LIQUID RING VACUUM PUMPS

液封式真空幫浦

NVD/NV Series

大豐機器股份有限公司
TA HONG MACHINERY CO., LTD.

產品特色 Features of Productions

液封式真空幫浦被廣泛地運用於真空製程工業上，其構造堅固又可容許所抽取的氣體中含有水份及少許的固體物，因此逐漸取代了耗能源的蒸汽噴射幫浦。

液封式真空幫浦是以水或其它液體當作抽真空的媒介物，故特別適用於濕式的真空製程上，如真空過濾、真空乾燥、真空凝結、真空抽取及真空分餾等。

液封式真空幫浦的最終壓力通常受限於封液的飽和蒸汽壓；例如以水當作封液時，兩段式液封式真空幫浦的最終壓力可抽至 25~30Torr；壓力的需求更低時，可採用較低飽和蒸汽壓的封液，或在幫浦的入口加裝一大氣助力器。

如果最終壓力的需求更低，且又要求更大的排氣速度時，可在幫浦的入口加裝一台機械式真空助力幫浦，它可達到的真空度，相當於一套三段式蒸汽噴射幫浦的能力。

Liquid ring vacuum pumps are used throughout the process industries. These pumps are a legitimate alternative to steam ejectors in applications requiring a rugged vacuum pumps that can tolerate entrained liquids and solids. Because the pump operates in a liquid environment, it is ideal for wet processes such as filtration, drying, condenser, exhausting, distillation.

The ultimate suction pressure of a liquid ring pump is usually limited by the vapor pressure of the liquid sealant. For water-sealed pumps, the lowest practical operating pressure for a two- stage design will probably fall between 25 and 30 Torr. Above these pressures, a water-sealed liquid ring pump is an excellent choice for most industrial applications. The use of low-vapor- pressure sealants or air ejector, booster stages with liquid ring vacuum pumps lowers the minimum pressure for practical operation to a point that is competitive with three-stage steam jets.

- 真空排氣系統 Vacuum Pumping Systems
- 機械助力幫浦 Mechanical Boosters
- 油迴轉真空幫浦 Oil Rotary Vacuum Pumps
- 液封式真空幫浦 Liquid Ring Vacuum Pumps
- 魯氏鼓風機、魯氏壓縮機 Roots Blowers and Compressor
- 多段式透浦鼓風機 Multi-stage Turbo Blowers
- 離心式送風機 Turbo Fans
- 斜流式送風機 Mixed Flow Fans
- 軸流式送風機 Axial Flow Fans

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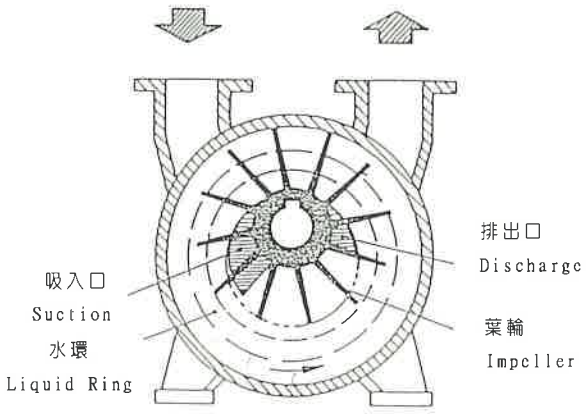
工作原理 Principle

液封式真空幫浦是一種無脈動式的真空幫浦，它是以水環當作活塞，將氣體吸入再壓縮排出。

幫浦葉輪的中心與汽缸的中心特別設計為偏心配置，當葉輪轉動時，封液會在汽缸內形成一水環；由於偏心的緣故，葉輪的葉片插入水環的深度會改變，使得水環如同活塞般在兩葉片間上下動作，因此從入口吸入的氣體會逐漸被壓縮至出口排出於大氣，達到抽取真空的目的。整個的抽氣、壓縮、排氣的動作均無閥門控制，同時也沒有金屬的相互摩擦，完全靠水環與葉輪的相對運動來完成。



The liquid ring vacuum pump is a nonpulsating vacuum pump that removes gases by means of rotating impeller blades entering and leaving a ring of liquid, usually water.

The sealing liquid is thrown to the periphery of the casing by the impeller where it forms a moving ring of liquid around a center void. The impeller shaft is mounted above the center line of the casing; thus the blades, although rotating concentrically, are located eccentrically with respect to the casing and the ring of liquid.

The axial suction and discharge ports of the pump are exposed to the void but are separated from each other by impeller blades and the ring of liquid. As the process fluid (gas or vapor)is drawn into the pump through the suction port, it is within the space formed by the impeller blades and the liquid ring. During rotation, the blades enter deeper into the liquid ring and the trapped space becomes progressively smaller, compressing the gas and exhausting it as it passes the discharge port. The entire pumping operation is accomplished without vanes, valves, pistons or any other metal-to-metal contact.

用途	Application
真空除氣	**Deaerating**
真空鑄造	**Molding**
真空乾燥	**Drying**
真空濃縮	**Concentration**
真空分餾	**Distillation**
真空含浸	**Impregnation**
真空包裝	**Packaging**
真空輸送	**Conveying**
真空過濾	**Filtering**
吸盤搬運	**Chucking**
造紙脫水	**Dehydration**
溶劑回收	**Solvent Recovery**
蒸汽殺菌	**Sterilization**
起動注給	**Priming**

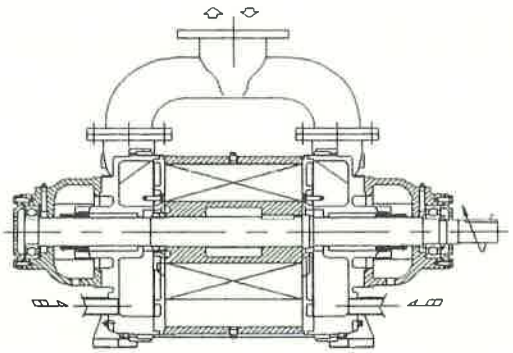
設計特點 Design Features

1. 液封式真空幫浦容許被抽取的氣體中含有大量的可凝結性氣體及相當程度的液渣，而不致損壞幫浦。
2. 當抽取可凝結性氣體時，封液本身相當於一個直接接觸式的冷凝器，會加大對可凝結性氣體的排氣量。
3. 壓縮過程中，壓縮產生的熱量絕大部份被封液吸收，趨近於等溫壓縮，故出口排氣溫度低。
4. 選用適當的材質及改用適當的液體來代替水為封液，不僅可回收被抽出的氣體，也可解決幫浦腐蝕的問題。
5. 入口加裝大氣助力器，可延伸壓力使用範圍；如串聯機械式真空助力泵浦，則可延伸壓力使用範圍並加大排氣能力。
6. 在許多的真空製程中，液封式的購入成本及運轉費用低於其它型式的真空幫浦。
7. 無脈動，振動小，噪音低，安裝保養容易。

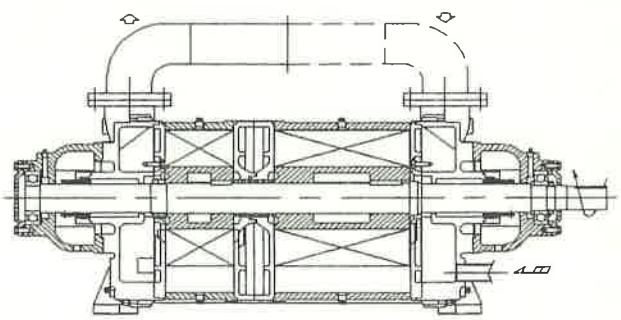
1. It is a rugged vacuum pump that can tolerate vapor -gas mixtures of entrained liquids and solids.
2. It increases the pumping speed of condensing gas and will not influence the pumping speed of air when drawing in vapor-gas mixtures, because sealant liquid itself equals to a direct contact condenser.
3. Heat produced during compressing is almost received by sealant liquid. It makes the temperature of output gas lower.
4. Instead of water, using proper material of liquid to be the sealant can recycle drawn gas and prevent from corrosion.
5. An air ejector equipped in entrance of pump can lower the minimum pressure for practical operation. When liquid ring vacuum pump series connect with a mechanical booster can lower the pressure and increase pumping speed simultaneously.
6. Purchasing cost and operation fee is the lowest among many vacuum processes.
7. No pulsation, low vibration, low noise, easy installation and maintenance.

構造 Constructions

單段式(機械軸封)　　**One-stage type** (with mechanical seal)



兩段式(機械軸封)　　**Two-stage type** (with mechanical seal)



機型選用 Factor of Pump Selection

要選擇一部適當的液封式真空幫浦，下例幾項主要因素是必須考慮的：

1. 操作壓力：單段或兩段式真空幫浦的選擇，可由操作壓力來決定。
   一般操作壓力高於 150Torr 時應選用單段式，而操作壓力低於 150Torr 時應選用兩段式。
   如果操作壓力低於液封式真空幫浦能及的範圍時，則可考慮在入口側串聯大氣助力器或機械式真空助力幫浦。
2. 抽氣時間：從大氣壓或最初壓力一直抽取到所需真空度能容許的時間。
3. 真空系統的容積：真空系統中含桶、管路及其它設備所有需被抽真空的容積大小。
4. 氣體負載量：此氣體包含可凝結性及非凝結性的氣體，其來源包括製程中蒸發出來之氣體及預估從外界洩入之氣體。
5. 真空配管：真空配管的長度、口徑、閥、彎頭及其它配件均會影響真空幫浦的排氣速度。
   一個很重要的原則，即管路愈短愈好，管徑不要小於真空幫浦入口的尺寸。

The selection of a proper-size pump for a given application is straight forward in principle but may be not so obvious in practice. The major factors that should be considered are:

1. The operating pressure required. This determines whether a single stage or a two- stage pump is needed. Ordinarily, you will need a single stage pump if operating pressure is higher than 150 Torr ,otherwise you should consider a two-stage pump. If working pressure is lower than operating pressure of pump, an air ejector or a mechanical booster series connected in entrance will be a good choice.
2. The pump down time from the initial pressure to the final desired pressure.
3. Volume of the system to be evacuated.
4. The gas load in terms of condensable and permanent type gases that will evolve from the process and are permitted to leak into the chamber.
5. The vacuum manifold and its effect on reducing pumping speed as related to length, diameter and orifice effect.

材質選用 Material Selection

零件名稱 Name	標準材質 Standard	特殊材質 Special (A)	特殊材質 Special (B)
氣缸及出入口殼 Casing	FC200	SCS13	SCS14
葉輪 Impeller	SCS13	SCS13	SCS14
車軸 Shaft	SUS304	SUS304	SUS316
水汽分離桶 Tank	SS400	SUS304	SUS316
配管 Piping	SS400	SUS304	SUS316
共同底台 Base	SS400	SS400	SS400
軸封 Shaft Seal	NVD(NV)-40,45	機械軸封(標準品) Mechanical Seal(Standard) 填函軸封(特殊品) Gland Packing(Special)	
	NVD(NV)-50,80,100,150	填函軸封(標準品) Gland Packing (Standard) 機械軸封(特殊品) Mechanical Seal (Special)	

兩段式性能表 Performance of Two-stage

機型	轉速	馬力	排氣速度 Pumping Speed m^3/min						出入口徑	封液量
Model	**RPM**	**HP**	25 Torr	50 Torr	75 Torr	100 Torr	125 Torr	150 Torr	**mm**	**1/min**
NVD-40	1460	5	0.5	1	1.2	1.3	1.3	1.3	40	15
NVD-40	1750	5	0.8	1.6	1.8	2	2	2	40	15
NVD-45	1460	7.5	1.3	2.5	2.8	3	3	3	40	20
NVD-45	1750	10	1.6	3.2	3.6	3.8	3.8	3.8	40	25
NVD-50	1160	10	2.1	4.2	5.2	5.5	5.5	5.4	50	30
NVD-50	1460	15	2.4	5.4	6.4	6.7	6.8	6.7	50	40
NVD-50	1600	20	2.7	6	7.1	7.4	7.5	7.4	50	40
NVD-50	1750	25	3	6.7	7.8	8.2	8.3	8.2	50	50
NVD-80	980	25	3.5	7	8.5	9.1	9.3	9.3	80	50
NVD-80	1160	30	3.8	8.1	9.8	10.5	11	10.5	80	55
NVD-80	1460	40	4.3	10	12	13	13.5	13	80	65
NVD-80	1750	50	5.8	13	15	16	16.5	16	80	75
NVD-100	750	40	7.2	15	18	19	19	19	100	80
NVD-100	880	50	8.5	18	21	22	23	22	100	90
NVD-100	980	60	10	21	24	25	26	25	100	100
NVD-100	1050	75	11	22	25.5	26.5	27	26.5	100	120
NVD-100	1160	100	13	25	28	29	29	28	100	140
NVD-100	1250	100	14	27	30	31	31	30	100	140
NVD-150	600	100	15	29	34	36	36	34	150	160
NVD-150	690	125	16	33	39	41	41	39	150	180
NVD-150	760	150	18	38	45	47	47	45	150	200
NVD-150	820	175	22	41	50	52	52	52	150	220
NVD-150	880	200	23	48	59	61	61	58	150	240

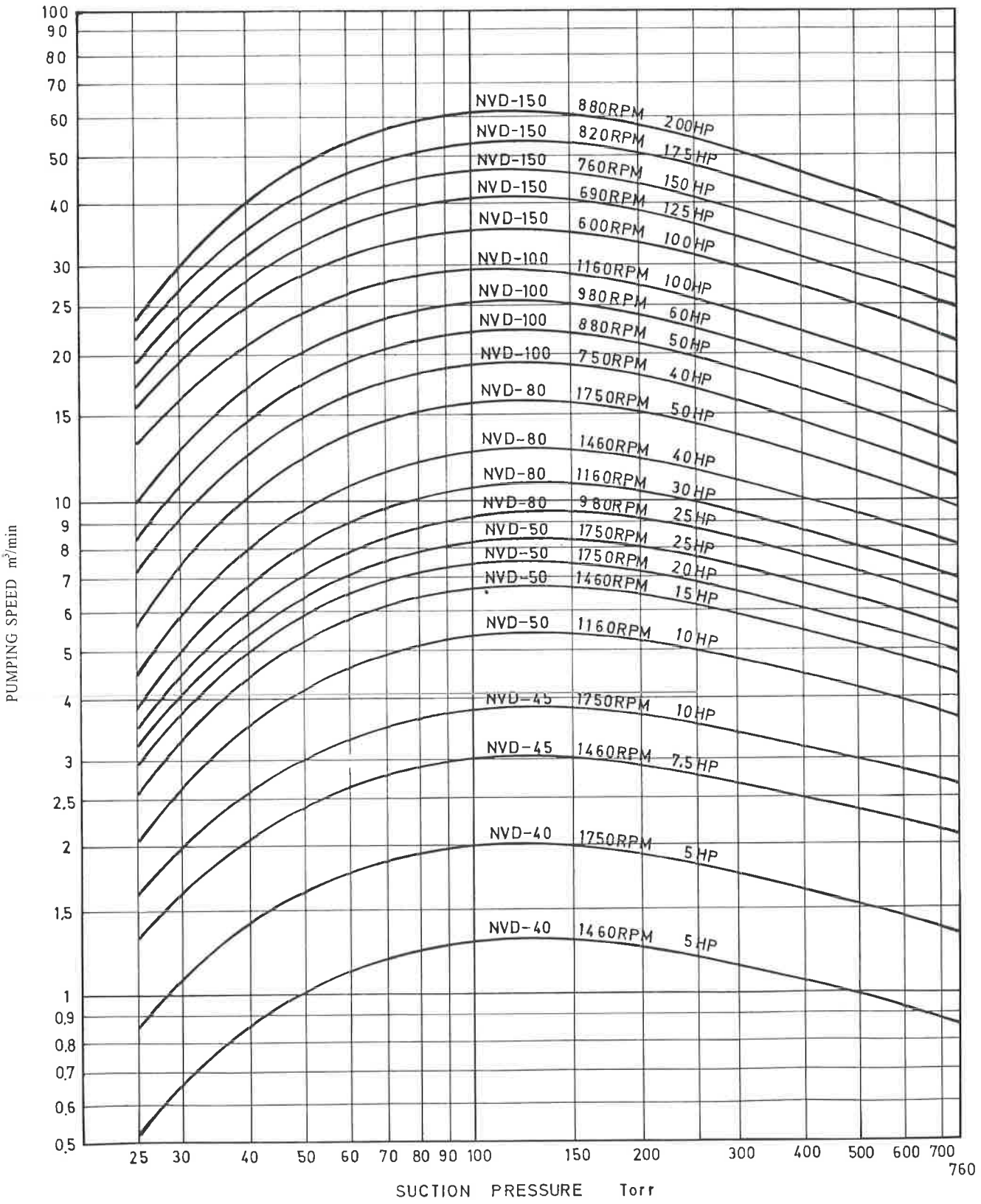
封液溫度：15°C

抽氣溫度：20°C

註：1.表列數據誤差值爲±5%

2.不銹鋼本體時性能約減低10%

兩段式性能曲線 Performance Curve of Two-stage



Sealing liquid temperature : 15°C

Gas temperature : 20°C

Note : 1. The tolerance of the performance data is ± 5%

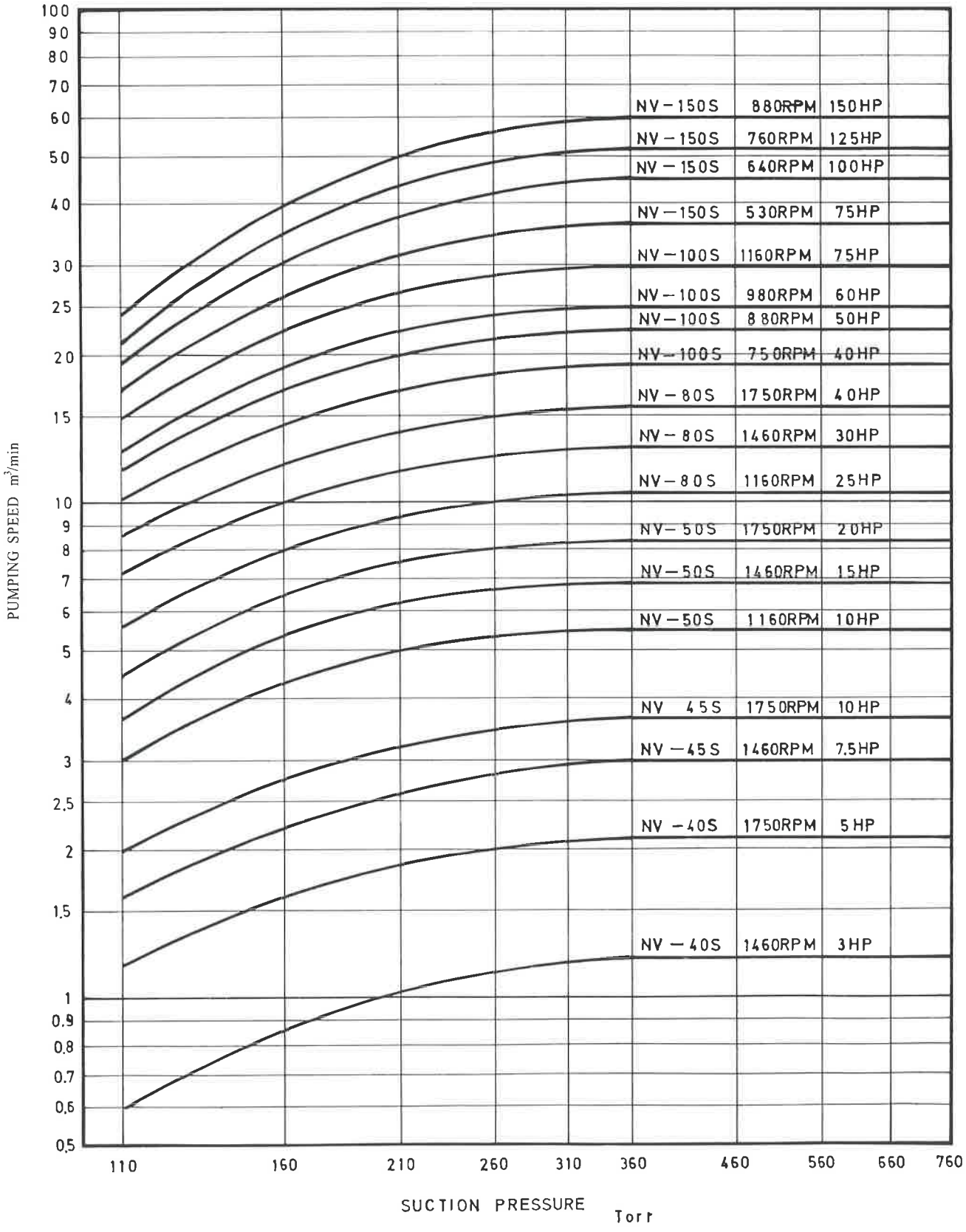
2. In case of stainless steel 10% of capacity decrease must be considered.

單段式性能表 Performance of One-stage

機型	轉速	馬力	排氣速度 Pumping Speed m^3/min						出入口徑	封液量
Model	**RPM**	**HP**	110 Torr	160 Torr	210 Torr	260 Torr	310 Torr	360 Torr	**mm**	**1/min**
NV-40S	1460	3	0.6	0.8	1	1.1	1.2	1.2	40	12
NV-40S	1750	5	1.2	1.6	1.9	2	2.1	2.1	40	15
NV-45S	1460	7.5	1.6	2.2	2.6	2.8	2.9	3	50	20
NV-45S	1750	10	2	2.8	3.3	3.5	3.6	3.7	50	25
NV-50S	1160	10	3	4.4	5	5.4	5.5	5.5	80	30
NV-50S	1460	15	3.7	5.5	6.3	6.8	6.9	6.9	80	40
NV-50S	1750	20	4.5	6.7	7.7	8.2	8.3	8.3	80	50
NV-80S	1160	25	5.6	8.3	9.5	10	10.2	10.3	100	55
NV-80S	1460	30	7.1	10	12	12.5	13	13	100	65
NV-80S	1750	40	8.5	12.5	14.5	15	15.5	15.5	100	75
NV-100S	750	40	10	14.5	17.5	18	19	19	150	80
NV-100S	880	50	11.5	17	21	22	23	23	150	90.
NV-100S	980	60	12.5	19	23	24	25	25	150	100
NV-100S	1160	75	15	23	27	28	30	30	150	120
NV-150S	530	75	17	27	27	32	35	37	200	140
NV-150S	640	100	19	30	37	42	45	45	200	160
NV-150S	760	125	21	33	42	50	52	52	200	180
NV-150S	880	150	24	38	50	57	60	60	200	220

封液溫度：15°C
抽氣溫度：20°C
註：1.表列數據誤差值爲±5%
2.不銹鋼本體時性能約減低10%

單段式性能曲線 Performance Curve of One-stage



Sealing liquid temperature : 15°C

Gas temperature : 20°C

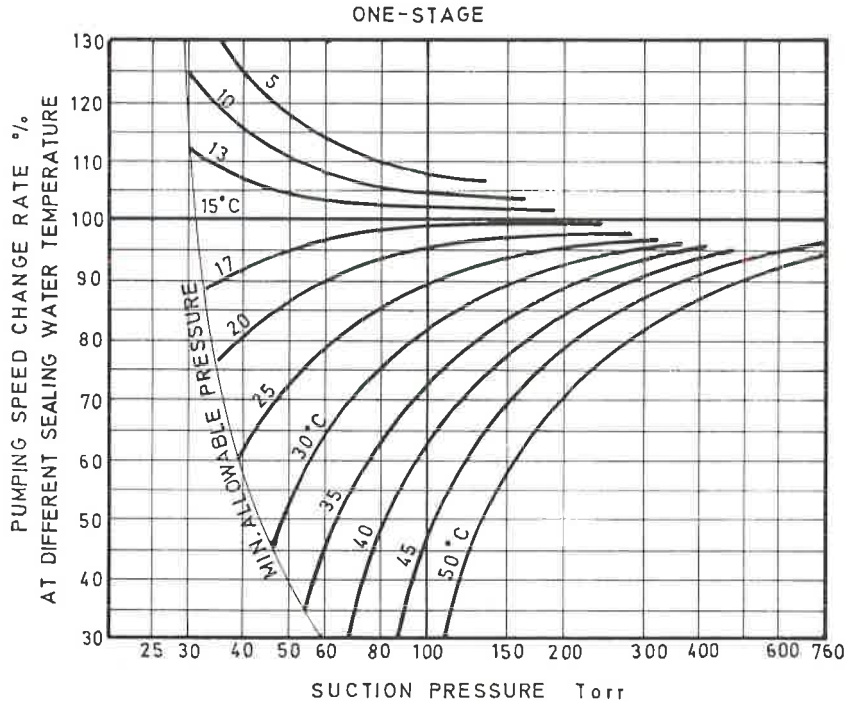
Note : 1. The tolerance of the performance data is ± 5%

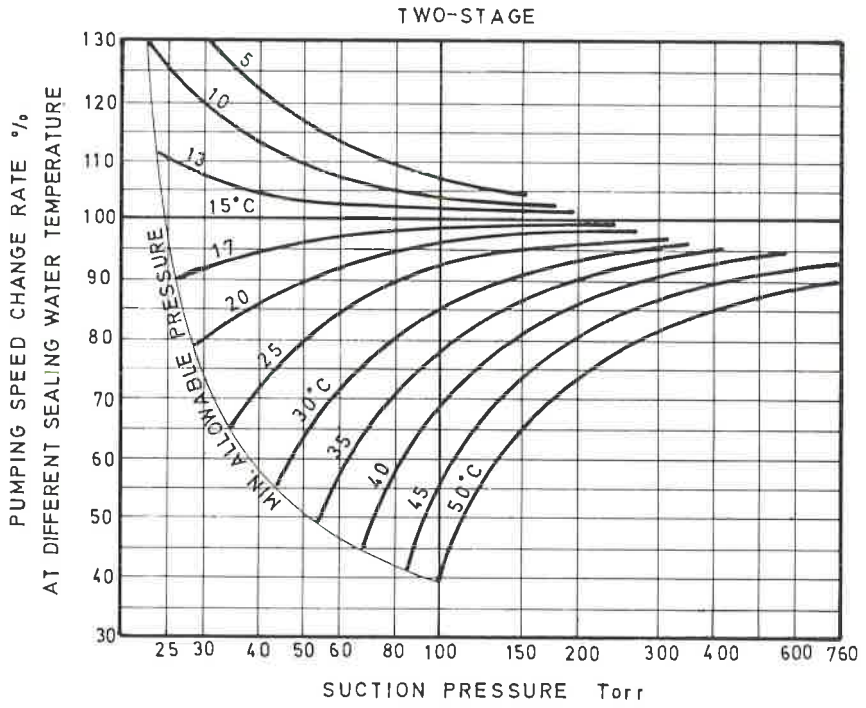
2. In case of stainless steel 10% of capacity decrease must be considered.

封液溫度的影響 Effect of Temperature

液封式真空幫浦的排氣速度會受到封液水的溫度影響。型錄上的性能是以封液水溫度15°C為基準，如果封液水的溫度不同於15°C時，幫浦的排氣速度將隨著下圖之比率而改變。

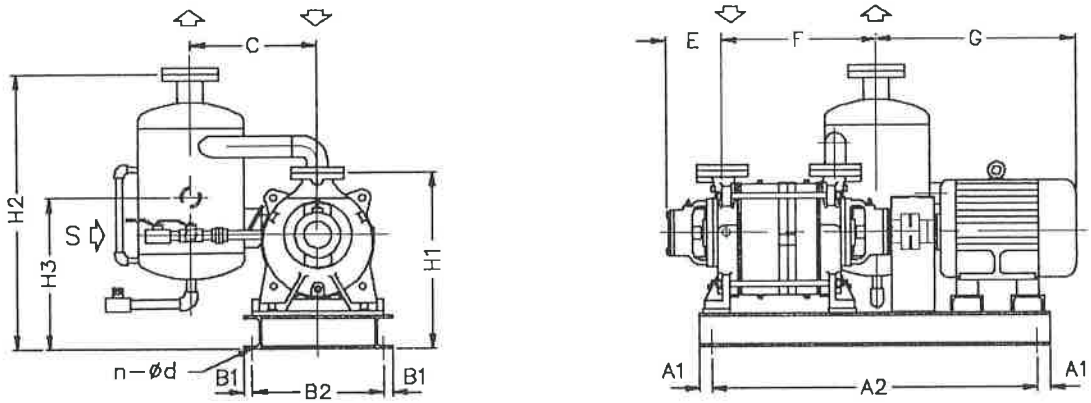
The performance curves shown are base on sealing water temperature at 15ºC, whenever the sealing water temperature is different from 15ºC, the pump speed of liquid ring vacuum pump should be change by the following charts.





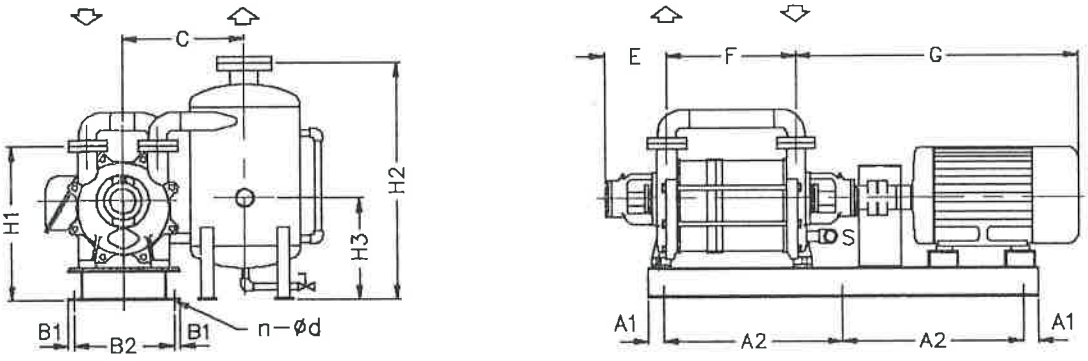
兩段式尺寸表 Dimensions of Two-stage

NVD-40



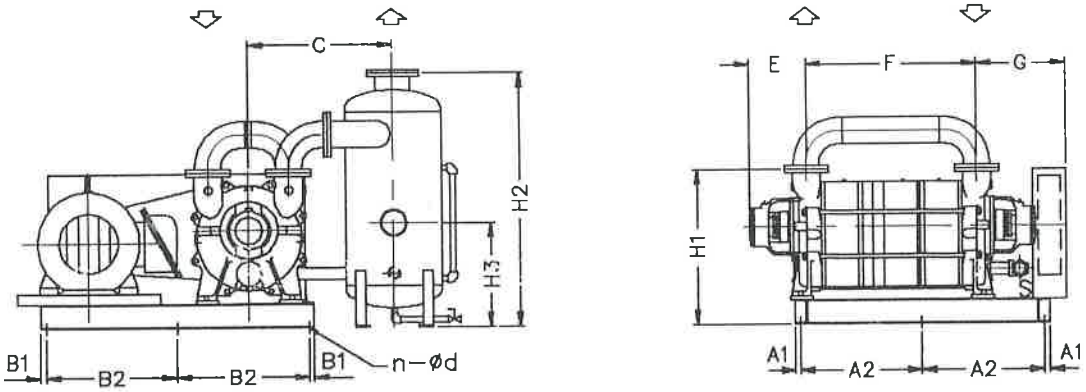
Model	A1	A2	B1	B2	C	E	F	G	H1	H2	H3	n	ød	S	Suction	Discharge	Weight (kg)
NVD-40	30	760	20	300	290	130	364	471	407	635	350	4	12	3/8"	JIS5K40A	JIS5K50A	190

NVD-45、50、80、100



Model	A1	A2	B1	B2	C	E	F	G	H1	H2	H3	n	ød	S	Suction	Discharge	Weight (kg)
NVD-45	30	470	20	300	350	142	341	682	407	660	280	6	12	3/4"	JIS5K40A	JIS5K50A	270
NVD-50	30	620	20	330	400	204	433	936	509	780	335	6	15	1"	JIS5K50A	JIS5K80A	540
NVD-80	30	785	30	420	575	250	553	1143	615	1015	440	6	19	1.25"	JIS5K80A	JIS10K100A	900
NVD-100	30	650	30	600	650	290	790	1326	770	1250	540	8	24	1.5"	JIS10K100A	JIS10K150A	1460

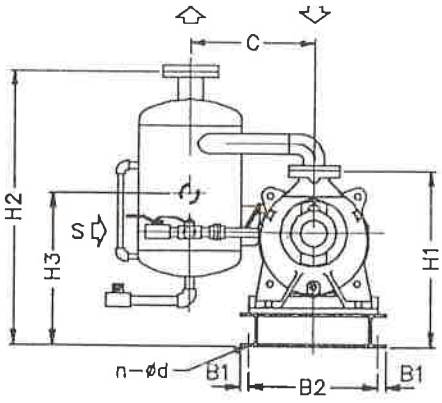
NVD-150

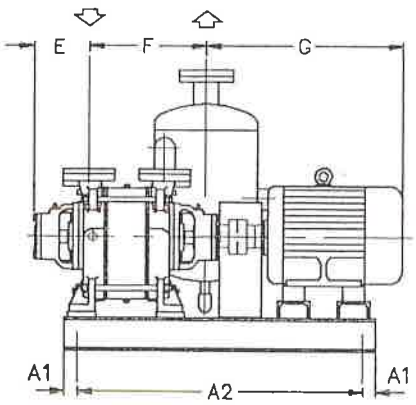


Model	A1	A2	B1	B2	C	E	F	G	H1	H2	H3	n	ød	S	Suction	Discharge	Weight (kg)
NVD-150	30	770	30	820	900	370	1075	555	965	1580	650	8	24	2.5"	JIS10K150A	JIS10K200A	2800

單段式尺寸表 Dimensions of One-stage

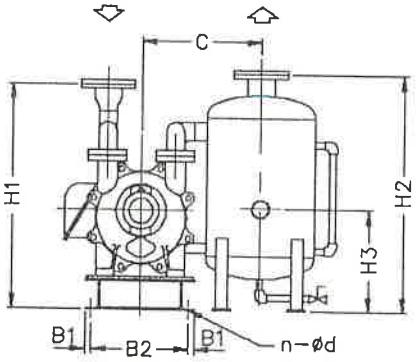
NV-40S

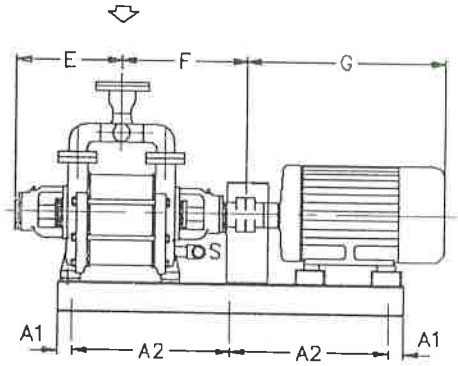




Model	A1	A2	B1	B2	C	E	F	G	H1	H2	H3	n	ød	S	Suction	Discharge	Weight (kg)
NV-40S	30	670	20	300	290	130	274	471	407	635	350	4	12	3/8"	JIS5K40A	JIS5K50A	180

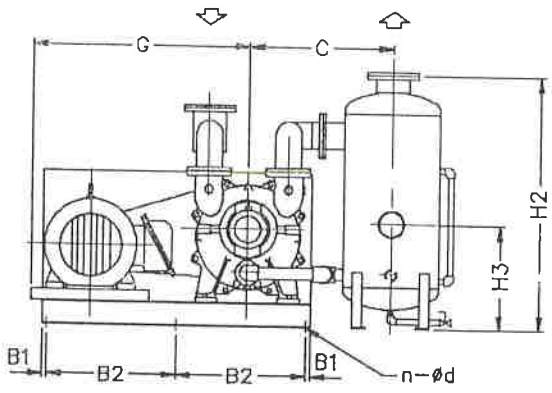
NV-45S、50S、80S、100S

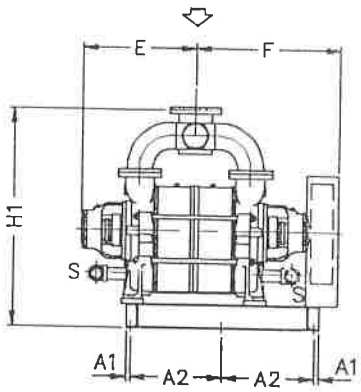




Model	A1	A2	B1	B2	C	E	F	G	H1	H2	H3	n	ød	S	Suction	Discharge	Weight (kg)
NV-45S	30	830	20	300	350	257	484	313	615	660	280	4	12	3/4"	JIS5K50A	JIS5K50A	258
NV-50S	30	550	20	330	400	351	416	667	743	780	335	6	15	1"	JIS5K80A	JIS5K80A	480
NV-80S	30	670	30	420	600	437	532	705	875	1015	440	6	19	1.25"	JIS5K100A	JIS10K100A	755
NV-100S	30	560	30	600	650	550	670	920	1060	1250	540	8	24	1.5"	JIS10K150A	JIS10K150A	1360

NV-150S



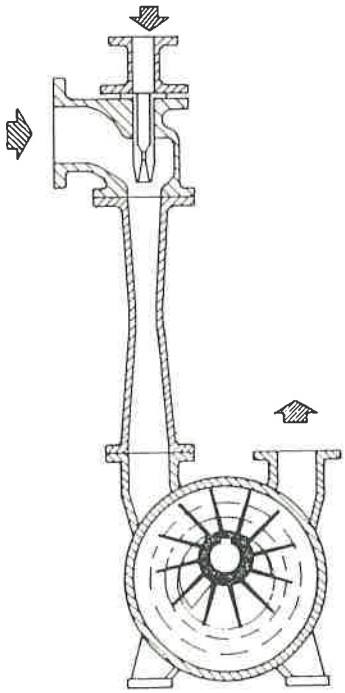


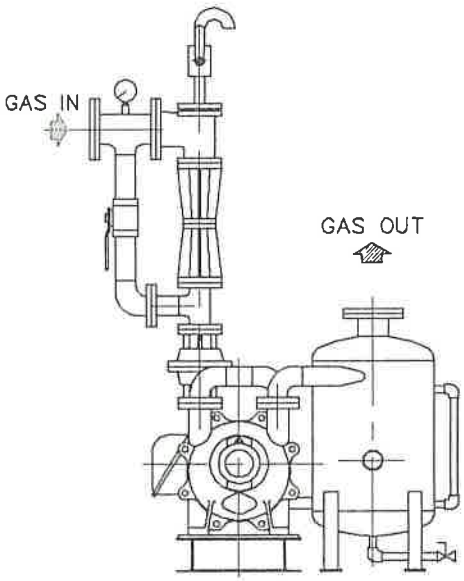
Model	A1	A2	B1	B2	C	E	F	G	H1	H2	H3	n	ød	S	Suction	Discharge	Weight (kg)
NV-150S	30	580	30	820	900	735	935	1375	1360	1580	650	8	24	2.5"	JIS10K150A	JIS10K200A	2400

大氣助力器 Atmoster

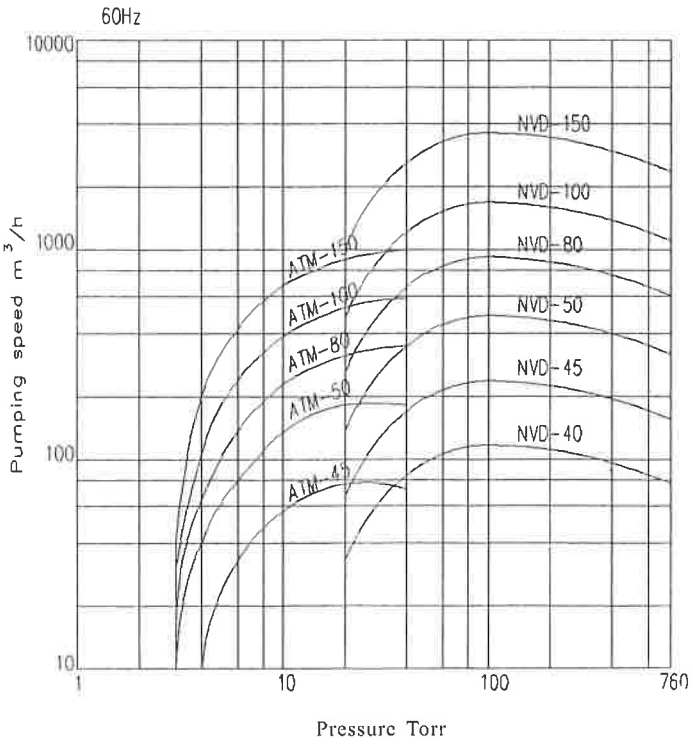
大氣助力器是空氣噴射器的一種，其原理是利用大氣中的空氣作為驅動流體，藉經過噴嘴及擴散管而產生的超音速氣流，將所需抽取的氣體帶入液封式真空幫浦後再排出大氣中。兩段式液封式真空幫浦串聯大氣助力器時，最終壓力可達 3 Torr。

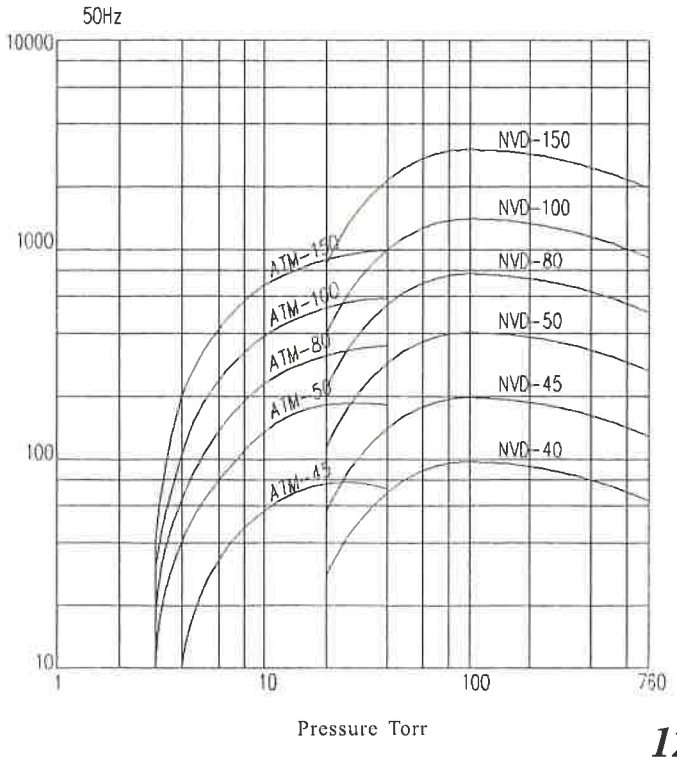
Atmoster, a type of air ejectors, that make atmosphere air to be the drive fluid, will guide attracted system gas into liquid ring vacuum pump through supersonic speed air stream, and then move to atmosphere. When Atmoster series connected with a two-stage liquid ring vacuum pump,it is able to reach ultimate pressure of 3 Torr.





性能曲線 Pumping Speed Curve





氣流的相關公式
Pertinent Equations Of Gas Flow

1. 氣流通量公式 Mass Flow

$$Q = PS \qquad Q = \frac{C}{\triangle P}$$

2. 氣導公式 Conductance

a. 串聯管路 Conductance in series

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots$$

b. 並聯管路 Conductance in parallel

$$C = C_1 + C_2 + C_3 + \cdots$$

3. 真空系統中的排氣速度
Pumping speed of vacuum system

$$\frac{1}{S} = \frac{1}{S_p} + \frac{1}{C}$$

Q ：氣流通量 Throughput
S ：排氣速度 Pumping speed
S_p ：真空幫浦排氣速度 Pumping speed of pump
△P：壓力差 Pressure difference
C ：總氣導 Total conductance
$C_{1,2,3}$ ：各管路的氣導 Conductance of different pipe sizes

抽氣時間
Pumpdown Time

$$t = \frac{2.3V}{S_p} \times \log\frac{P_1}{P_2} \times K$$

K	壓力Pressure
1	760～100Torr
1.25	100～ 10Torr
1.5	10～1 Torr
2	1～0.1Torr
4	0.1～0.01Torr

t ：時 間Time
V ：體 積Volume
P_1 ：最初壓力Initial pressure
P_2 ：最終壓力Final pressure
K ：修正因數Correction factor

註：以上公式只適用於空氣且壓力在760～0.01Torr
NOTE:The above equation is suiable for air and pressure between 760～0.01Torr

排氣速度單位 Pumping Speed Units

	m^3/h	m^3/min	l/min	l/sec	CFM
1 m^3/n	1	1.67×10^{-2}	16.67	2.78×10^{-2}	5.89×10^{-2}
1 m^3/min	60	1	1000	16.67	35.31
1 l/min	6×10^{-2}	1×10^{-3}	1	1.67×10^{-2}	3.53×10^{-2}
1 l/sec	3.60	6×10^{-2}	60	1	2.12
1 CFM	1.70	2.83×10^{-2}	28.32	4.72×10^{-1}	1

眞空度區分 Degrees Of Vacuum

	低眞空 Rough Vacuum	中眞空 Medium Vacuum	中高眞空 Medium-High Vacuum	高眞空 High Vacuum	超高眞空 Ultra-High Vacuum
壓力範圍 Torr Pressure Range	760～100	100～1	1～10^{-3}	10^{-3}～10^{-7}	10^{-7}
平均自由行徑 Mean free Path cm at 20°C	5×10^{-6} ～5×10^{-5}	5×10^{-5} ～5×10^{-3}	5×10^{-3} ～5	5 ～5×10^{5}	5×10^{5}
氣體分子數 Number of Molecules cm^3 at 20°C	2.5×10^{19} ～3.3×10^{18}	3.3×10^{18} ～3.3×10^{16}	3.3×10^{16} ～3.3×10^{13}	3.3×10^{13} ～3.3×10^{9}	3.3×10^{9}

壓力單位 Pressure Units

	Torr	Pa	bar	mbar	atm
1 Torr	1	1.3332×10^{2}	1.3332×10^{-3}	1.332	1.3158×10^{-3}
1 Pa	7.5006×10^{-3}	1	1×10^{-5}	1×10^{-2}	9.8692×10^{-6}
1 bar	7.5006×10^{2}	1×10^{5}	1	1×10^{3}	9.8692×10^{-1}
1 mbar	7.5006×10^{-1}	1×10^{2}	1×10^{-3}	1	9.8692×10^{-4}
1 atm	760	1.0133×10^{5}	1.0133	1.0133×10^{3}	1

壓力常用換算公式
Pressure Conversion formula

1Pa = 0.102 mmAq
1mbar = 10.197 mmAq
1mmHg = 13.6 mmAq
1psi = 703 mmAq
1Torr = 133.3 Pa
1Torr = 1.333 mbar

※型錄內容若有更改，恕不另行通知。 Revision of this catalogue will make no additional information.

訂製資料表 Data Sheet

顧　　客	Customer
機　　型	Model
用　　途	Service
數　　量	Quantity
請購案號	Purchasing No.

操作條件 Operating Conditions

抽氣種類	Gas Handled		
入口壓力	Suction Pressure		Torr
出口壓力	Discharge Pressure	☐ ATM	☐
抽 氣 量	Capacity		m^3/min(at suction conditions)
氣體溫度	Gas Temperature		°C
封液種類	Sealing Liquid	☐ Water	☐
封液溫度	Sealing Liquid Temp.		°C

材　　質 Material

外　　殼	Casing	☐ FC200	☐
葉　　輪	Impeller	☐ SCS13	☐
主　　軸	Shaft	☐ SUS304	☐
連 通 管	Connecting Pipe	☐ SS400	☐
軸　　封	Shaft Seal	☐	☐
底　　台	Base	☐ SS400	☐
分 離 桶	Separator	☐ SS400	☐

馬　　達 Motor

型　　式	Type			廠　牌	Brand	
	HP	P	V	ϕ	Hz	Class

附　　件 Accessories

☐	Separator	☐
☐	Check Valve	☐
☐	Atmoster	☐
☐		☐

主要產品　　Main Products

- 工業用送排風機 • Fans & Blowers
- 魯氏鼓風機 • Roots Blowers
- 多段魯氏壓縮機 • Multi-Stage Roots Compressor
- 真空幫浦 • Vacuum Pumps
- 真空排氣系統 • Vacuum Pumping Systems
- 多段魯氏真空幫浦 • Multi-Stage Roots Vacuum Pump

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