meet the requirements of your particular application. Varian now offers exact pump charges for many of our diffusion pumps, including the VHS-6, VHS-10, HS-16, HS-20, HS-32, and NHS-35. Exact pump charges enables you to purchase just enough fluid to fill your diffusion pump, thus eliminating costly waste. This eliminates problems associated with the disposal of diffusion pump fluid and eliminates the guess work associated with filling the pump.

	NEOVAC SY	DC-702	DC-704	DC-705	SANTOVAC 5*
Chemical description	Synthetic Hydrocarbon	Silicone	Single-Component Silicone	High-Purity Silicone	Mixed 5-Ring Polyphenyl Ether
Chemical composition	Mono-N Alkyldiphenylether	Mixed Phenylmethyldimethyl Cyclosiloxane	Tetramethyltetra-phenyltrisiloxane	Penta phenyltri-methyltrisiloxane	Mixed 5-Ring Polyphenyl Ether
Ultimate pressure Untrapped (torr) Trapped (torr)	 Low 10^{-8} Range 1 x 10^{-11} Range	 10^{-6} –	 10^{-7} to 10^{-8} range to 10^{-11} range	 10^{-9} to 10^{-10} range 10^{-11} range	 10^{-10} –
Vapor pressure at 25 °C (torr)	1 x 10^{-8}	1 x 10^{-6}	2 x 10^{-8}	3 x 10^{-10}	1 x 10^{-9} at 20 °C
Viscosity (cst) at 25 °C	25 at 40 °C	45	39	175	2400
Average molecular weight	405	–	484	546	446
Boiling temperature (°C) at 0.5 torr	220 at 0.8 torr	180	215	245	275
Flash point	230	193	221	243	288
Ultimate pressure	Very Good	Fair	Very Good	Excellent	Excellent
Thermal stability	Good	Excellent	Excellent	Excellent	Very Good
Oxidation resistance	Good	Excellent	Excellent	Excellent	Very Good
System cleanliness	Very Good	Good	Very Good	Very Good	Excellent
NOTE • Santovac 5 is the only recommended fluid for leak detectors					

NEOVAC SY is a high quality, low cost synthetic organic compound (alkyldiphenylether) that performs as well as DC-704. With its low vapor pressure, it will achieve base pressures in the low 10^{-8} torr range untrapped and will not produce inorganic deposits which can cause electrostatic charge buildup on electrodes of sensitive instruments.

Dow Corning DC-702 is an all-purpose silicone fluid that is capable of achieving pressures of 10^{-7} torr range. With lower boiling points than DC 704 and DC 705, it gives higher throughput for a given power.

Dow Corning DC-704 is a single component silicone fluid that will a
its lo
istic

Dow Corning DC-705 is a high-purity, single component silicone fluid designed for ultrahigh vacuum applications. It can achieve pressures in the low 10^{-10} torr range untrapped. The vapor pressure and backstreaming rate of this fluid is so low that the use of traps and baffles is often unnecessary.

Santovac 5 is a five-ring polyphenylether for use in ultrahigh vacuum applications. With ultra low vapor pressure and backstreaming rates, this fluid is very clean and often eliminates the need for traps and baffles. Ultimate pressures in the 10^{-10} torr range can be achieved and will not produce inorganic deposits which can cause electrostatic charge buildup on electrodes of sensitive instruments.

Ordering Information

Description	Diffusion Pump Exact Charge	Part Number	Shipping Weight lbs. (kg)
NEOVAC SY			
1 liter/1,000 cc	VHS-10, VHS-400	K6948301	3.0 (1.4)
1 U.S. gallon (3.8 liters)		K6948305	10.6 (4.8)
5 U.S. gallons (18.9 liters)		K6948315	53.0 (23.9)
Dow Corning DC-702			
500 cc	VHS-6, VHS-250	695472005	3.0 (1.4)
1 U.S. gallon (3.8 liters)		695472008	12.0 (5.4)
5 U.S. gallons (18.9 liters)		695472015	51.0 (23.0)
Dow Corning DC-704			
500 cc	VHS-6, VHS-250	695474005	3.0 (1.4)
1 U.S. gallon (3.8 liters)		695474008	12.0 (5.4)
6.2 U.S. gallons (23.5 liters)		695474015	51.0 (23.0)
Dow Corning DC-705			
500 cc	VHS-6, VHS-250	695475005	3.0 (1.4)
1 U.S. gallon (3.8 liters)		695475008	12.0 (5.4)
Santovac 5			
40 cc		695405001	1.0 (0.5)
65 cc		695405002	2.0 (0.9)
500 cc	VHS-6, VHS-250	695405005	2.5 (1.1)

Baffles and Traps

362-6 Cryotrap

Varian **Low-Profile Water-Cooled Baffles** combine 100% optical density with high conductance and unusually low overall height. They are especially useful in applications where clean operation down to 10^{-8} torr is required but cryogenic traps are not. With M-series pumps, these traps retain approximately 50% of the pumping speed. Mechanical refrigeration can be used to reduce the re-evaporation of pump fluid and attain a partial trapping effect.

The liquid nitrogen **Cryotraps** provide optimum performance for diffusion pumps. These traps offer optical density intercepting 100% of primary backstreaming while giving additional pumping speed for condensables. Each trap has a large built-in reservoir that gives long, unattended service. Cryogenic temperatures are maintained even as liquid nitrogen level drops. High conductance internal geometry achieves the highest possible pumping speed at the inlet, taking full advantage of the diffusion pump's speed.

Varian's **Halo Baffles** are used instead of a standard cold cap and are therefore integral to the pump, adding no height to the pump. They reduce primary backstreaming by approximately 90% while cutting the pump speed by less than 80%, about half that of opaque chevron baffles. Pumps can be ordered with halo baffles installed or can be retrofitted in the field.

Extended Cold Caps are used in place of the standard cold caps in the VHS-series diffusion pumps. They reduce primary back-streaming to levels that cannot be measured by the American Vacuum Society standard collection methods. They can be ordered installed in a new pump or can be retrofitted in the field.

The chart below shows the speed of Varian diffusion pumps when using the appropriate baffle or trap.

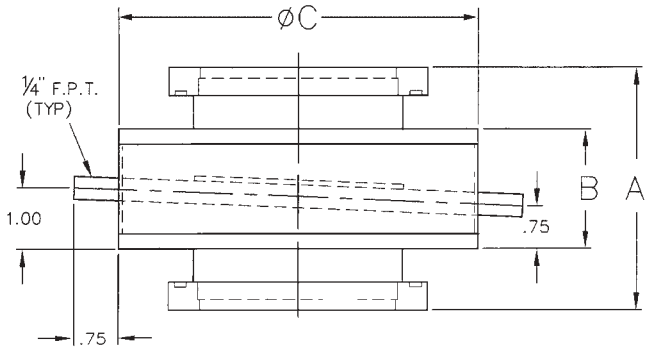
Retained Pumping Speed Air Speed l/s

Diffusion Pump	With Extended Cold Cap	With Halo Baffle	With Water Baffle	With Cryotrap
M-2			110	125
HS-2			145	175
M-4			420	470
VHS-4	950		570	500
M-6			750	850
VHS-6	1,900		920	1,100
VHS-10	4,400		2,150	2,400
HS-16		8,300		4,500
HS-20		13,000		8,000
		25,600		
		40,000		

332 Water-Cooled Baffle

For Varian's M-2, HS-2, V and PVMS-31A Diffusion Pumps

Outline Drawing — inches



PART NO.	FLANGE		FLG. O.D.	FLG. B.C.	HOLE SIZE	"A"	"B"	"C"
F9453-302	INLET	2" ASA	ø6.00"	ø4.75"	4 X ø.68	N/A	2.00"	6.00"
	OUTLET	2" ASA	ø6.00"	ø4.75"	4 X ø.68			
F9453-303	INLET	ISO-80K	ø4.33"	N/A	N/A	4.06"	2.00"	6.00"
	OUTLET	ISO-80K	ø4.33"	N/A	N/A			
F9453-304	INLET	6" CFF	ø6.00"	ø5.128"	16 X ø.332	5.06"	2.00"	6.00"
	OUTLET	6" CFF	ø6.00"	ø5.128"	16 X 5/16"-24 TAP			

Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Retains 60% of M-2 pump speed
- Adds only 2 inches to system

Technical Specifications

Nominal Conductance	300 *l*/s (air)
Recommended Flow	0.1 to 0.2 gpm (20-40 *l*/hr)

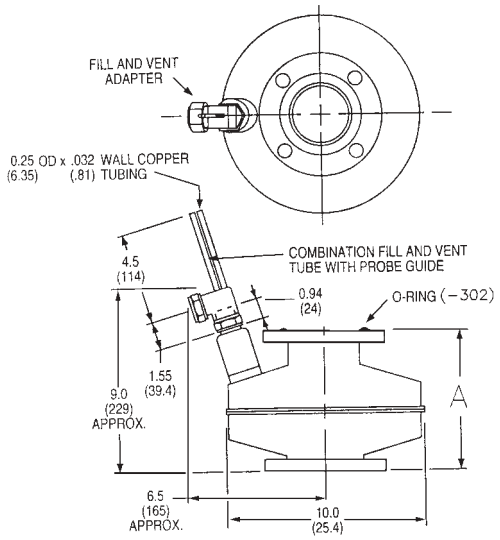
Ordering Information

Description	Part Number	Shipping Weight lbs. (kg)
332 Water-cooled baffle – ASA	F9453302	10.0 (4.5)
332 Water-cooled baffle – ISO	F9453303	10.0 (4.5)
332 Water-cooled baffle – CFF	F9453304	10.0 (4.5)

325 Cryotrap

For Varian's M-2, HS-2, and PVMS-31A Diffusion Pumps

Outline Drawing — inches (mm)



PART NO.	FLANGE		FLG. O.D.	FLG. B.C.	HOLE SIZE	"A"
86132-302	INLET	2" ASA	ø6.00"	ø4.75"	4 X ø.75	7.00"
	OUTLET	2" ASA	ø6.00"	ø4.75"	4 X 5/8"-11 TAP	
86132-303	INLET	ISO-80K	ø4.33"	N/A	N/A	7.13"
	OUTLET	ISO-80F	ø5.71"	ø4.92	8 X M8 TAP	
86132-304	INLET	6" CFF	ø6.00"	ø5.128"	16 X ø.332	7.56"
	OUTLET	6" CFF	ø6.00"	ø5.128"	16 X 5/16"-24 TAP	

Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Additional pumping of condensables
- Retains 60% of pump speed

Technical Specifications

Nominal Conductance	460 l/s air 1,000 l/s helium 1,500 l/s hydrogen
Pumping Speed	675 l/s water vapor
Initial LN2 Charge	3.5 liters
Reservoir Capacity	1.5 liters
Holding Time	7.5 hours
Body Construction	Stainless steel

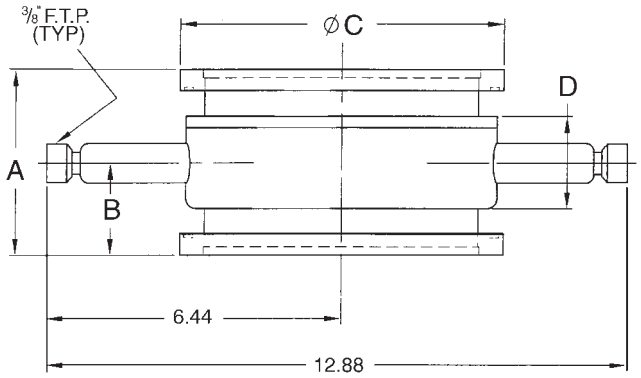
Ordering Information

Description	Part	Shipping Weight lbs. (kg)
325		15.0 (7.0)
325		15.0 (7.0)
325		15.0 (7.0)
Fill a		
Inst		

334 Water-Cooled Baffle

For Varian's M-4 and VHS-4 Diffusion Pumps

Outline Drawing — inches



PART NO.	FLANGE		FLG. O.D.	FLG. B.C.	HOLE SIZE	"A"	"B"	"C"	"D"
F8286-304	INLET	ASA	ø6.81"	N/A	N/A	N/A	1.00"	6.81"	2.00"
	OUTLET	ASA	ø6.81"	N/A	N/A				
F8286-305	INLET	ISO-160K	ø7.09"	N/A	N/A	4.09"	2.03"	7.09"	2.00"
	OUTLET	ISO-160K	ø7.09"	N/A	N/A				
F8286-306	INLET	8" CFF	ø8.00"	ø7.128"	20 X ø.332	5.29"	2.63"	8.00"	2.00"
	OUTLET	8" CFF	ø8.00"	ø7.128"	20 X 5/16"-24 TAP				

Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Retains 50% of M-4 pump speed
- Adds only 2 inches to system

Technical Specifications

Nominal Conductance	900 *l*/s (air)
Recommended Flow	0.1 to 0.2 gpm (20-40 *l*/hr)

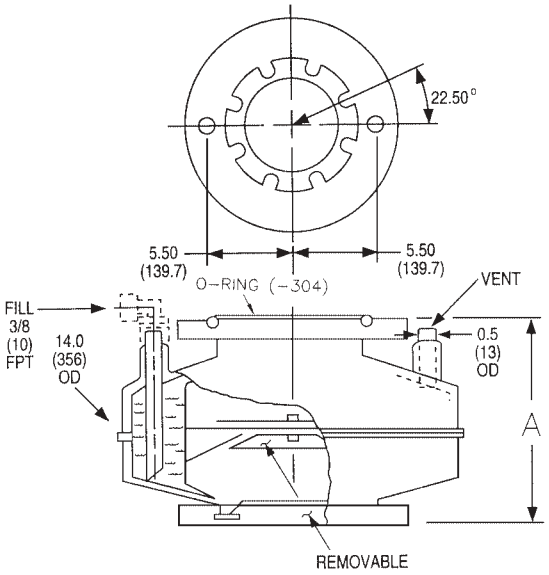
Ordering Information

Description	Part Number	Shipping Weight lbs. (kg)
334 Water-Cooled Baffle – ASA	F8286304	10.0 (4.5)
334 Water-Cooled Baffle – ISO	F8286305	10.0 (4.5)
334 Water-Cooled Baffle – CFF	F8286306	10.0 (4.5)

362-4 Cryotrap

For Varian's M-4 and VHS-4 Diffusion Pumps

Outline Drawing inches (mm)



PART NO.	FLANGE		FLG. O.D.	FLG. B.C.	HOLE SIZE	"A"
K2653-304	INLET	ASA	ø9.00"	7.50"	8 X ø.75	8.10"
	OUTLET	ASA	ø9.00"	7.50"	8 X 5/8"-11 TAP	
K2653-305	INLET	ISO-160K	ø7.09"	N/A	N/A	8.31"
	OUTLET	ISO-160F	ø8.86"	ø7.87	8 X M10 TAP	
K2653-306	INLET	8" CFF	ø8.00"	ø7.128"	20 X ø.332	8.63"
	OUTLET	8" CFF	ø8.00"	ø7.128"	20 X 5/16"-24 TAP	

Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Additional pumping of condensables
- Retains 50% of M-4 pump speed
- Integral ambient baffle included

Technical Specifications

Nominal Conductance	1,100 *l*/s air 2,900 *l*/s helium 4,000 *l*/s hydrogen
Water Vapor Pumping Speed	2,000 *l*/s
Initial LN2 Charge	7 liters
Reservoir Capacity	4.7 liters
Holding Time	17 hours
Body Construction	Stainless steel

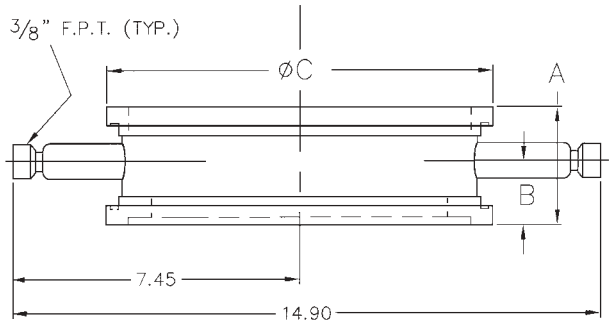
Ord

Des	Shipping Weight lbs. (kg)
362	35.0 (16.0)
362	35.0 (16.0)
362	35.0 (16.0)
Fill a	

336 Water-Cooled Baffle

For Varian's M-6 and VHS-6 Diffusion Pumps

Outline Drawing — inches



PART NO.	FLANGE		FLG. O.D.	FLG. B.C.	HOLE SIZE	"A"	"B"	"C"
F8277-306	INLET	ASA	ø8.69"	N/A	N/A	2.00"	1.00"	8.69"
	OUTLET	ASA	ø8.69"	N/A	N/A			
F8277-307	INLET	ISO-200K	ø9.45"	N/A	N/A	2.90"	1.58"	9.45"
	OUTLET	ISO-200K	ø9.45"	N/A	N/A			
F8277-308	INLET	10" CFF	ø10.00"	ø9.128"	24 X ø.332	5.42"	2.71"	10.00"
	OUTLET	10" CFF	ø10.00"	ø9.128"	24 X 5/16"-24 TAP			

Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Retains 50% of M-6 pump speed
- Adds only 2 inches to system

Technical Specifications

Nominal Conductance 1,500 *l*/s (air)

Recommended Flow 0.1 to 0.2 gpm (20-40 *l*/hr)

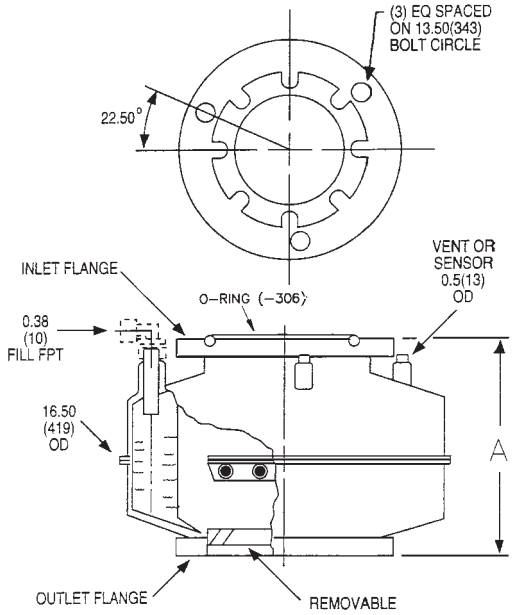
Ordering Information

Description	Part Number	Shipping Weight lbs. (kg)
336 Water-cooled baffle – ASA	F8277306	15.0 (7.0)
336 Water-cooled baffle – ISO	F8277307	15.0 (7.0)
336 Water-cooled baffle – CFF	F8277308	15.0 (7.0)

362-6 Cryotrap

For Varian's M-6 and VHS-6 Diffusion Pumps

Outline Drawing inches (mm)



PART NO.	FLANGE		FLG. O.D.	FLG. B.C.	HOLE SIZE	"A"
K1531-306	INLET	ASA	ø11.00	ø9.50	8 X ø.81	10.09"
	OUTLET	ASA	ø11.00	ø9.50	8 X 3/4"-10 TAP	
K1531-307	INLET	ISO-200K	ø9.45"	N/A	N/A	10.25"
	OUTLET	ISO-200F	ø11.22"	ø10.24"	12 X M10 TAP	
K1531-308	INLET	10" CFF	ø10.00"	ø9.128"	24 X ø.332	10.56"
	OUTLET	10" CFF	ø10.00"	ø9.128"	24 X 5/16"-24 TAP	

Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Additional pumping of condensables
- Retains 50% of M-6 pump speed
- Integral ambient baffle included

Technical Specifications

Nominal Conductance	2,000 l/s air 5,300 l/s helium 7,400 l/s hydrogen
Pumping Speed	3,800 l/s water vapor
Initial LN2 Charge	10 liters
Reservoir Capacity	8.4 liters
Holding Time	17 hours
Body Construction	Stainless steel

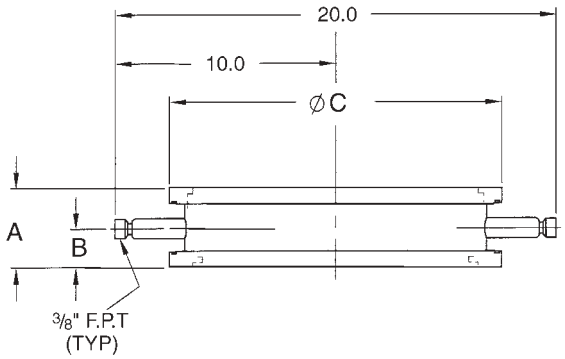
Ord

Des		Shipping Weight lbs. (kg)
362		50.0 (23.0)
362		50.0 (23.0)
362		50.0 (23.0)
Fill and vent assembly	86364301	

330 Water-cooled Baffle

For Varian's VHS-10 Diffusion Pump

Outline Drawing — inches



PART NO.	FLANGE		FLG. O.D.	FLG. B.C.	HOLE SIZE	"A"	"B"	"C"
F8600-310	INLET	ASA	ø13.25"	N/A	N/A	2.87"	1.37"	13.25"
	OUTLET	ASA	ø13.25"	N/A	N/A			
F8600-311	INLET	ISO-320K	ø14.57"	N/A	N/A	3.47"	1.69"	14.57"
	OUTLET	ISO-320K	ø14.57"	N/A	N/A			
F8600-312	INLET	16.50" CFF	ø16.50"	ø15.310"	36 X ø.390	4.24"	2.12"	16.50"
	OUTLET	16.50" CFF	ø16.50"	ø15.310"	36 X 3/8"-24 TAP			

Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Retains 50% of pump speed
- Adds only 2 inches to system

Technical Specifications

Nominal Conductance	3,550 *l*/s (air)
Recommended Flow	0.1 to 0.2 gpm (20-40 *l*/hr)

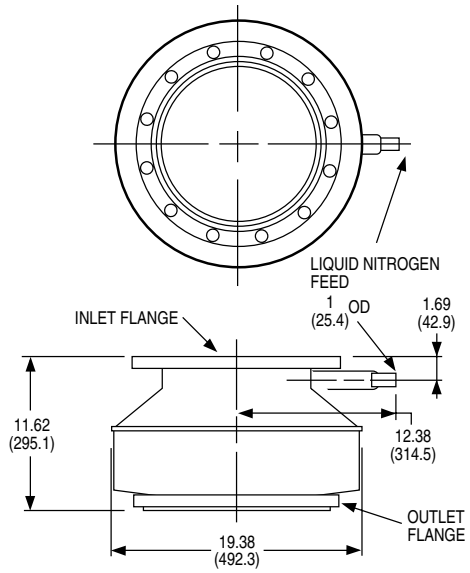
Ordering Information

Description	Part Number	Shipping Weight lbs. (kg)
Low-profile 330 Water-cooled baffle – ASA	F8600310	20.0 (9.0)
Low-profile 330 Water-cooled baffle – ISO	F8600311	20.0 (9.0)
Low-profile 330 Water-cooled baffle – CFF	F8600312	20.0 (9.0)

316-10 Cryotrap

For Varian's VHS-10 Diffusion Pump

Outline Drawing inches (mm)



Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Additional pumping of condensables
- Retains 50% of VHS-10 pump speed

Technical Specifications

Nominal Conductance	4,200 *l*/s air 11,000 *l*/s helium 15,540 *l*/s hydrogen
Pumping Speed	10,000 *l*/s water vapor
Initial LN2 Charge	9 liters
Reservoir Capacity	5.4 liters
Holding Time	6 hours
Body Construction	Stainless steel

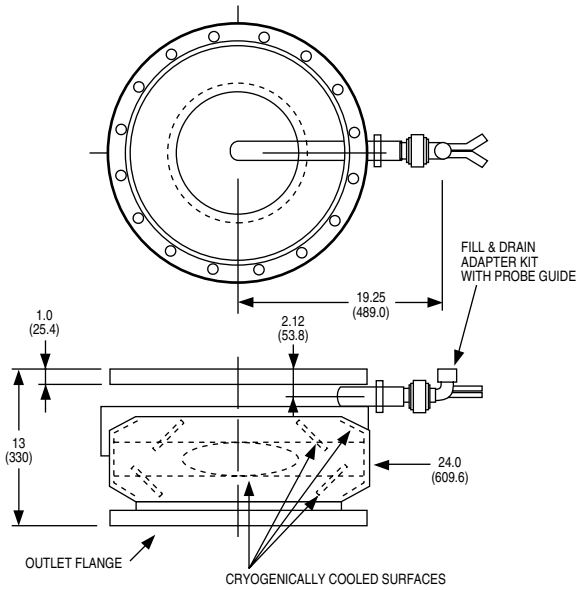
Ordering Information

Description	Part Number	Shipping Weight lbs. (kg)
316-10 Cryotrap – ASA	F0844310	90.0 (41.0)
316-10 Cryotrap – ISO	F0844311	90.0 (41.0)
316-10 Cryotrap – CFF	F0844312	90.0 (41.0)

315-16 Cryotrap

For Varian's HS-16 Diffusion Pumps

Outline Drawing — inches (mm)



Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Additional pumping of condensables
- Retains 45% of pump speed

Technical Specifications

Nominal Conductance	8,000 *l*/s air 21,000 *l*/s helium 29,000 *l*/s hydrogen
Pumping Speed	23,500 *l*/s water vapor
Initial LN2 Charge	11 liters
Reservoir Capacity	5 liters
Holding Time	3 hours
Body Construction	Stainless steel

Flange Dimensions — mm (inches)

Description	Flange	OD	ID	Thickness	Bolt Circle	Qty. Holes	Hole Size	O-Ring Groove ID	O-Ring Groove Width
Inlet	ASA	23.5 (596.9)	18.25 (463.6)	0.88 (22.4)	21.25 (539.8)	16	1.12 (28.4)	18.69 (474.7)	0.275 (6.9)
Outlet	ASA	23.5 (596.9)	18.25 (463.6)	0.88 (22.4)	21.25 (539.8)	16	1.12 (28.4)	–	–

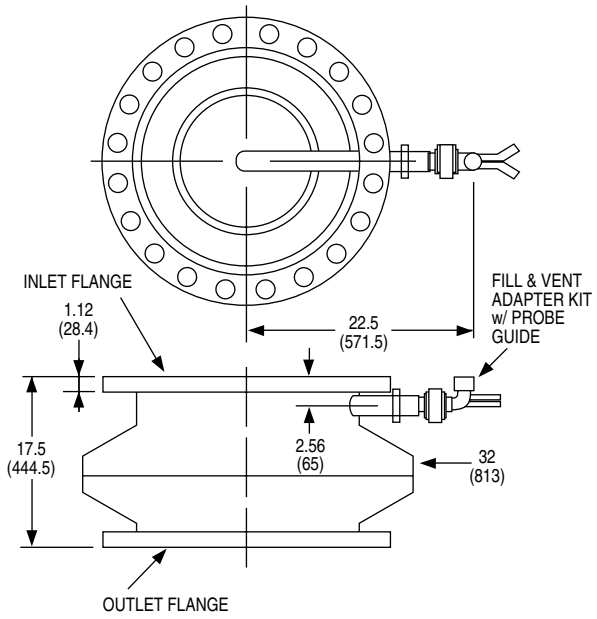
Ordering Information

	Shipping Weight lbs. (kg)
	120 (55.0)

315-20 Cryotrap

For Varian's HS-20 Diffusion Pumps

Outline Drawing inches (mm)



Features

- Optically dense
- Intercepts 100% of primary backstreaming
- Additional pumping of condensables
- Retains 45% of pump speed

Technical Specifications

Conductance	12,000 l/s air 32,000 l/s helium 44,400 l/s hydrogen
Pumping Speed	31,000 l/s water vapor
Initial LN_2 Charge	17 liters
Reservoir Capacity	10 liters
Holding Time	3 hours
Body Construction	Stainless steel

Flange Dimensions mm (inches)

Description	Flange	OD	ID	Thickness	Bolt Circle	Qty. Holes	Hole Size	O-Ring Groove ID	O-Ring Groove Width
Inlet	ASA	27.5 (698.5)	21.25 (539.8)	1.12 (28.4)	25 (635)	20	1.25 (31.8)	21.625	0.47
Outlet	ASA	27.5 (698.5)	21.25 (539.8)	1.12 (28.4)	25 (635)	20	1.25 (31.8)	–	–

Orde

Des	Shipping Weight lbs. (kg)
316	130 (59.0)
Inst	

Water-cooled Baffles

For Varian's HS-16, HS-20, HS-32, and NHS-35 Diffusion Pumps

Features

- Optically dense baffle designs
- Intercepts 100% of primary backstreaming
- Adds only 7.1 in. (180 mm) to system height
- Retains 50% of pumping speed
- Uses water cooling
- Both cooling water lines on same side of baffle without fittings

Technical Specifications

Recommended Cooling-water Flow Rate	1-2 gpm (227-554 liter/hr)
Supportable Weight	designed to support weight of corresponding diffusion pump

Flange Dimensions mm (inches)

Baffle Part Number	Diffusion Pump Model	Inlet & Outlet Flanges	Flange Bolt Circle	Hole Size	Flange Height	Flange Outside Diameter	Cooling Water Tubing OD
R1152301	HS-16	16 in. ASA	21.25 in. (540 mm)	1.125 in. (29 mm)	7.09 in. (180 mm)	23.50 in. (597 mm)	0.59 in. (15 mm)
R1153301	HS-16	ISO-500K	Clamped flanges without bolts		7.09 in. (180 mm)	21.65 in. (550 mm)	0.59 in. (15 mm)
R1154301	HS-20	20 in. ASA	25.00 in. (635 mm)	1.25 in. (32 mm)	7.09 in. (180 mm)	27.50 in. (699 mm)	0.59 in. (15 mm)
R1155301	HS-20	ISO-630K	Clamped flanges without bolts		7.09 in. (180 mm)	27.17 in. (690 mm)	0.59 in. (15 mm)
R1156301	HS-32	32 in. ASA	36.25 in. (921 mm)	0.875 in. (22 mm)	7.09 in. (180 mm)	38.12 in. (968 mm)	0.59 in. (15 mm)
R1157301	HS-32	ISO-800F	35.04 in. (890 mm)	0.55 in. (15 mm)	7.09 in. (180 mm)	36.22 in. (920 mm)	0.59 in. (15 mm)
R1158301	NHS-35	35 in. ASA	38.50 in. (978 mm)	0.875 in. (22 mm)	7.09 in. (180 mm)	41.75 in. (1060 mm)	0.59 in. (15 mm)
R1159301	NHS-35	ISO-1000F	42.91 in. (1090 mm)	0.55 in. (14 mm)	7.09 in. (180 mm)	44.09 in. (1120 mm)	0.59 in. (15 mm)

Ordering Information

Description	Part Number	Shipping Weight lbs. (kg)
		180 (80)
		130 (60)
		215 (100)
		160 (70)
		350 (160)
		300 (135)
		495 (225)
Water-cooled baffle for NHS-35 with ISO flanges	R1159301	375 (170)

Halo Baffles for Large Diffusion Pumps

For Varian's 16 in., 20 in., and 35 in. Diffusion Pumps

Varian's Halo Baffles provide nearly twice the speed at the pump inlet as that achieved with conventional chevron baffles, while adding no height to the system. These water-cooled baffles are very economical compared to other opaque chevron baffles.

Features

- High retained speed
- 90% reduction of primary backstreaming
- Adds no height to system

Technical Specifications

Net Speed with Halo Baffle	Approximately 60% of pump speed*
Backstreaming Reduction	Approximately 90%*
Materials	Nickel-plated copper (16 in., 20 in.) Nickel-plated mild steel (32 in., 35 in.)
Cooling: Recommended Water Flow	In series with diffusion pumps. See specific diffusion pump technical specs HS16 – HS-35.

Ordering Information

Baffle Size	Part Number	Shipping Weight lbs. (kg)
16 in.	K0143316	20.0 (9.0)
20 in.	K1855320	25.0 (11.0)
32 in.	K1856332	35.0 (16.0)
35 in.	K1857335	45.0 (20.0)

*Values are estimates. Actual speed and backstreaming rate will vary depending on the application conditions.

Extended Cold Caps

For Varian's VHS-4, -6, and -10 Diffusion Pumps

The Extended Cold Cap is an option that fits inside the VHS-4, VHS-6, and VHS-10 pumps in place of the standard cold cap. It stops backstreaming as effectively as an optically dense baffle, yet it retains 80% of the pump's speed. Residual backstreaming is so low that it cannot be measured by the American Vacuum Society's standard collection method.

Features

- High retained pump speed
- Reduces backstreaming
- Adds no height to system

Technical Specifications

Speed with Extended Cold Cap	≈ 80% of pump speed
Materials	Nickel-plated copper
Cooling	Conduction (no water)

Ordering Information

Description	Part Number	Shipping Weight lbs. (kg)
VHS-4	F6898301	1.0 (0.5)
VHS-6	F6455001	1.0 (0.5)
VHS-10	L8917301	2.0 (0.9)

Diffusion Pump Technical Notes

Historical Notes

Producing low pressures is the function of vacuum pumps, one type of which is the diffusion pump. Diffusion pumps were first conceived and constructed by W. Gaede (1915-Germany) and I. Langmuir (1916-U.S.A). They operate on the principle of transferring momentum from high velocity vapor molecules to the gas molecules that are to be moved out of the system. The vapor molecules are formed by heating a suitable condensable fluid. The early pumps used mercury for this purpose.

In the late 1920's, C.R. Burch (England) and K.C. Hickman (U.S.A.) found that certain high molecular weight oils having high boiling points and low vapor pressures could be used as pumping fluids. These oils, not generally synthetic hydrocarbons, were useful because they remained in the pump indefinitely and allowed lower pressures to be attained without the use of a cold trap (see section on Baffles and Traps). Today, with the exception of a few isolated applications like some analytical instruments, all diffusion pumps utilize some form of oil. For additional information in this area, see the discussion on pumping fluids below.

As industrial and scientific requirements for rarefied atmospheres increased, research and development into the nature and production of high vacuum increased. By the early 1940's, a well-developed vacuum technology existed and was intensified both during World War ll and by the space effort of the 1960's. Engineering has continued in the vacuum field, and in 1965 Varian's M.H. Hablanian, et al. made a significant contribution to diffusion pump design that markedly increased pumping speeds.

Applications

Due to its simplicity, high performance, and low initial cost, the diffusion pump remains as the primary industrial high vacuum pumping mechanism. Applications for this type of pump are found in such diverse areas as:

1. Analytical instruments
2. Coating, functional
3. Coating, ornamental
4. Electron tube manufacture
5. Metallurgy
6. Optics
7. Outer space simulation
8. Particle accelerators
9. Petrochemicals
10.
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Basic Performance Factors

1. **Pumping speed** is volume per unit time. It is generally specified in liters/second and is an important parameter in determining the ultimate pressure of a system. This is expressed by the relationship

$$Q = PS$$

Where:

Q is the system gas load in torr-liters/second
P is the attainable pressure in torr
S is the effective pump speed at the system
"Q" is the total leakage of the system which includes vapors given off by dirt and outgassing of internal surfaces as well as holes to the outside world. Ultimate pressure is also affected by such factors as the compression ratio for light gases and the nature of the pumping fluid.

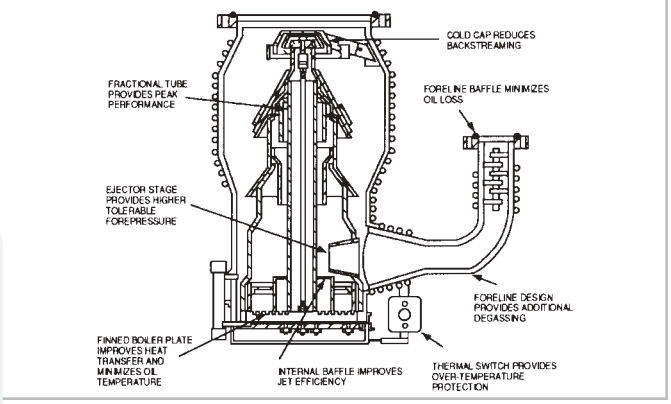
2. **Maximum throughput** is the pump's maximum gas mass transfer capability – pressure x volume per unit time. It is generally specified in torr-liters/second or mbar *l*/s.
3. **Tolerable forepressure** is the maximum allowable pressure in the foreline. It is maintained at or below this value by a suitably-sized mechanical foreline (backing) pump. If this pressure increases above that specified for a given pump, gas will diffuse back through the pump and pumping will stop. It should be noted that the size of this mechanical pump can affect the maximum throughput value.
4. **Backstreaming rate** is the rate at which the pumping fluid vapor leaves the inlet opening of the pump, moving back in the direction of the system being pumped. It is measured in milligrams per cm^2 per unit time and will vary with the type of motive fluid employed.

Operation

Diffusion pumps are vapor jet pumps that work on the basis of momentum transfer from a heavy high speed vapor molecule to a gas molecule. This results in the gas molecules being moved through the pump.

With reference to Figure 1, the bottom of the pump contains an electric heater which is used to produce the vapor by heating the pumping (motive) fluid to its boiling point at reduced pressure.

Figure 1 Typical Cross-sectional View of a Diffusion Pump



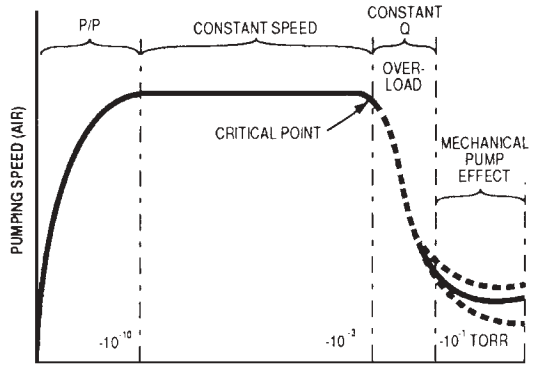
This means that before the pump is started, it must be "rough pumped" down to and held at an acceptable pressure, typically 10^{-1} torr. (For information on rough pumping, see section on Primary Pumps.) To do otherwise will result in no pumping action and possible damage to the pumping fluids. Once boiling of the fluid has begun, the vapor is forced up the central columns of the jet assembly. It then exits at each downward-directed jet in the

form of a molecular curtain that impacts the water-cooled pump body. Here, the vapor condenses and runs back down to the boiler. This refluxing action continues as long as proper heat and forepressure are maintained.

As gas molecules from the system randomly enter the pump (molecular flow conditions), they encounter the top jet. Some of them are correctly impacted and driven on to the next jet. Subsequently, they reach the foreline where they are exhausted to the atmosphere by the mechanical backing pump.

The diffusion pump is similar in character to other compression pumps in that it develops a relatively high exhaust pressure compared to the inlet pressure. This compression ratio for an inlet pressure of 2×10^{-7} torr and a foreline pressure of 2.0×10^{-1} would be ten million to one for most gases. Figure 2 shows how the pumping speed varies with pressure. Note that the speed remains constant from the 10^{-3} torr scale to the X^{-10} torr scale and then falls off as a result of the compression ratio for hydrogen and helium plus the vapor pressure contribution of the pumping fluid.

Figure 2 Inlet Pressure



Typical plot of diffusion pump performance. Four regions are evident: 1) Effect of the pressure ratio limit; 2) Normal operating range with constant speed; 3) Throughput limited condition; 4) Effect of backing pump.

In the same way that the pump must be rough pumped before starting, so must the system to be evacuated by rough pumping prior to exposure to the pump. Exposing a hot pump to a rush of air at atmospheric pressure could be catastrophic for the equip-
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1. Varian oil diffusion pumps incorporate an ejector stage as well as the full fractionation jets. This feature assures the user of constantly purified pumping fluid and the capability of maintaining low pressures.
2. Varian oil diffusion pumps incorporate insulated jet drip shields which prevent re-boiling of oil droplets outside the jet assembly. This feature assures the user of the lowest backstreaming rates attainable.
3. Varian water cooling coils are attached by a proprietary weld/brace technique. This special technique means excellent thermal contact and no chance for coils to "melt" away from the pump body in cases of accidental overheating.
4. Varian pumps all incorporate a water-cooled cold cap which reduces 98 percent of the backstreaming common to most diffusion pumps. Thus, the user is assured of a cleaner system.
5. Varian water-cooled pumps incorporate the quick cool boiler coils, allowing faster shutdown of the system with no damage to the oil.
6. Varian pumps utilize standard ASA flanges. This feature permits wide flexibility formatting with systems and other hardware.
7. Varian (4-inch and larger) pumps have a thermal protection switch as a standard feature. This device prevents damage to the pump and surroundings due to overheating.

Pumping Fluids

In an oil diffusion pump, high speed heated oil vapor provides the kinetic energy that moves gas molecules to the foreline and prevents their back-migration. These oils may be derived from a petroleum base but more typically are synthesized from phthalates, sebacates, phenyl groups, or siloxanes.

To be an effective pumping fluid, the compound must have a relatively high molecular weight and a low vapor pressure at elevated temperatures. Other desirable properties are inertness and stability in order to resist chemical reaction and disintegration into undesirable fractions.

Phenyl ethers such as Neovac-SY and Santovac-5 are fairly resistant to oxidation and are used successfully around electronic devices. These oils polymerize into a conducting film when bombarded with electrons and thus do not promote static charge build-up. In addition, they are quite soluble and "clean up" easily. Neovac-SY has the advantage of economy while Santovac-5 is more durable and has a lower vapor pressure.

For additional oxidation resistance, many applications lend themselves to the use of silicone fluids. These are phenyl siloxane compounds that polymerize as a non-conducting film that can allow static charge buildup and are difficult to "clean up". Two common fluids of this type are DC-704 and DC-705; the former has four phenyl groups and the latter has five. The DC-705 is, therefore, a heavier molecule, and it has a lower vapor pressure, so it is highly suitable for achieving very low pressures. However, it is somewhat less effective under high throughput conditions than DC-704, due to the fact that fewer molecules emerge from the top jet.

Another extremely stable fluid under reactive conditions is the fluorinated polyphenyl ether (Fomblin® or Krytox). This oil is widely used in mechanical oil-sealed pumps where large amounts of oxygen are pumped. It is also suitable as a diffusion pump fluid where large quantities of oxygen or other reactive gases may be encountered.

Speed measurements

Pumping speed is measured by introducing a known, steady state flow of gas into a measuring dome of specified geometry and measuring the resulting pressure established in the dome. Figure 1 shows the experimental setup used by Varian as recommended by the American Vacuum Society (Standard 4.1). The speed is determined by the AVS Standard as:

$$S = Q / (P - P_0),$$

where Q is the flow rate (throughput) and P_0 is the ultimate pressure prior to the experiment. All diffusion pump curves shown in the catalog are based on the use of DC704 diffusion pump fluid and the standard cold cap (unless otherwise noted). The speed curves are created by calculating the speed at increasing levels of gas throughput, allowing time between readings to ensure steady state conditions are reached.

Diffusion pumps exhibit different speeds for different gases. Thus, the speed of each gas is obtained by dividing the throughput of the gas by the partial pressure of the same gas in the dome. Unless otherwise noted, the speeds shown in this catalog are for air.

Measuring the speed of a diffusion pump installed in a vacuum system often gives different results since the geometry, surface area, construction materials, and most importantly, pressure measurement locations differ from the measuring dome.

Backstreaming measurements

Primary backstreaming can be measured by relatively simple means for pumps without baffles or traps. AVS Standard 4.5 (*Journal of Vacuum Science and Technology,* Volume 8, Number 5.) recommends the test dome configuration shown in Figure 2. The backstreaming rates published in Varian's catalog are measured using this technique. Any molecules which cross the pump inlet in the upward direction and condense in the dome may be said to be backstreaming. The condensed pumping fluid collects in the trough around the periphery of the dome and drains into a measuring tube. Usually, it takes several days to collect sufficient fluid for satisfactory measurements. Regular volumetric measurements are taken and recorded on a volume versus time graph until the rate is observed to be steady (±10%) for at least 72 hours. The backstreaming rate is the average slope of the Volume-Time curve in the 72 hour time period. Note that this test will ignore "spikes" in the backstreaming rate, which may occur during startup, since only the volume collected during the steady-state, 72-hour period is considered. All backstreaming tests are performed with DC-704 pumping fluid.

The measured backstreaming rate is very dependent on the test method used. If any method other than the dome method described above is used, the results can differ significantly from published values. Note also that the reported backstreaming values are valid for the normal operating range of the pump, at a pressure well below the point at which the top jet starts to

Figure 1

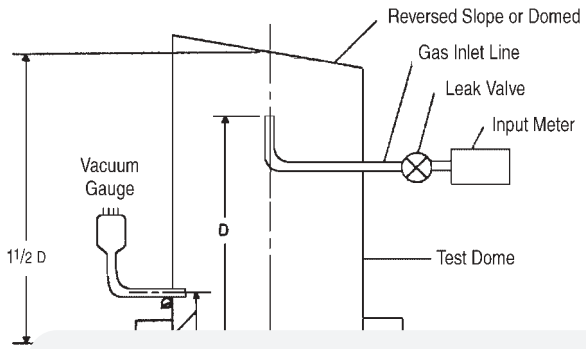
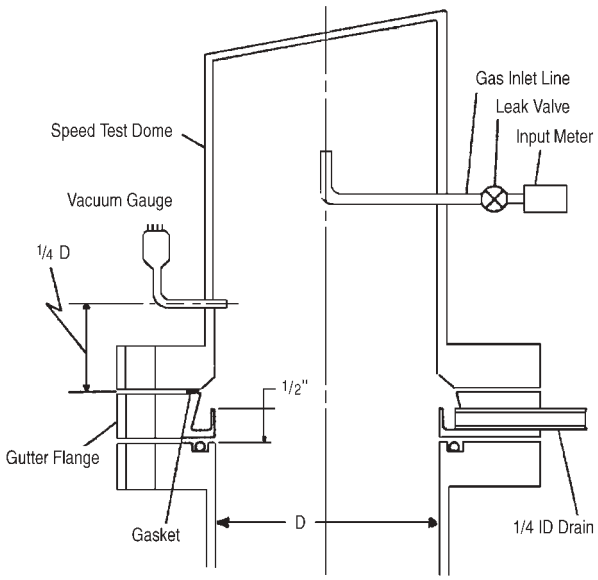


Figure 2



break down (i.e. below the "knee" of the speed curve, where the speed is no longer constant with pressure). Above this critical pressure the backstreaming rate may rise markedly.

Backstreaming measurements above the baffle cannot be made with the standard test apparatus. The rates are so low that the collecting surfaces must be refrigerated to prevent re-evaporation, and the collection surface must be designed to collect smaller amounts of fluid.

Using baffles to reduce backstreaming

If the vacuum system has intolerance to backstreaming, a baffle or trap should be considered. Too often a system designer will forego the use of baffles to reduce system cost, only to find the normal amount of backstreaming from the diffusion pumps is too high for the application. This is usually the case for high quality coating applications. The choice of baffle type is a trade-off between backstreaming level, net pumping speed, size, and cost. The designer can choose a water-cooled halo baffle, water-cooled optically dense baffle, or a cryotrap. A diffusion pump can be ordered with a cold cap or a halo baffle (which has an integral cold cap). If an external baffle is to be used, the diffusion pump is typically ordered with a cold cap.

A water-cooled halo baffle is designed to intercept a majority of the primary backstreaming which escapes the cold cap. A cooled ring, or halo, is strategically placed where most of the backstreaming occurs. The rate is reduced by *approximately* 90% with a corresponding reduction in speed of roughly 40%.

The actual reduction in backstreaming and speed depends on the type of pump and the application conditions. A water-cooled, optically tight baffle is designed to intercept 100% of the primary backstreaming, so what remains is secondary backstreaming. The temperature of the baffle surface, rather than the baffle geometry, determines the secondary backstreaming rate. Thus the choice of baffle becomes a trade-off between size (height), conductance, and cost.

A cryotrap, or liquid nitrogen trap, has a liquid nitrogen reservoir and various baffling surfaces. The reservoir is insulated from the environment by an evacuated space. The LN_2 boils off to atmosphere through a vent port. Since LN_2 boils at –196 °C, the trap's internal surfaces are extremely cold. In systems with liquid nitrogen traps, the backstreaming level can be controlled at such a low level that contaminants from sources other than the diffusion pump will predominate.

Estimating the effect a baffle has on the speed of the pump

The degree to which a baffle will reduce the effective pumping speed of a diffusion pump depends on its conductance, which is a function of its geometry. Manufacturers either publish conductance values in L/s or provide an estimate of the retained pumping speed (e.g. "Retains 50% of pumping speed"). When a conductance value for the baffle, C_{baffle}, is published, an estimate off the effective pumping speed, S_{eff}, is given by:

$$S_{eff} = (C_{baffle} * S_{pump})/ (C_{baffle} + S_{pump})$$

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