LIQUID JET VACUUM EJECTORS

Suction and compression of gas Mod. GEL

Liquid jet vacuum ejectors are simple and versatile devices that generate vacuum using water or other pressurized liquid, sucking gas or steam and discharging them at an intermediate pressure between the motive and suction pressures.

The ejector sucks in gases and /or vapours thanks to the kinetic energy gained from the motive liquid. At the same time the vapours – as far as physically possible - will be condensed.

Liquid jet compressors have no moving parts: they consist of a head, a motive nozzle (with twist piece) and a diffuser.

Being self-priming, they are ideal for discontinuous operations: for this reason they often are used to assist non-priming centrifugal pumps.

An ejector is based upon the Bernoulli's principle which states: "When the speed of a fluid increases, its pressure decreases and vice versa." The liquid ejector uses a converging nozzle to increase fluid velocity to transform high static pressure into velocity pressure. This conversion of static pressure to velocity pressure results in a low-pressure zone that provides the driving force to entrain a side fluid. The mixed fluid then flows through a diffuser section comprising a diverging diffuser which then reduces the velocity and increases the pressure, thereby recompressing the mixed fluid.

The achievable vacuum of the water jet vacuum pump corresponds to the vapour pressure of the motive liquid and therefore depends on its temperature.

Considering water as the motive fluid, the relationship between the water temperature and the lowest suction pressure, is shown in fig.2

Higher vacuum can be reached by an additional cooling of the motive liquid.

Operating Mod. GEL

Liquid is pumped through the nozzle, emerging at a relatively high velocity, creating a zone of lower pressure contained within the suction chamber of the ejector.

The secondary or suction fluid is drawn to this lower pressure zone, where the momentum of the motive liquid is transferred to the suction fluid, causing the suction fluid to be pumped.

When the mixtures reach the diffuser, they gradually reduce the speed and recover the energy of pressure at discharge with very little loss.

Applications — Mod. GEL

Liquid jet vacuum pumps can be used in different industries for multiple applications.
Mainly they can be divided in three categories:

- Concentrators an evaporation plants. Added to the centrifugal pump, it is the main element of the vacuum system.
- Mixing of liquids with gases and vapours. Due to the high turbulence inside the diffuser, micro-bubbles are generated to get elevated liquid/gas exchange rates (i.e. ozone plants)
- To prime centrifugal pumps or drain pipes. The ejector is used for the evacuation of the suction line of a centrifugal pump before its start -up. Usually the required vacuum is between 1,5 to 6 meter of water column.

Manufacturing — Mod. GEL

Ejectors are manufactured from any machinable materials.
Thanks to the wide range of construction features, they guarantee high resistance to different liquids and conditions.
When their application uses water as motive fluid, they usually are made of plastic material such as PVC, PP, PVDF.
Units can be made of cast iron, bronze, stainless steel, carbon steel, titanium, depending on the application.

Liquid jet connections

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

Installation — Mod. GEL

Liquid jet vacuum ejectors normally use water as motive fluid.

To avoid waste of water, it is possible to circulate the operating water (see fig.1).

Temperature of the motive flow can be cooled by adding liquid from outside or from a chiller type refrigeration system.

They should be mounted in a vertical position with the flow direction from top to bottom.

Provide at the discharge a straight pipe of at least 500 mm (min 150 immersed below the liquid level).

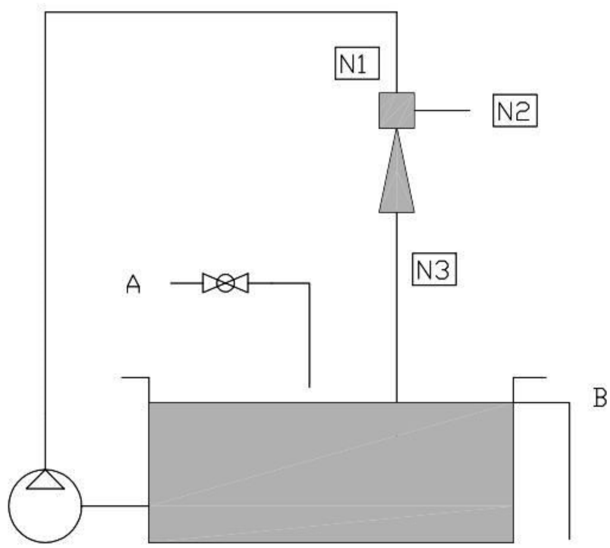

Fig.1

Operation — Mod. GEL

If present, open the shut-off valve on the discharge line, to prevent motive liquid from flowing through the suction connection.

Slowly open the shut-off valve on the motive line; check that the liquid flow rate is equal to the design value and that the ejector discharge is regular.

Slowly open the optional shut-off valve on the suction pipe.

Install a valve closed to the suction connection to adjust the flow rate to the required value.

It's mandatory to verify that the ejector does not work on a cavitation range, which causes an increase in the noise and a quick wear of the diffuser.

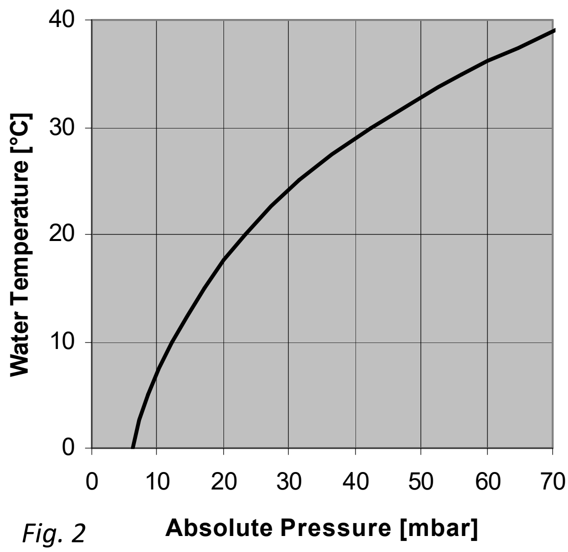

Fig. 2

To avoid cavitation, the temperature of the motive flow must be at least 3°C lower that the saturation temperature corresponding to the suction pressure.

Motive Flow Rate Diagram Mod. GEL

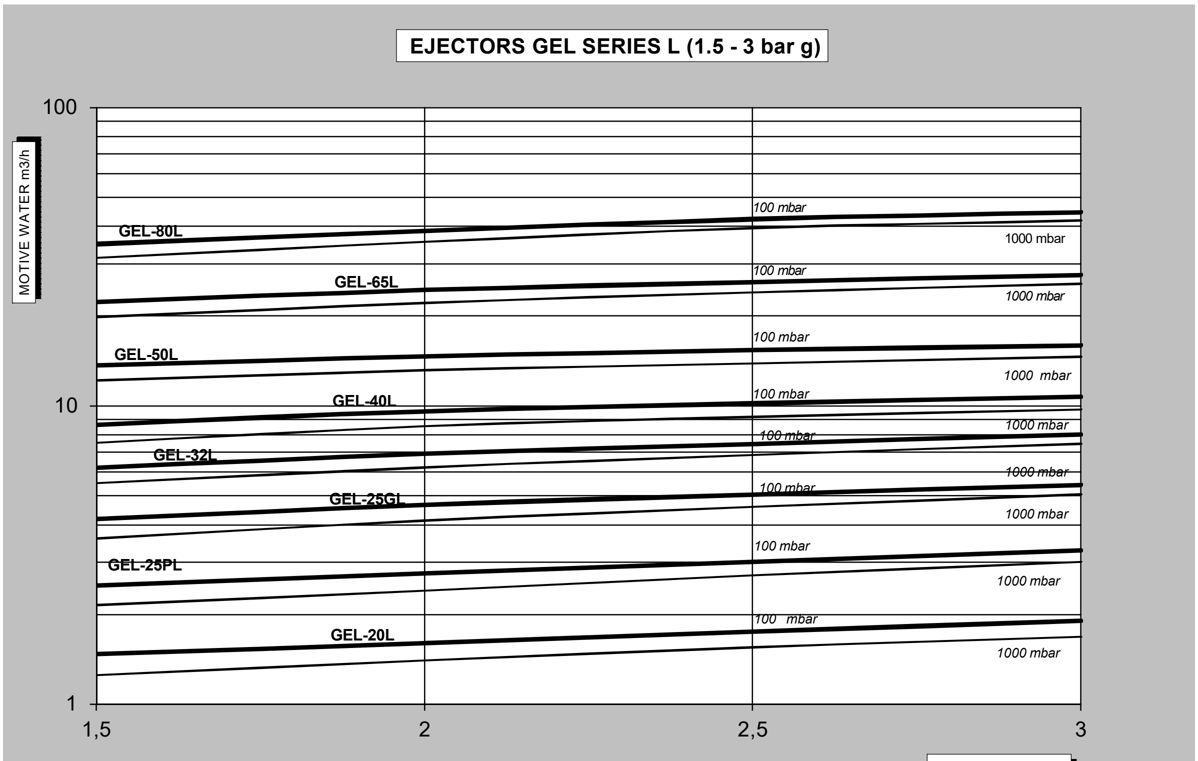

Fig.3

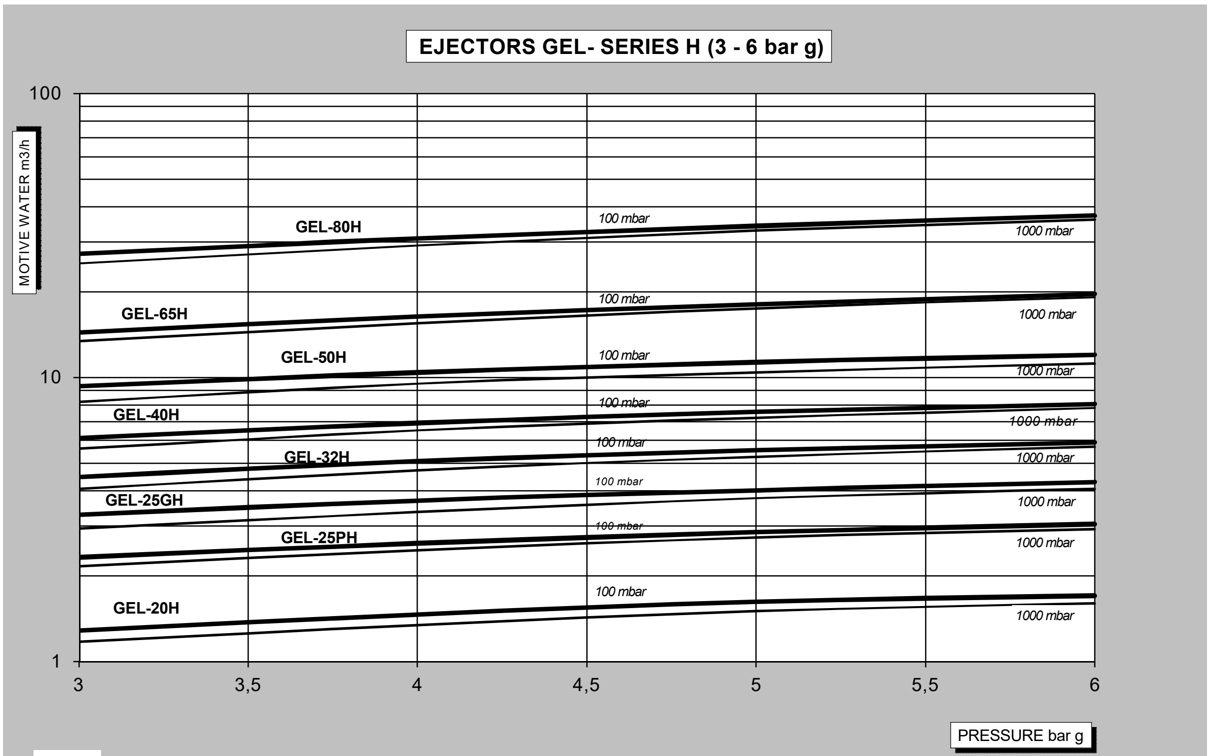

Fig.4

SUCTION FLOW RATE – OPERATING EJECTOR (Motive pressure 1.5 ÷ 3 bar g) Mod. GEL

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

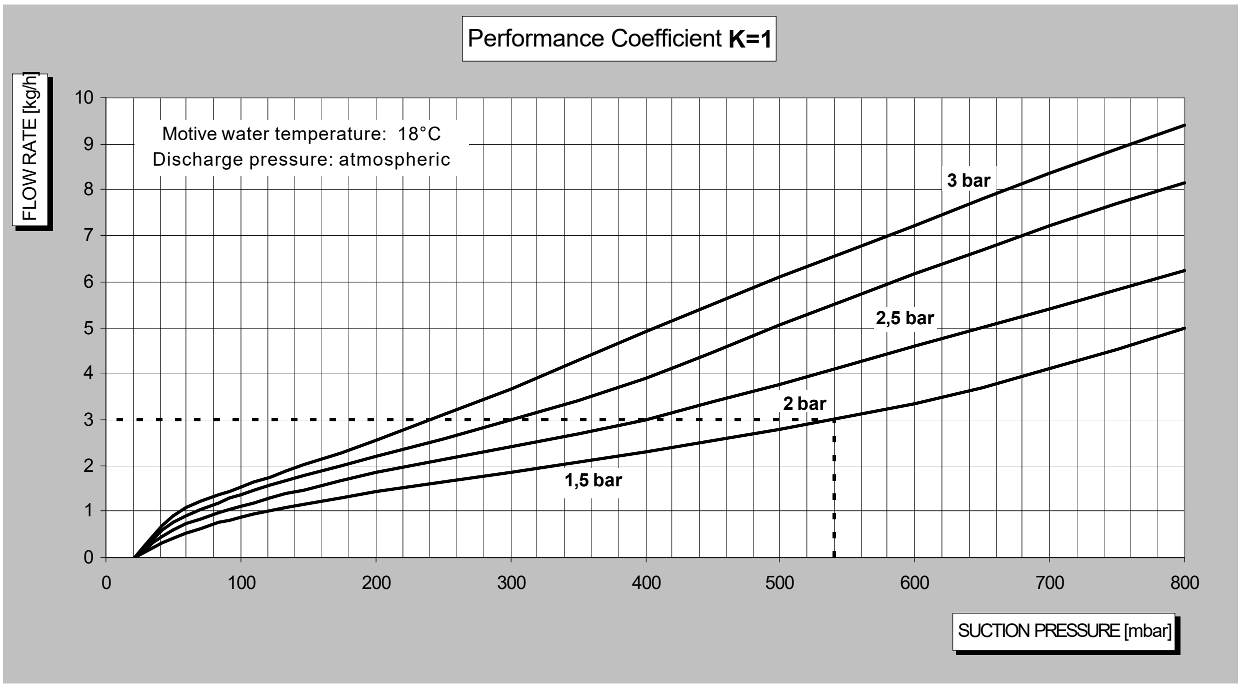

Fig. 5

Example of calculation:

Temperature of motive water: 18°C
Suction pressure: 540 mbar
Motive pressure: 1.5 bar g
Air suction flow rate: 2 kg/h

As indicated in fig. 5, the suction flow rate is about 3kg/h of air (coefficient K=1).

According to the table of performance (fig.6), the coefficient K is obtained from the comparison between the required flow rate and the reference one (K=1): it means 2/3=0,66 which corresponds to GEL25PL (K=0,7).

The motive flow rate, referred to the suction pressure (Fig.3) is approximately 4m^3/h of water.

In case of operation with discharge pressure higher than the atmosphere, please contact our Technical Department.

The ejectors operating at low motive pressure have a notable decrease in performances as the discharge pressure increases.

In case of long pipes, increase the size of the pipes to reduce the pressure drop.

CODE	COEFFICIENT K
GEL-20L	0.2
GEL-25PL	0.35
GEL-25GL	0.7
GEL-32L	1
GEL-40L	1.38
GEL-50L	2.2
GEL-65L	3.6
GEL-80L	5.65

Fig.6

SUCTION FLOW RATE – OPERATING EJECTOR (motive pressure 3 ÷ 6 bar g) Mod. GEL

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

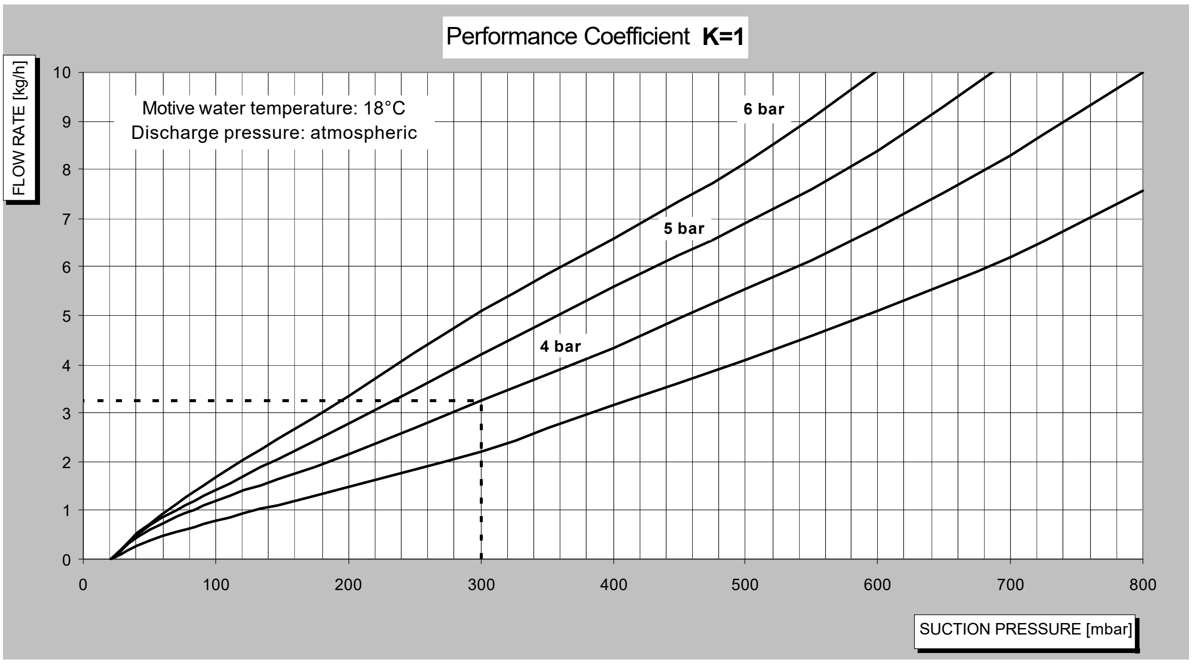

Fig. 7

<u>Example of calculation:</u>

Pressure of suction:	300 mbar
Motive pressure:	4.0 bar g
Air Suction flow rate:	4.6 kg/h

As indicated in fig.7, the suction flow rate is about 3.25 kg/h of air (coefficient K=1).
According to the table of performance (fig.8), the coefficient K is obtained by the comparison between the required flow rate and the reference one (K=1): it means 4.6/3.25=1,41 which corresponds to GEL40H (K=1,49).
The motive flow rate, referred to the suction pressure (Fig.4), is approximately 6.9 m^3/h of water.

CODE	COEFFICIENT K
GEL-20H	0.29
GEL-25PH	0.52
GEL-25GH	0.67
GEL-32H	1
GEL-40H	1.49
GEL-50H	2.26
GEL-65H	3.25
GEL-80L	6.15

Fig .8

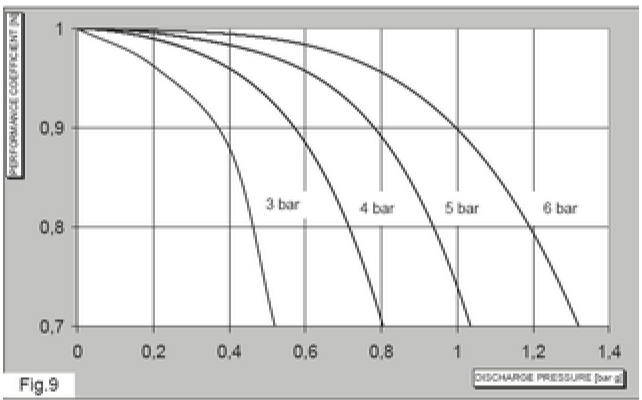

Fig.9

In case of operation with discharge pressure higher than the atmosphere, the decrease in performance is obtained by the coefficient N in fig. 9.

SUCTION FLOW RATE – START UP EJECTOR (motive pressure 1.5 ÷ 3 bar g) Mod. GEL

The diagram estimates evacuation time starting from atmospheric pressure.

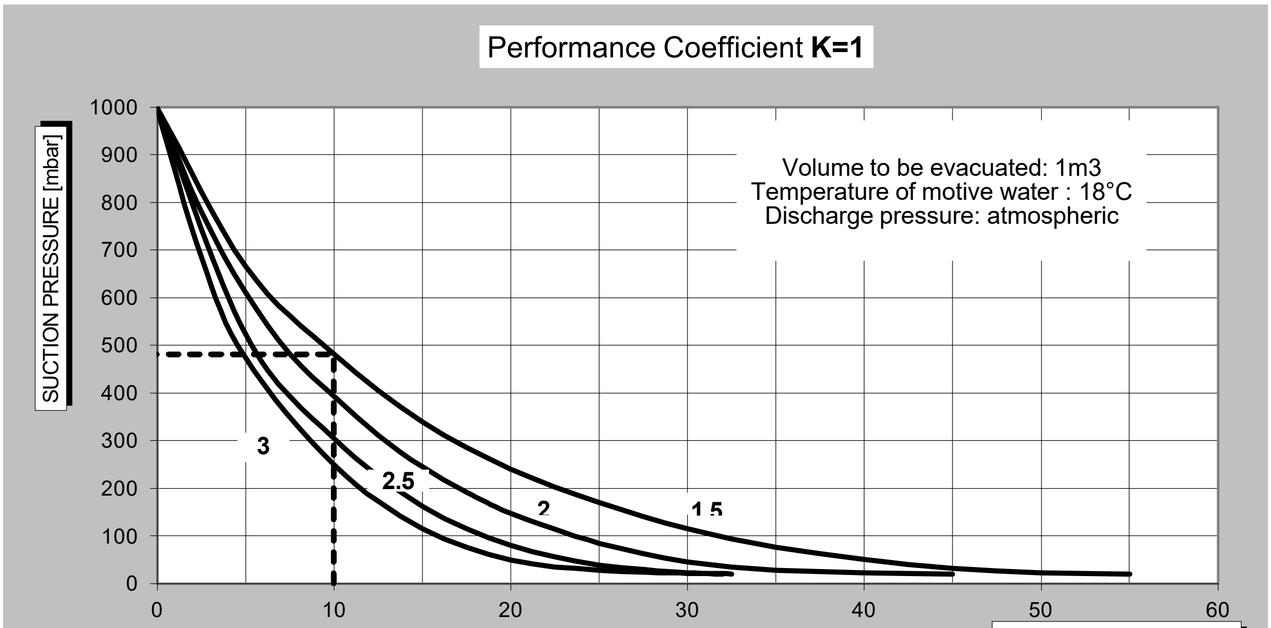

Fig.10

<u>Example of calculation:</u> atmospheric
Initial suction pressure: 480 mbar
Final suction pressure: 1.5 bar g
Motive pressure: 1 m³
Volume to be evacuated: 12’
Evacuation time:

As indicated in fig. 10, the evacuation of 1 m^3 volume (coefficient K=1) is about 10 minutes.
According to the table of performance (Fig.8), the coefficient K is obtained considering the required volume and time, as follows: K= 10/12 * 0.8/1 = 0.66 which corresponds to GEL-25GL (K=0.7; Fig.11).
The motive flow (Fig. 3) is between 3.6 m^3/h – if the suction pressure is atmospheric – and 3.75 m^3/h if the suction pressure is about 480 mbar.

In case of operation with a discharge pressure higher than the atmosphere, please contact our Technical Department.
Ejectors operating at low motive pressure have a notable decrease in performance as the discharge pressure increases.
In case of long pipes, increase the size of the pipes to reduce the pressure drop.

CODE	*COEFFICIENT K*
GEL-20L	*0.2*
GEL-25PL	*0.35*
GEL-25GL	*0.7*
GEL-32L	*1*
GEL-40L	*1.38*
GEL-50L	*2.2*
GEL-65L	*3.6*
GEL-80L	*5.65*

Fig. 11

SUCTION FLOW RATE – START UP EJECTOR (motive pressure 3 ÷ 6 bar g) Mod. GEL

The diagram estimates evacuation time starting from atmospheric pressure.

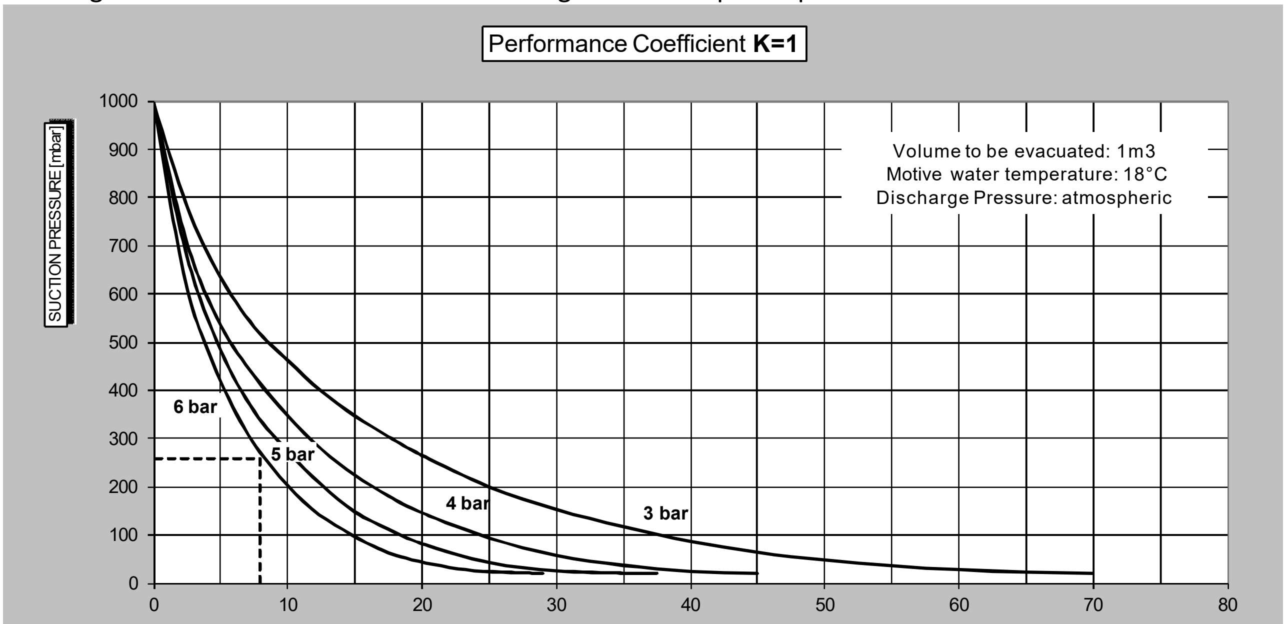

Fig.12

<u>Example of calculation:</u>

Initial suction pressure: Atmospheric
Final suction pressure: 260 mbar
Motive pressure: 6.0 bar g
Volume to be discharged: 2.0 m³
Duration for discharging: 5’

As indicated in fig. 12, the evacuation of 1 m^3 volume (coefficient K=1) is about 8 minutes.
According to the table of performance coefficients (Fig.13), the coefficient K is obtained considering the volume and time required, as follows:
K= 8/5 * 2/1 = 3.2 which correspond to GEL-65H (K=3.25; Fig.8).
The motive flow (Fig. 4) is between 19 m³/h – if the suction pressure is atmospheric – to 19.5 m³/h if the suction pressure is about 300 mbar

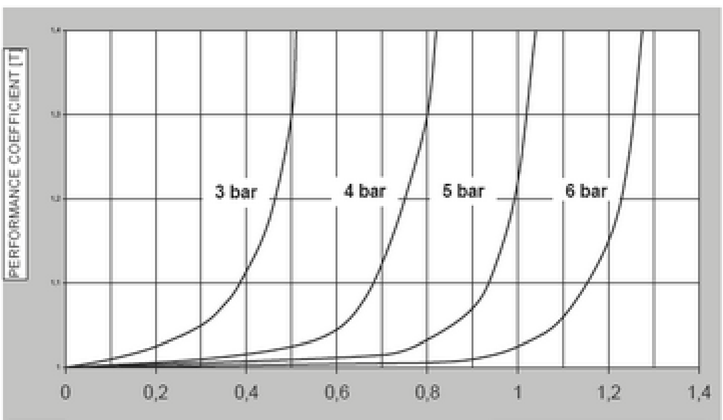

Fig.13

In case of operation with discharge pressure higher than the atmosphere, the decrease in performances is obtained by the coefficient N in fig.13

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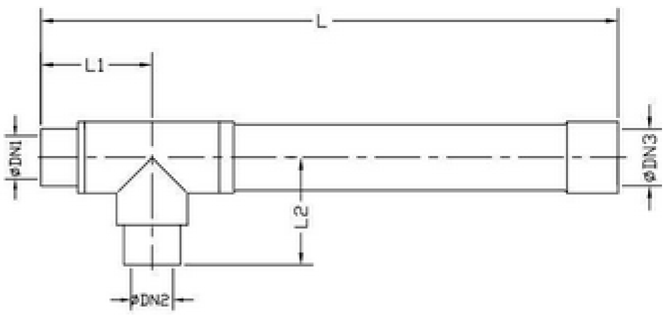
Connections, dimensions and weights — Mod. GEL

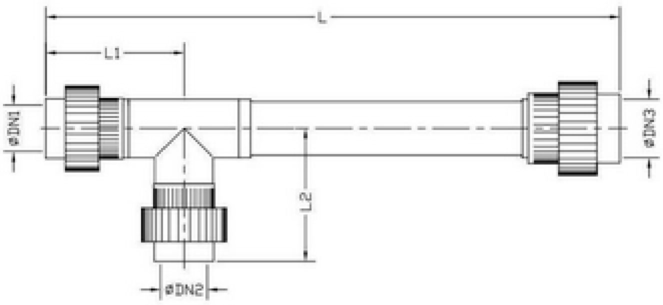
DN1 = motive liquid **DN2 = suction fluid** **DN3 = discharge**



PVC – GLUED

Code	Connections DN1	DN2	DN3	Dimensions [mm] L	L1	L2	Weight kg
GELV-20I L/H	15	15	20	226	54	52	0.3
GELV-25PI L/H GELV-25GI L/H	20	20	25	250	56	52	0.4
GELV-32I L/H	25	25	32	316	66	65	0.6
GELV-40I L/H	32	32	40	408	79	77	1.2
GELV-50I L/H	40	40	50	496	94	90	1.6
GELV-65I L/H	50	50	65	605	115	113	2.3
GELV-80I L/H	65	65	80	800	134	127	3.4

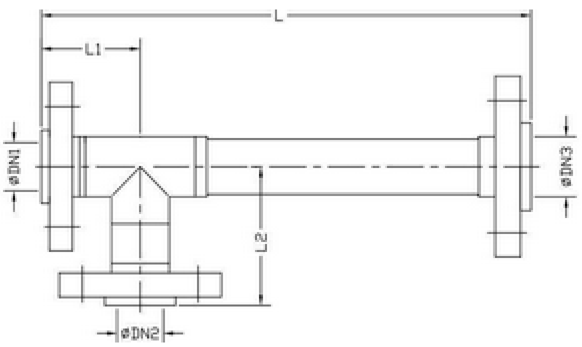
L = motive pressure 1.5 -3.0 bar g
H = motive pressure 3.0 - 6.0 bar g



PVC – PIPE UNION

Code	Connections DN1	DN2	DN3	Dimensions [mm] L	L1	L2	Weight kg
GELV-20B L/H	15	15	20	289	84	79	0.4
GELV-25PB L/H GELV-25GB L/H	20	20	25	320	90	85	0.5
GELV-32B L/H	25	25	32	392	102	99	0.8
GELV-40B L/H	32	32	40	500	120	117	1.5
GELV-50B L/H	40	40	50	605	143	140	2.0
GELV-65B L/H	50	50	65	732	175	173	3.0
GELV-80B L/H	65	65	80	930	202	198	4.5

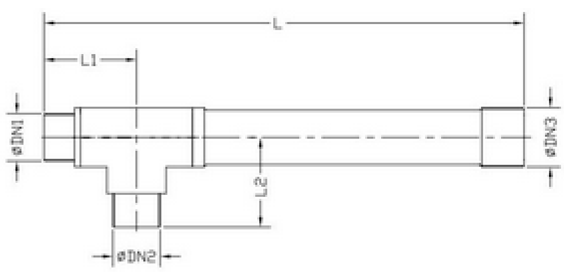
L = motive pressure 1.5 - 3.0 bar g
H = motive pressure 3.0 - 6.0 bar g



PVC – LAP JOINT PP-V EN 1092-1

Code	Connections DN1	DN2	DN3	Dimensions[mm] L	L1	L2	Weight kg
GELV-20FL L/H	15	15	20	232	57	79	0.7
GELV-25PFL L/H GELV-25GFL L/H	20	20	25	258	60	85	0.8
GELV-32FL L/H	25	25	32	325	71	91	1.2
GELV-40FL L/H	32	32	40	412	81	114	2.1
GELV-50FL L/H	40	40	50	491	98	122	3.0
GELV-65FL L/H	50	50	65	656	119	134	4.5
GELV-80FL L/H	65	65	80	810	139	145	7.0

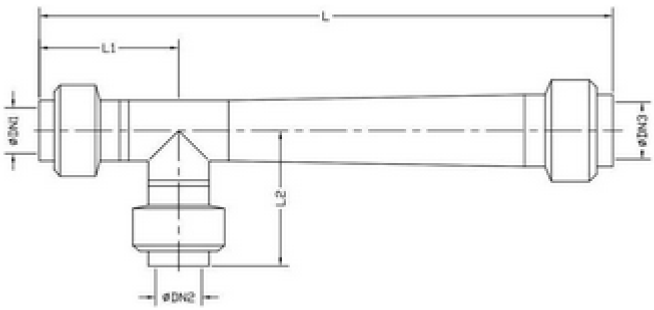
L = motive pressure 1.5 - 3.0 bar g
H = motive pressure 3.0 - 6.0 bar g



PVC – THREATED BSP G.

Code	Connections DN1	DN2	DN3	Dimensions [mm] L	L1	L2	Weight kg
GELV-20F L/H	1/2	1/2	3/4	241	69	70	0.3
GELV-25PF L/H GELV-25GF L/H	3/4	3/4	1”	265	71	70	0.4
GELV-32F L/H	1”	1”	1”1/4	331	81	88	0.6
GELV-40F L/H	1”1/4	1”1/4	1”1/2	428	99	100	1.2
GELV-50F L/H	1”1/2	1”1/2	2”	516	114	113	1.6

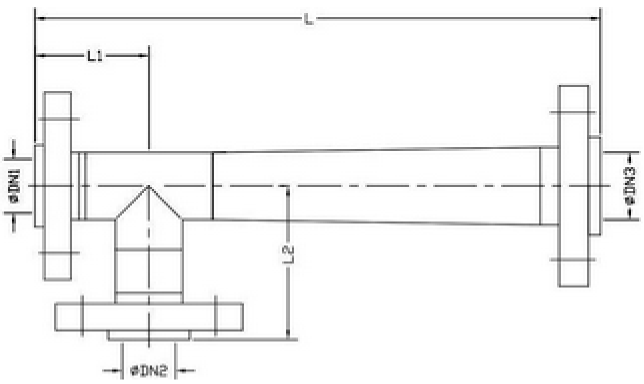
L = motive pressure 1.5 -3.0 bar g
H = motive pressure 3.0 -6.0 bar g



PP – PIPE UNION

Code	Connections DN1	DN2	DN3	Dimensions [mm] L	L1	L2	Weight kg
GELP-20B L/H	15	15	20	285	89	87	0.4
GELP-25PB L/H GELP-25GB L/H	20	20	25	335	97	95	0.5
GELP-32B L/H	25	25	32	411	112	108	0.8
GELP-40B L/H	32	32	40	500	122	119	1.5
GELP-50B L/H	40	40	50	598	142	135	2.0
GELP-65B L/H	50	50	65	778	180	175	3.0
GELP-80B L/H	65	65	80	930	205	200	4.5

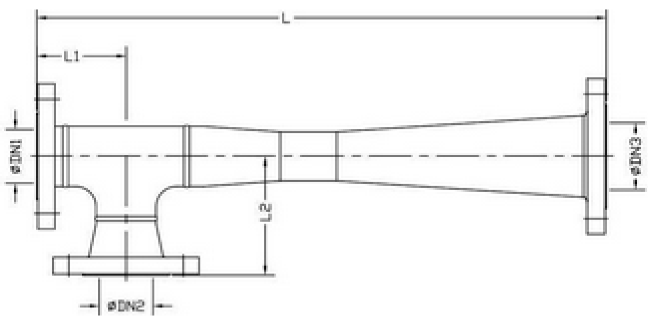
L = motive pressure 1.5 -3.0 bar g
H = motive pressure 3.0 -6.0 bar g



PP – LAP JOINT PP-V EN 1092-1

Code	Connections DN1	DN2	DN3	Dimensions [mm] L	L1	L2	Weight kg
GELP-20FL L/H	15	15	20	215	55	79	0.7
GELP-25PFL L/H GELP-25GFL L/H	20	20	25	255	59	85	0.8
GELP-32FL L/H	25	25	32	326	71	91	1.2
GELP-40FL L/H	32	32	40	405	77	112	2.1
GELP-50FL L/H	40	40	50	493	91	122	3.0
GELP-65FL L/H	50	50	65	650	116	134	4.5
GELP-80FL L/H	65	65	80	800	137	145	7.0

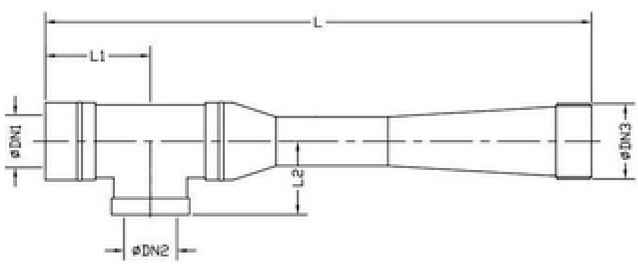
L = motive pressure 1.5 -3.0 bar g
H = motive pressure 3.0 -6.0 bar g



CARBON/STAINLESS STEEEL – FLANGED EN 1092-1

Code	Connections DN1	DN2	DN3	Dimensions [mm] L	L1	L2	Weight kg
GELC/6-20FL L/H	15	15	20	218	45	82	4.6
GELC/6-25PFL L/H GELC/6-25GFL L/H	20	20	25	241	47	84	6.1
GELC/6-32FL L/H	25	25	32	327	70	88	7.4
GELC/6-40FL L/H	32	32	40	398	60	115	8.8
GELC/6-50FL L/H	40	40	50	470	65	120	11.0
GELC/6-65FL L/H	50	50	65	608	70	125	16.0
GELC/6-80FL L/H	65	65	80	755	88	140	22.0

C = carbon steel L = motive pressure 1.5 - 3.0 bar g
6 = AISI 316L H = motive pressure 3.0 - 6.0 bar g



CARBON STEEL/STAINLESS STEEL - THREATED BSP G.

Code	Connections DN1	DN2	DN3	Dimensions [mm] L	L1	L2	Weight kg
GELC/6-20F L/H	1/2	1/2	3/4	210	47	27	1.9
GELC/6-25PF L/H GELC/6-25GF L/H	3/4	3/4	1”	234	46	28	2.8
GELC/6-32F L/H	1”	1”	1”1/4	302	52	38	3.5
GELC/6-40F L/H	1”1/4	1”1/4	1”1/2	397	77	46	4.9
GELC/6-50F L/H	1”1/2	1”1/2	2”	500	92	48	6.7

C = carbon steel L = motive pressure 1.5 - 3.0 bar g
6 = AISI 316L H = motive pressure 3.0 - 6.0 bar g

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