

Diffusion Vacuum Pumps

Diffusion vacuum pumps are one of the oldest high-vacuum pumping technologies and provide the highest pumping speed at the lowest purchase cost. They are built on a dependable pumping design that can provide stable high-vacuum pressures down to the 10^{-8} Torr range. Because it is a high-vacuum pump, it must be backed by a roughing pump that can generate and maintain a constant backing vacuum pressure below 10^{-2} Torr.

The diffusion vacuum pump is an oil pump that contains an oil heating element, where its oil is heated to high temperatures while being held under vacuum through its foreline by the roughing pump. The heated diffusion pump oil boils and its vapors expand rapidly up a center jet-stack, "Christmas Tree" looking baffle system. The vaporized diffusion pump oil forms vapor jets as it exits the jet-stack, for this reason, the diffusion pump is sometimes called a vapor jet pump. The pumping mechanism occurs by momentum transfer where high-speed vaporized diffusion pump fluid molecules collide with smaller gas molecules. The vapor jet is supersonic and gases that come in contact with it diffuse in the jet and are transferred downwards and ejected to a higher pressure zone. Diffusion pump designs may contain 2-3 stages of compression for small pumps and go up to 7 stages for larger pumps. These downward directed baffle nozzles force the mixed vapor stream on to the cooled metal walls of the pump, condensing the oil and the cycle repeats. The end result is gas compression that increases from top intake to the bottom foreline of the diffusion pump.

If the foreline pressure goes above the critical pressure limit the pumping action ceases, this is because at high pressures the directed supersonic vapor don't reach the pump walls to condense. Instead the vapor jet deteriorates short of the pump wall leading to random motion allowing the gas molecules to go backward up into the vacuum chamber. The walls of the pump are often air cooled for small and water cooled for larger diffusion pumps. The vapor density of the oil is less in the bottom stages than the top do to effective condensation.

It should be noted that diffusion pumps provide an ultimate pressure of around 10^{-8} Torr and even lower when used in combination with a water cooled intake baffle or liquid nitrogen trap. When considering a diffusion pump for your high-vacuum application it is important to realize that even with a good cold trap molecular layers of diffusion pump oil will back-stream into the vacuum chamber. If your application requires absolutely clean dry high-vacuum then other high-vacuum pump technologies, such as, turbo or cryogenic pumps should be considered. Diffusion pumps are economical and so for general purpose high-vacuum applications are a great option as they require little maintenance and many years of trouble free operation.

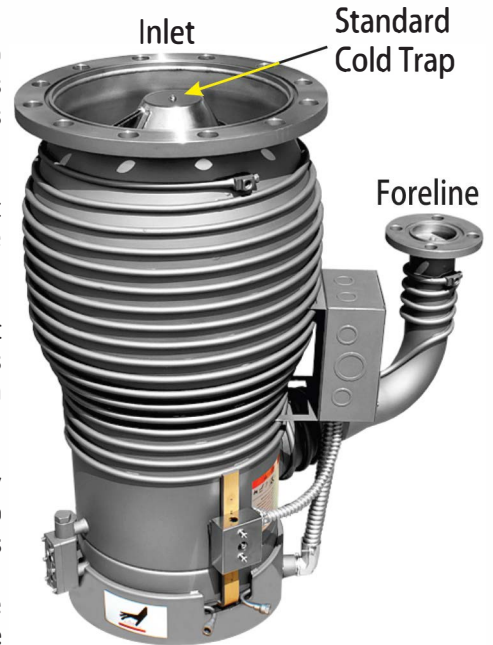
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Diffusion

AGILENT Varian Diffusion Pumps

These Varian Agilent diffusion high vacuum pumps are the primary industrial standard for high vacuum pumping mechanism. The pumps have a high pumping speed for all gases and low cost per unit pumping speed when compared with other types of pump used in the same vacuum range. The bulge contour in the Agilent Varian VHS-Series maintains lower pressure for the process and increases the gas captured. VHS pumps feature glass fill and drain assemblies for easy maintenance of pump fluid and continuous monitoring. Finned boilers increase the surface area which prolongs fluid life. The full fractionating design 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.

Diffusion pumps use a high-speed jet of vapor to direct gas molecules in the pump throat down into the bottom of the pump and out the exhaust. The oil diffusion pump is operated with an oil that has low vapor pressure. Its purpose is to achieve higher vacuum (lower pressure) than possible by use of positive displacement pumps alone. Although its use has been mainly associated within the high vacuum range (down to 10^{-9} Torr), diffusion pumps today can produce pressures approaching 10^{-10} Torr when properly used with modern fluids and accessories. The features that make the diffusion pump attractive for high and ultra-high vacuum use are its high pumping speed for all gases and low cost per unit pumping speed when compared with other types of pump used in the same vacuum range. Diffusion pumps cannot discharge directly into the atmosphere, so a mechanical forepump is typically used to maintain an outlet pressure around 1 mTorr.



Agilent Varian VHS Diffusion Pump SPECIFICATIONS

	VHS-4	VHS-6	VHS-250	VHS-10	VHS-400
Flange INLET (FORELINE)	ASA 4" (KF40)	ASA 6" (ASA 1.5")	ISO 250F (ASA 5")	ASA 10" (ASA 2")	ISO 400K (ISO 63K)
Pumping speed / Operating range (l/s)	750 air, 940 He/H ₂	1550 air, 1930 He/H ₂	2125 air, 2660 He/H ₂	3650 air, 4560 He/H ₂	4500 air, 5625 He/H ₂
Maximum throughput in operating range	1.5T-l/s (2.0mbar-l/s)	2.4T-l/s (3.2mbar-l/s)	2.6T-l/s (3.5mbar-l/s)	6.3T-l/s (8.4mbar-l/s)	6.3T-l/s (8.4mbar-l/s)
Operating range	2×10^{-3} to $< 5 \times 10^{-9}$ Torr	1.5×10^{-3} to $< 5 \times 10^{-9}$ Torr	1.2×10^{-3} to $< 5 \times 10^{-9}$ Torr	1.7×10^{-3} to $< 5 \times 10^{-9}$ Torr	1.4×10^{-3} to $< 5 \times 10^{-9}$ Torr
Maximum forepressure	No load: 0.65 Torr Full load: 0.55 Torr	No load: 0.65 Torr Full load: 0.55 Torr	No load: 0.65 Torr Full load: 0.55 Torr	No load: 0.65 Torr Full load: 0.55 Torr	No load: 0.65 Torr Full load: 0.55 Torr
Backing pump	≥ 10 cfm	≥ 17 cfm	≥ 17 cfm	≥ 30 cfm	≥ 30 cfm
Backstreaming rate standard cold cap	5×10^{-4} mg/cm ² /min.	5×10^{-4} mg/cm ² /min.	5×10^{-4} mg/cm ² /min.	5×10^{-4} mg/cm ² /min.	5×10^{-4} mg/cm ² /min.
Warmup time	10 minutes	10 minutes	10 minutes	15 minutes	15 minutes
Cool down time	10 minutes with quick cool coil	10 minutes	10 minutes	25 minutes	25 minutes
Fluid charge	300 cc	500 cc	500 cc	1000 cc	1000 cc
Electrical requirements	1 ph. 120/208/240 VAC	1 ph. 120/208/240 VAC	1 ph. 120/208/240 VAC	3 ph. 208/240/380/480 VAC	3 ph. 208/380/480 VAC
Pump power	1450 watts	2200 watts	2200 watts	4400 watts	4400 watts
Cooling water requirements	0.15 gpm at 60-80° F	0.25 gpm at 60-80° F	0.25 gpm at 60-80° F	0.40 gpm at 60-80° F	0.40 gpm at 60-80° F
Water connections / Pump Weight	1/8 in. FPT Tee / 55lb.	1/8 in. FPT Tee / 75lb.	1/8 in. FPT Tee / 75lb.	1/8 in. FPT Tee / 150lb.	1/8 in. FPT Tee / 180lb.

AGILENT *Varian* Diffusion Pumps

Model	IDEAL VACUUM P/N	Agilent P/N	Flange INLET (FORELINE)	Voltage (60hz)	Price*
VHS-4	P102156	86460301	ASA 4" (KF40)	120 VAC 1Ø	\$5,990.00
VHS-6	P102157	85826301	ASA 6" (ASA 1.5")	120 VAC 1Ø	\$7,983.00
VHS-250	P102159	K0543301	ISO 250F (ASA 5")	120 VAC 1Ø	\$9,196.00
VSH-10	P102158	F0426307	ASA 10" (ASA 2")	208 VAC 3Ø	\$13,291.00
VHS-400	P102160	L9767307	ISO 400K (ISO 63K)	208 VAC 3Ø	\$14,946.00

All pumps listed have standard cold cap, extended cold cap also available. Other voltages also available.

ACCESSORIES	Pump Models	IDEAL P/N	Agilent	Price*
Stove top style heater, 120 VAC, 1450w, 12.1amp, 9.9 ohms	VHS-4	P103140	647304205	\$225.00
Stove top style heater 208 VAC, 1450w, 7amp, 29.7 ohms	VHS-4	P103141	647304210	\$245.00
Stove top style heater 240 VAC, 1450w, 6amp, 40 ohms	VHS-4	P103142	647304250	\$225.00
Ceramic fiber heater insulating blanket	VHS-4	P103162		\$24.00
Full replacement heater assembly, 120 VAC, 1450w, 12.1amp, 9.9 ohms	VHS-4	P103165		\$425.00
Full replacement heater assembly, 08 VAC, 1450w, 7amp, 29.7 ohms	VHS-4	P103166		\$425.00
Full replacement heater assembly, 240 VAC, 1450w, 6amp, 40 ohms	VHS-4	P103167		\$425.00
Bottom metal heater cover	VHS-4	P103151		\$165.00
Stove top style heater, 120 VAC, 2200w, 18.3amp, 6.6 ohms	VHS-6, VHS-250	P103143	647306125	\$275.00
Stove top style heater 208 VAC, 2200w, 10.6amp, 19.6 ohms	VHS-6, VHS-250	P103144	647306225	\$275.00
Stove top style heater 240 VAC, 2200w, 9.2amp, 26 ohms	VHS-6, VHS-250	P103145	647306175	\$275.00
Ceramic fiber heater insulating blanket	VHS-6, VHS-250	P103154	L8998001	\$25.00
Full replacement heater assembly, 120 VAC, 2200w, 12.1amp, 6.6 ohms	VHS-6, VHS-250	P103153		\$455.00
Full replacement heater assembly, 08 VAC, 2200w, 7amp, 19.6 ohms	VHS-6, VHS-250	P103163		\$455.00
Full replacement heater assembly, 240 VAC, 2200w, 6amp, 26 ohms	VHS-6, VHS-250	P103164		\$455.00
Bottom metal heater cover	VHS-6, VHS-250	P103150		\$175.00
Tubular style heater, 208 VAC, 2200w, 10.6amp, 19.6 ohms	VHS-10, VHS-400	P103146	647310140	\$333.31
Tubular style heater, 240 VAC, 2200w, 9.2amp, 26 ohms	VHS-10, VHS-400	P103147	647310150	\$299.95
Tubular style heater, 380 VAC, 2200w, 5.8amp, 66 ohms	VHS-10, VHS-400	P103148	647310160	\$333.31
Tubular style heater, 480 VAC, 2200w, 4.6amp, 104 ohms	VHS-10, VHS-400	P103149	647310170	\$299.95
Bottom metal heater cover	VHS-10, VHS-400	P103152		\$395.00
Crush plate for diffusion pump	VHS-10, VHS-400	P105188	K7667001	\$230.87
Electrical input receptacle for 1 phase 120, 208, 240 VAC, 20amp	VHS-4 & VHS-6	P103158		\$65.00
Thermal overload switch aluminum cover box	VHS-4, M-4 & VHS-6, M-6	P103155		\$42.50
Diffusion pump heater wire, 22amp, 10 gauge, price per ft.		P103156		\$22.50
Diffusion pump heater wire, 15amp, 12 gauge, price per ft.		P103159		\$19.95
Diffusion pump heater wire, 8amp, 16 gauge, price per ft.		P103160		\$18.95
Electrical connecting lugs for 10 or 12 gauge wire (qty. 10)		P103157		\$15.00
Electrical connecting lugs for 14 or 16 gauge wire (qty. 10)		P103161		\$14.45

ACCESSORIES for Agilent VHS Diffusion Pumps



* Catalog Pricing
Subject to Change