AIR JET VACUUM EJECTOR FOR LIQUID RING VACUUM PUMPS GES Series

Suction and compression of gas

AISI 316 ejector

Carbon steel ejector.

PP ejector

Unlike other types of gas ejectors, air jet vacuum ejectors for liquid ring vacuum pump, use atmospheric air pressure as motive fluid.
These ejectors are used to increase the vacuum level of the liquid ring vacuum pump, preventing it from cavitation even if the suction port of the ejector is closed, thus ensuring its integrity and long- lasting use.

Ejectors are usually installed on the suction connection of the pump; they are simple and sturdy and by selecting suitable material, they are adaptable to different operating conditions.

Since they have no moving parts, they do not require maintenance and operate at atmospheric pressure, without energy impact.

To speed up the evacuation, the air ejector can be bypassed and operated only when the required interstage pressure is reached.

The performance of the ejectors is strictly related to the suction capacity of the liquid ring vacuum pump and to the vapour pressure and temperature of the service liquid used.

Usually the obtainable vacuum is limited to 33 mbar (using water to 15°C)

To suit all needs, we offer two different series of ejectors:

Sealant Liquid Ring Vacuum pump	Water up to 20°C	Water up to 30°C
Ejector suction pressure	4…6 ÷ 40 mbar	12..15 ÷ 80 mbar
Ejector Series	LT	HT

Fig.1

A necessary condition for the proper functioning of the ejector is that the pump can suck the outlet flow at a pressure equal to or lower than the ejector discharge pressure.

It is recommended to choose a pump for a suction pressure that is 10% lower than the ejector discharge pressure.

If steam is available as a motive fluid, it is advisable to place a condenser between the ejector and the liquid ring vacuum pump, to condense the steam without discharging it inside the pump, as would happen in the case of operation with atmospheric pressure.

Operating

The ejector is a static pump, without moving parts.

The operation, based on the Bernoulli principle, works in two phases: in the first one the static energy of the motive fluid (atmospheric air) is converted in kinetic energy, flowing through a special designed nozzle.

The sucked fluid, having absorbed part of the motive fluid kinetic energy, enters the low pressure area next to the nozzle through the suction connection.

In the second phase, the motive and suction gas, completely mixed, pass though the diffuser where the velocity is reconverted back to pressure energy. The mixture is then discharged into the pump and recompressed into the atmosphere

Applications

Air jet vacuum ejectors find their best application whenever it is necessary to extend the operating range of a liquid ring vacuum pump, limited by the high temperature of the sealing liquid or where there is a risk of operating in cavitation
A typical application is for vacuum evaporators and concentration units.
Combined with the liquid ring vacuum pump, they constitute the main element of the vacuum system circuit (Fig. 2).

Fig.2

A common application is the two-stage cold water degasser.
Two atmospheric air ejectors operating simultaneously and in parallel, discharging on the same liquid ring vacuum pump, maintain a different vacuum in the two different compartments of the degasser.

Manufacturing

The air jet vacuum ejectors can be manufactured with any plastic or metallic material that can be machined by machine tool.

Thanks to the numerous manufacturing options, they guarantee a high resistance to erosive/corrosive fluid and to the environment in which they are installed.

The standard production includes flanged connections at suction and discharge and threated connection to the motive air.

Fig.3

Connections

- Flanged - according to normative EN or ANSI
- Threaded
- Pipe union
- Butt weld
- Special connections on request

(See Connections and dimensions' scheme at page 6)

Installation

Air jet vacuum ejectors are normally installed on the suction pump connection.

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To obtain the best performance in particular situations, it is recommended to install a by-pass system in parallel to the ejector (fig. 4), to avoid operation when not necessary, and to avoid pressure drops due to the flow through the diffuser.

N1: motive air at atmospheric pressure

N2: suction process fluid

N3: ejector discharge = suction pump

A: pump discharge atmosphere

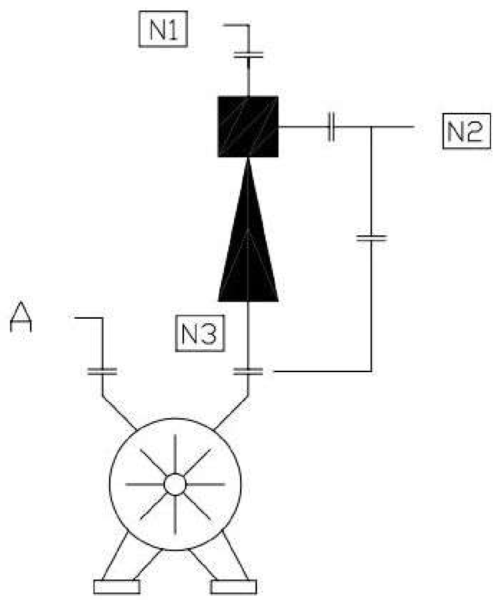

Fig.4

PERFORMANCE CURVE (motive water at 15°C)

The diagram estimates the suction flow rate at different suction pressures.

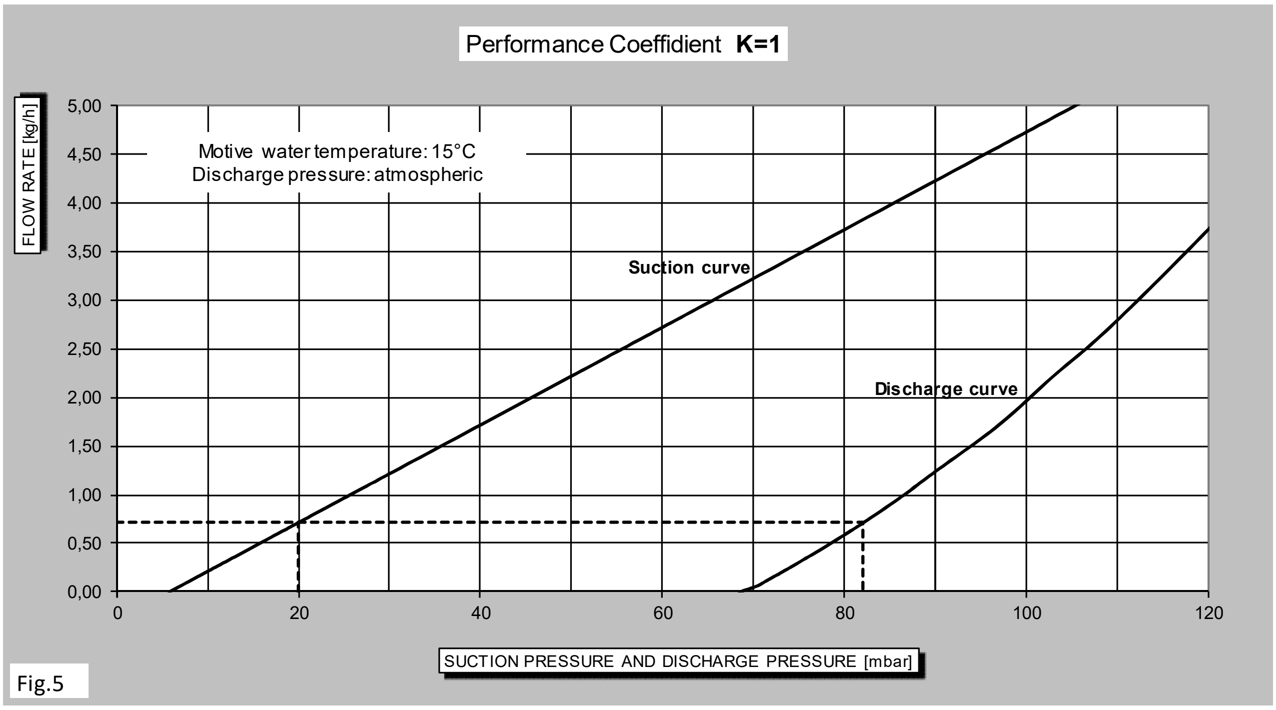

Fig.5

Example of calculation:

Suction pressure: 20 mbar

Suction flow rate: 1.3 kg/h

As indicted in fig. 5, the suction flow rate is about 0.7 kg/h of air (coefficient K=1).
According to the table (Fig.6), the coefficient K is obtained by the comparison between the requested flow rate and the reference one (K=1) that means 1.3/0.7 = 1.71 which correspond to the motive flow rate of 7.3 kg/h (coefficient of 1.89).
Crossing the discharge line, the delivery pressure value is obtained equal to 82 mbar.
The total delivery flow rate is 7.3 kg/h + 1.32 kg/h (0.7*1.89) = 8.62 kg/h of air which corresponds, at 82 mbar and 20°C, to 82 m³/h.

As already detailed, it is recommended to choose a pump for a suction pressure 10% lower than the ejector discharge pressure.

In case of operating with a suction fluid other than air or with different temperatures, please contact our Technical Department.

Motive flow rate (kg/h)	Coefficient K
1.5	0.35
2.68	0.66
3.86	1
7.3	1.89
12.4	3.28
20.3	5.57
32.8	9.35
53.1	15.8

Fig.6

PERFORMANCE CURVE (motive water at 30°C)

The diagram estimates the suction air flow rate at different suction pressures.

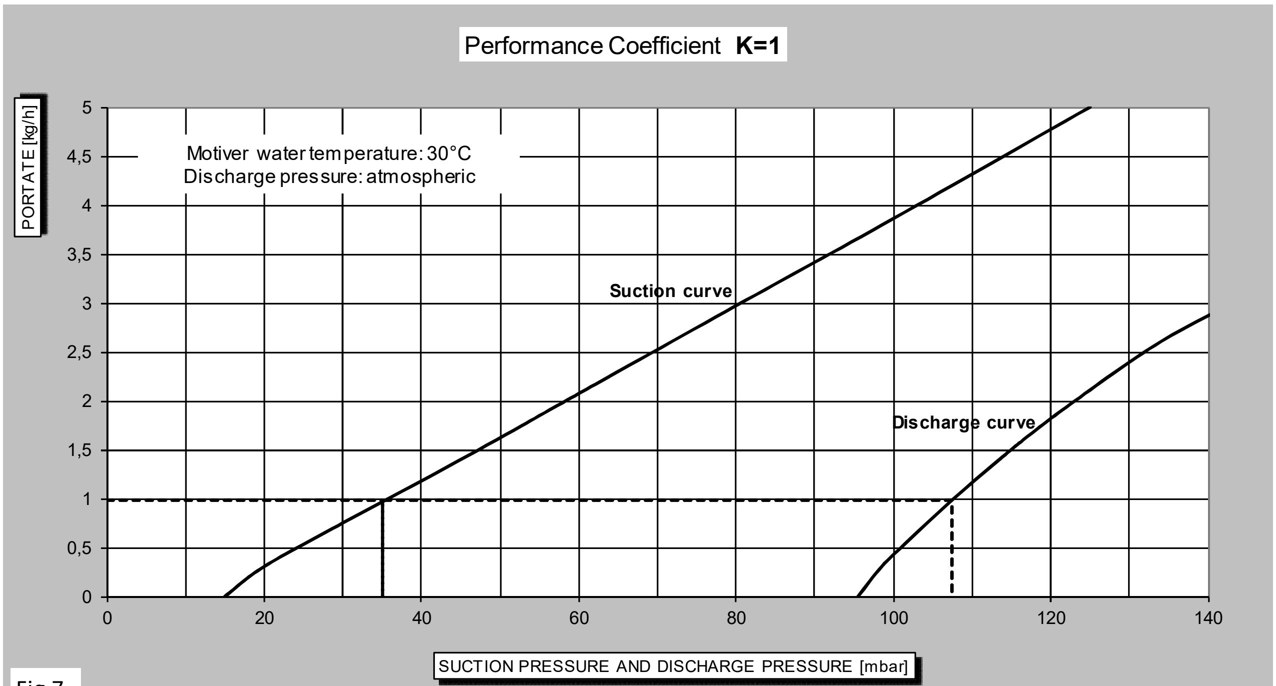

Fig.7

Example of calculation:

Suction pressure: 35 mbar
Suction flow rate: 5.5 kg/h

As indicated in fig. 7, the suction flow rate is about 1.0 kg / h of air (K coefficient = 1).
According to the table (Fig. 6), the coefficient K is obtained from the comparison between the requested flow rate and the reference one (K=1) that means 5.5/1.0 = 5.5 which correspond to the motive flow rate of 20.3 kg/h. (coefficient of 5.57)
Crossing the discharge line, the delivery pressure value is obtained equal to 107.5 mbar.
The delivery flow rate is 20.3 kg/h +5.57 kg/h (1*5.57) = 25.87 kg/h of air which correspond, at 107.5 mbar and 20°C, to 188 m³/h.

As already detailed, it is recommended to choose a pump for a suction pressure 10% lower than the ejector discharge pressure.

In case of operating with a suction fluid other than air or with different temperatures, please contact our Technical Department.

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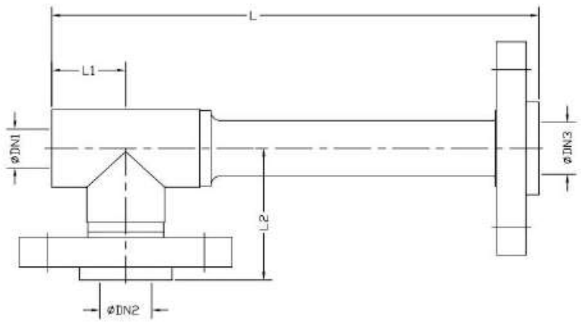
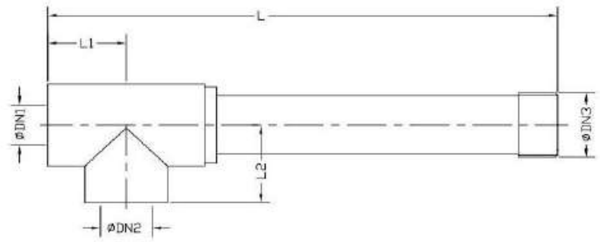
Connections, dimensions and weight

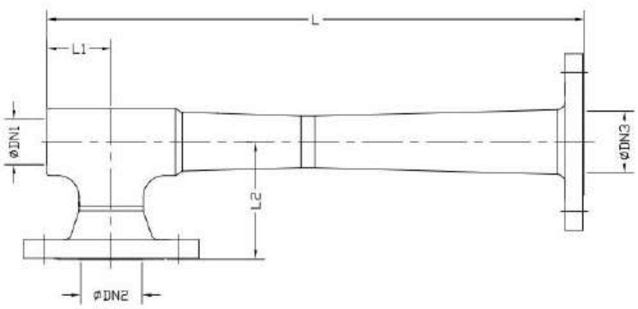
DN1 = motive liquid **DN2 = suction fluid** **DN3 = discharge**



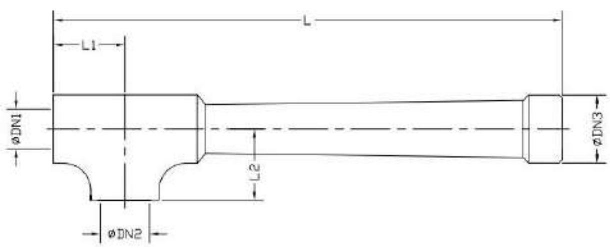
PVC, PP – LJ FLANGES CONNECTION IN PP_V EN 1092-1							
	Connections			Dimensions [mm]			Weight
Air motive [kg/h]	DN1	DN2	DN3	L	L1	L2	Kg
1.5 - 2.68	1/2	25	25	263	40	71	0.75
2.68 - 3.86	3/4	32	32	350	49	86	1.5
3.86 -7.3 -12.4	3/4	40	40	439	57	100	2.2
7.3 – 12.4 – 20.3	1”	50	50	484	71	123	3.5
12.4 – 20.3	2”	65	65	579	83	142	4.5
32.8 – 53.1	2”	80	80	725	97	165	7.0
32.8 – 53.1	2”	100	100	950	116	195	11.0
Connection air motive: threated BSP F.							



PVC, PP – THREATED BSP CONNECTION							
	Connections			Dimensions			Weigh
Air motive [kg/h]	DN1	DN2	DN3	L	L1	L2	Kg
1.5 - 2.68	1/2	3/4	1”	26 0	40	40	0.35
2.68 - 3.86	3/4	1”1/4	1”1/4	34	49	10	1.0
3.86 -7.3 -	3/4	1”1/2	1”1/2	43	57	11	1.8
7.3 – 12.4 –	1”	2”	2”	48	71	14	2.8
12.4 – 20.3	2”	2”1/2	2”1/2	57	83	16	3.6
32.8 – 53.1	2”	3”	3”	72	97	19	5.5
32.8 – 53.1	2”	4”	4”				
Connection air motive: threated BSP F.							



CARBON/STEINLESS STEEL – FLANGES CONNECTION EN							
	Connections			Dimensions [mm]			Weight
Air motive [kg/h]	DN1	DN2	DN3	L	L1	L2	kg
1.5 - 2.68	1/2	25	25	248	35	78	3
2.68 - 3.86	3/4	32	32	320	45	90	6
3.86 -7.3 -	3/4	40	40	395	53	10	12
7.3 – 12.4	1”	50	50	500	60	11	15
12.4 – 20.3	2”	65	65	600	81	12	19
32.8 – 53.1	2”	80	80	765	81	13	26
32.8 – 53.1	2”	100	100	945	95	15	28
Connection air motive: threated BSP F							



CARBON/STEINLESS STEEL – THREATED CONNECTIONS							
	Connections			Dimensions [mm]			Weig
Air motive [kg/h]	DN1	DN2	DN3	L	L1	L2	kg
1.5 - 2.68	1/2	3/4	1	256	42	28	2.4
2.68 - 3.86	3/4	1”1/4	1”1/4	320	51	38	3.0
3.86 -7.3 -	3/4	1”1/2	1”1/2	405	60	46	4.5
7.3 – 12.4	1”	2”	2”	505	65	48	6.0
12.4 – 20.3	1”1/2	2“1/2	2“1/2	590	75	57	8.5
32.8 – 53.1	2”	3”	3”	750	90	69	12.6
Connection air motive: threated BSP F							