Körting Hannover AG

Körting Liquid Jet Vacuum Ejectors

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Liquid Jet Vacuum Ejectors

Liquid jet vacuum ejectors convey and compress gases or vapours with the aid of a liquid motive fluid. During this action vapours - corresponding to pressure- and temperature ratios - can be partially or completely condensed.

Liquid jet vacuum ejectors consist - as far their function is concerned - of 3 main parts: motive nozzle, mixing zone and diffuser. These three components form a flow path with an extremely varied cross-section for the motive medium, water or any other liquid.

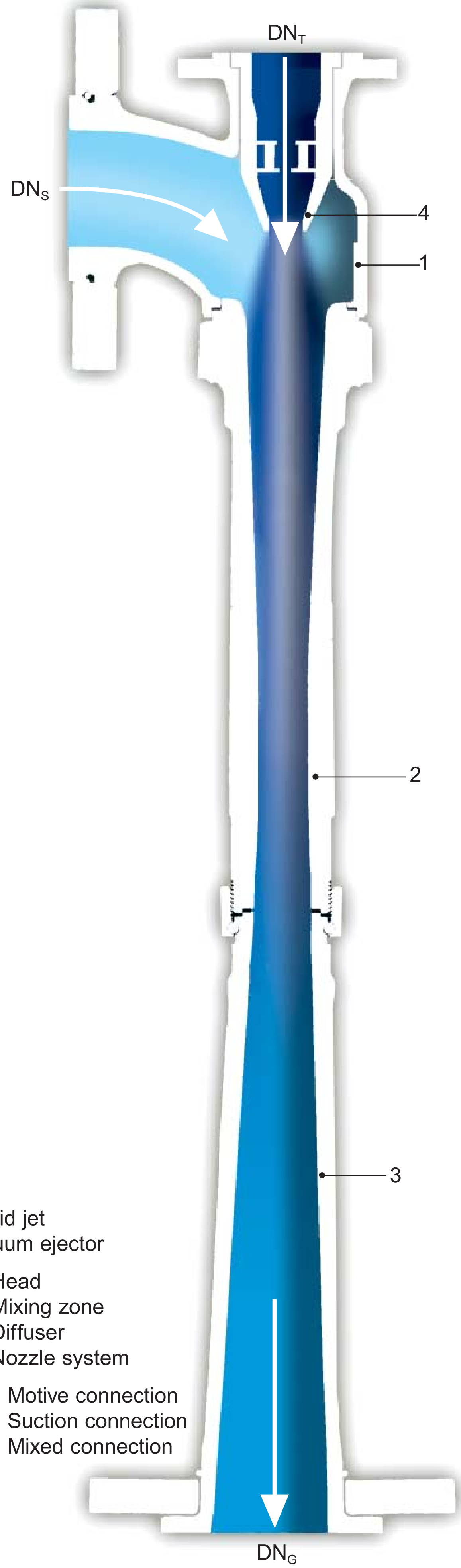
The motive nozzle's shape causes a transformation of pressure- into speed energy, the diffuser's shape then effects a re-conversion of kinetic energy into pressure energy. If the motive medium now flows through these three series-connected ejector components as a result of the total pressure difference between motive pressure ptr and the necessary lower counter-pressure pd, the result will be a static pressure at the end point of the motive nozzle which will be considerably lower than counter-pressure pd and motive pressure ptr. At this point the suction flow is introduced into the ejector.

Motive flow and suction flow intermingle and, by means of impulse exchange, a part of the motive jet's kinetic energy is transferred to the suction medium. The resulting mixed flow is delivered under pressure gain in the diffuser to counter-pressure pd.

Only by a special combination of the geometry for the nozzle, mixing zone and diffuser is it possible to achieve maximum efficiency under the desired operation conditions.

Highest efficiency will result for certain suction- and counter pressures at an optimum pairing of motive flow and motive pressure. The motive pressure should therefore always be matched up with the case in question.

The following design diagrams are based on the physical properties of water as a motive medium. Liquids with other physical properties require a special ejector design as, amongst other things, boiling behaviour, viscosity and the specific weight of the respective liquid have to be taken into consideration for the ejector's design.



Liquid jet vacuum ejector

1 Head
2 Mixing zone
3 Diffuser
4 Nozzle system

DN_T Motive connection
DN_S Suction connection
DN_G Mixed connection

Delivery behaviour

Liquid jet vacuum ejectors can extract gases and vapours and compress them. In the case of liquid jet vacuum ejectors the achievable suction pressure at zero load corresponds more or less to the vapour pressure of the motive liquid.

So for example, the suction pressure cannot be below 23 mbar = 17,5 mm Hg for a jet ejector with water as a motive liquid and a motive water temperature of 20° C. For motive media with negligibly small vapour pressure the achievable suction pressure is between 4 and 6 mbar at zero load.

When transporting gases with water or another liquid as motive flow we have two media with very different specific weights. Therefore not only the liquid's pressure energy has to be transformed into speed energy but the jet itself must also be torn apart so far as to include the gas components. This duty is fulfilled by means of a suitable spiral in the motive nozzle. The liquid jet leaves the nozzle at high velocity, entrains the surrounding gas into the mixing zone and delivers it to the required counterpressure in the diffuser (normally this is atmospheric pressure). During this action condensable vapours can be condensed or gas components can be absorbed in the motive liquid.

Suction performance and pressure rise are determined by the suction and motive flow as well as by pressure and temperature of the motive liquid.

During a start-up process a multiple of the gas flow can be achieved in the upper pressure range compared to the suction flow at final vacuum. This is why the liquid jet vacuum ejector is especially suitable for the start-up evacuation of vacuum vessels.

Application

Körting liquid jet vacuum ejectors are utilised e.g. for starting up centrifugal pumps, in chemical processes, for venting vacuum condensers but also for mixing gases and liquids.

Furthermore, because of their simplicity of constructional form, low purchasing price and ease of installation, liquid jet vacuum ejectors can be applied in all branches of industry where low investment costs are especially required.

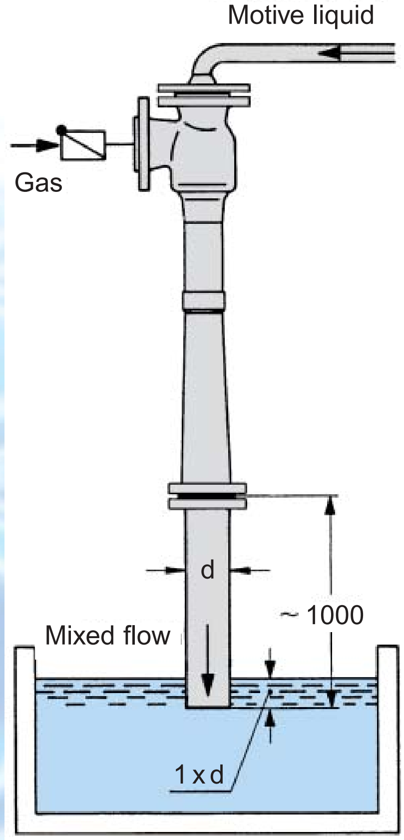
One particular advantage of the jet ejectors is to be seen in the fact that they can be manufactured practically of all materials such as metals, plastics or graphite. So it is easy to find a suitable material for each corrosion problem arising on the gas or the liquid side. They can also be operated in such application fields where other pump types can only be used with difficulty or even not at all.

Liquid jet vacuum ejectors are available ex stocks in standard executions up to a mixed flow connection of DN 150. Special designs can be chosen to suit specific requirements.

Installation position

Liquid jet vacuum ejectors should be mounted in a vertical position with the flow direction from top to bottom. Pipelines can be installed in the respective nominal connection widths. A reduction in performance of approx. 15% must be considered if the ejector is mounted in a horizontal position. For normal installation a down pipe of approx. 1 m in length should be after-connected and should lead into an overflow vessel and be submerged there at least 1x the pipe diameter. The free liquid surface in the overflow vessel should be at least 5 times the pipe cross-section.

If required, a standard separator to separate gas and motive liquid can also be supplied.



Layout of a liquid jet vacuum ejector

Liquid jet vacuum ejectors for continuous operation
Motive medium = water at 25 °C
Motive pressure range 2 - 3 bar (abs.)

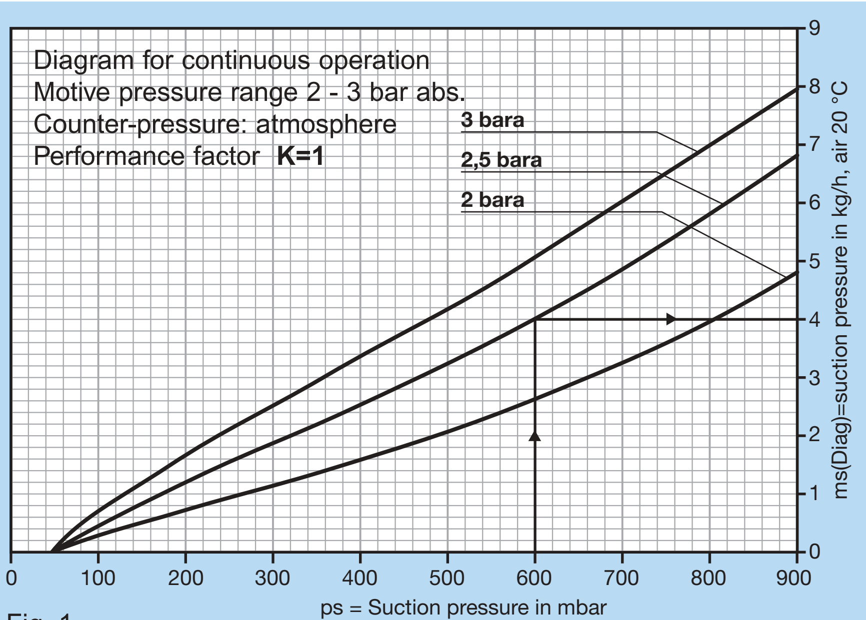


Fig. 1

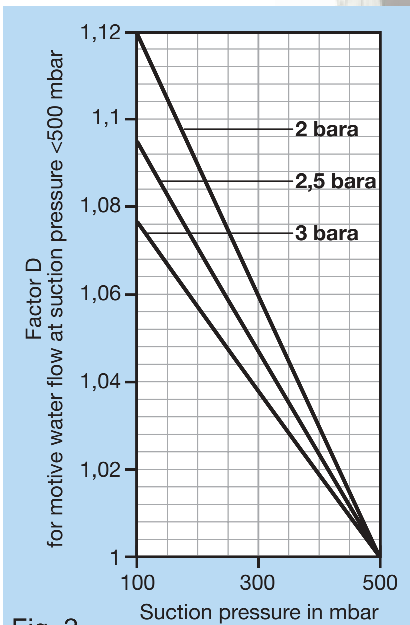


Fig. 2

Example:

Suction pressure:	ps = 600 mbar
Motive water temp.:	ttr = 25 °C
Motive water pressure:	ptr = 2,5 bar abs.
Suction flow (air):	ms = 6,0 kg/h

Acc. to Fig. 1 the result is: ms(Diag) = 4,0 kg/h air (K=1)
Size determination acc. to performance factor (table):
K=ms/ms(Diag) = 6,0/4,0= 1,50 chosen K=1,56
Size G 1 - _" or DN 40
Motive flow acc. to table at 2,5 bar abs.: 8 m^3/h water
For suction pressures <500 mbar the motive water throughput
is increased by factor D acc. to Fig. 2.
Constructional dimensions and connections acc. to table of dimensions.

Operation under increased counter-pressure:

Information on reduction in performance at increased counter-pressure can be given on demand.

Size	Size	PErformance	Motive flow (m^3/h) at motive pressure (bara)		
Thread	**Flange**	**Factor K**	**2**	**2,5**	**3**
G ¾	20	0,4	1,75	2	2,3
G 1	25	0,6	2,8	3,2	3,6
G 1¼	32	1	4,4	5	5,7
G 1½	**40**	**1,56**	6,9	**8**	8,9
G 2	50	2,44	11,3	13	14,5
	65	3,87	17,6	20,4	22,8
	80	6,25	27,5	31,8	35,6
	100	9,76	43,7	50,5	56,5
	125	15,5	70,5	81,5	91
	150	25	110	127	142

Required order data:

Determine factor K in acc. with the above given example.

Indicate your motive pressure.

Choose your material and connection type acc. to the tables given on pages 8 and 9.

Factor K: ______

Motive pressure: ______

Material: ______

Connection type: ______

Liquid jet vacuum ejectors for continuous operation
Motive medium = water at 25 °C
Motive pressure range 4 - 7 bar (abs.)

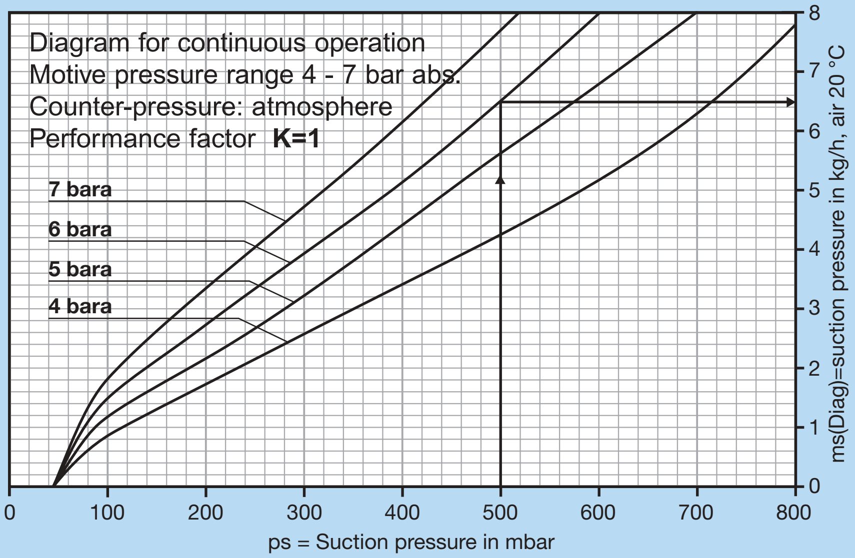


Fig. 3

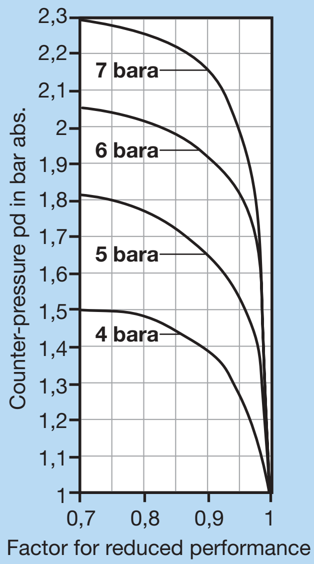


Fig. 4

Example:

Suction pressure:	ps = 500 mbar
Motive water temp.:	ttr = 25 °C
Motive water pressure:	ptr = 6,0 bar abs.
Suction flow (air):	ms = 15 kg/h

Acc. to Fig. 3 the result is: ms(Diag) = 6,5 kg/h air (K=1)
Size determination acc. to performance factor (table):
K=ms/ms(Diag) = 15/6,5 = 2,3 chosen K=2,44 size G2" or DN 50
Motive flow acc. to table at 6 bar abs.: 13,2 m³/h water
Constructional dimensions and connections acc. to table of dimensions.

Operation under increased counter-pressure:
Liquid jet vacuum ejectors can be operated at a counter-pressure above atmospheric pressure. Such operating conditions can occur when the resistances after the ejector are increased by long pipelines or filters. To ensure a safe operation the motive pressure must be at least 4 bar.

Surmounting a higher counter-pressure is connected to a reduction in suction performance. The decrease in performance in comparison to normal operation may be taken from the diagram in Fig. 4.

Size	Size	Performance	Motive flow (m³/h) at motive pressure (bara)			
Thread	**Flange**	**Factor K**	**4**	**5**	**6**	**7**
G 3/4	20	0,4	1,7	1,9	2,1	2,3
G 1	25	0,6	2,7	3	3,4	3,6
G 1 1/4	32	1	4,3	4,9	5,4	5,9
G 1 1/2	40	1,56	6,7	7,6	8,5	9,2
G 2	**50**	**2,44**	10,5	12	**13,2**	14,4
	65	3,87	17,2	19,5	21,6	23,5
	80	6,25	27	30,5	33,8	36,8
	100	9,76	42	47,8	53	57,5
	125	15,5	67	76	84	91
	150	25	108	122	135	147

Required order data:

Determine factor K in acc. with the above given example.

Indicate your motive pressure.

Choose your material and connection type acc. to the tables given on pages 8 and 9.

Factor K: ____________________

Motive pressure: ____________________

Material: ____________________

Connection type: ____________________

Liquid jet vacuum ejectors for start-up operation
Motive medium = water at 25 °C
Motive pressure range 2 - 3 bar (abs.)

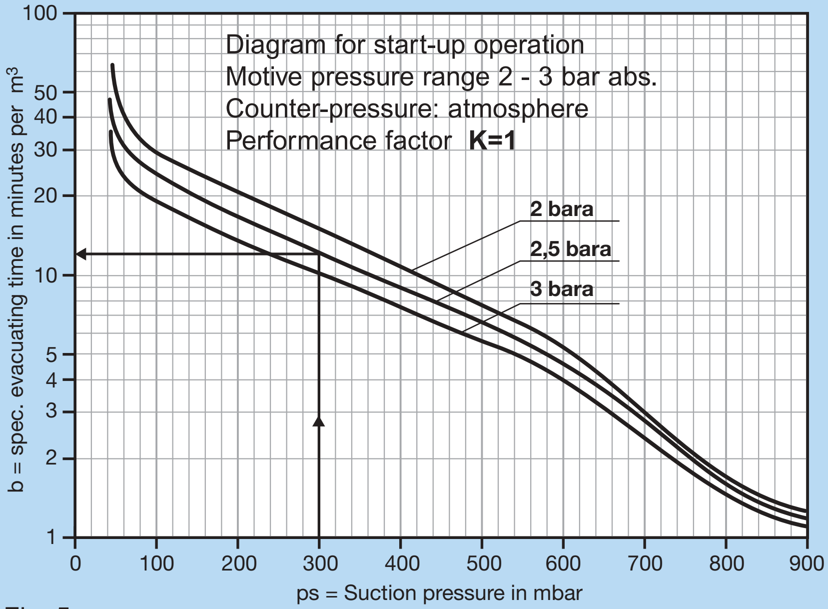


Fig. 5

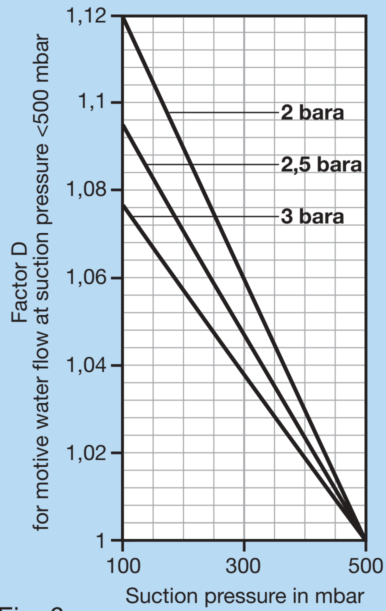


Fig. 6

Example:

A tank with V=2,5 m³ contents is to be evacuated in t=8 min. from atmospheric pressure to 300 mbar.

Motive water pressure: ptr = 2,5 bar abs.
Motive water temp.: ttr = 25 °C

Acc. to Fig. 5 with performance factor K=1 the spec. evacuation time will be b = 12 minutes per m³. The required performance factor can be calculated as follows:
K = (V x b) / t = (2,5 x 12) / 8 = 3,75

The next largest performance factor K=3,87 acc. to table will be chosen and size DN 65 is the result.
Motive flow at 2,5 bar abs. acc. to table: 20,4 m³/h water.

At suction pressures <500 mbar the motive water throughput increases by factor D acc. to Fig. 6. Constructional dimensions and connections acc. to table of dimensions.

Operation under increased counter-pressure:

Information on reduction in performance at increased counter-pressure can be given on demand.

Size Thread	Size Flange	Performance Factor K	Motive flow (m³/h) at motive pressure (bara) 2	2,5	3
G ¾	20	0,4	1,75	2	2,3
G 1	25	0,6	2,8	3,2	3,6
G 1¼	32	1	4,4	5	5,7
G 1½	40	1,56	6,9	8	8,9
G 2	50	2,44	11,3	13	14,5
	65	**3,87**	17,6	**20,4**	22,8
	80	6,25	27,5	31,8	35,6
	100	9,76	43,7	50,5	56,5
	125	15,5	70,5	81,5	91
	150	25	110	127	142

Required order data:

Determine factor K in acc. with the above given example.

Indicate your motive pressure.

Choose your material and connection type acc. to the tables given on pages 8 and 9.

Factor K: __________

Motive pressure: __________

Material: __________

Connection type: __________

Liquid jet vacuum ejectors for start-up operation
Motive medium = water at 25 °C
Motive pressure range 4 - 7 bar (abs.)

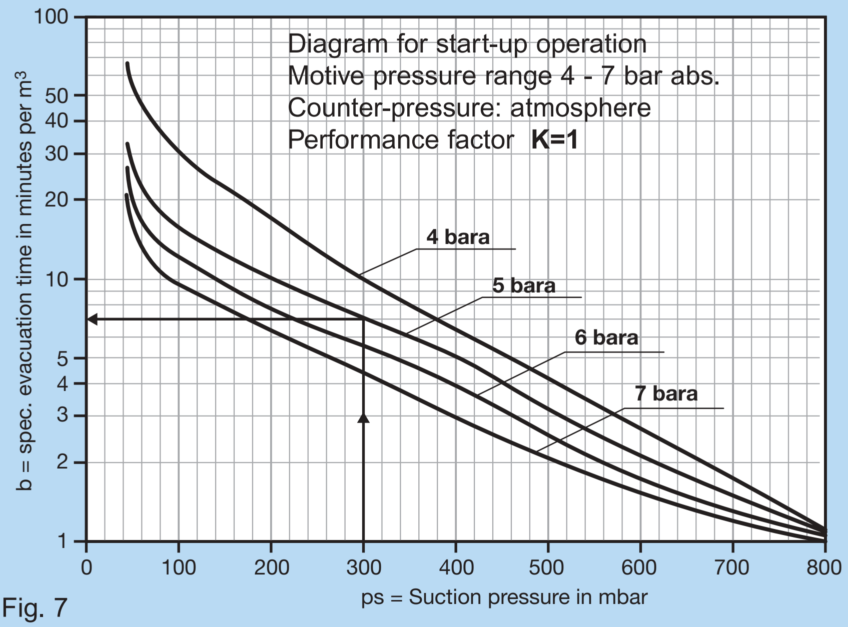


Fig. 7

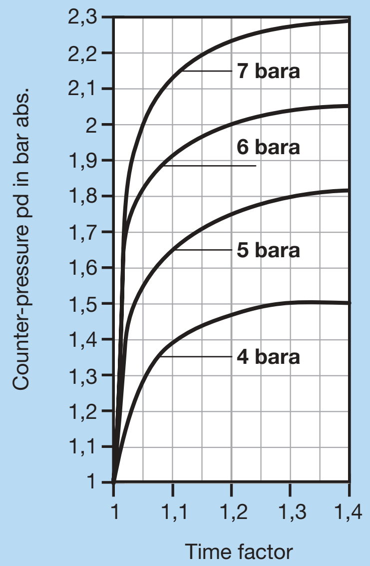


Fig. 8

Example:

A tank with V=12 m³ contents is to be evacuated in t=10 min.
from atmospheric pressure to 300 mbar.

Motive water pressure: ptr = 5 bar abs.
Motive water temp.: ttr = 25 °C

The spec. evacuation time acc. to Fig. 7 with performance factor K=1 will be b = 7 minutes per m³, the required performance factor can be calculated as follows:
K = (V x b) / t = (12 x 7) / 10 = 8,4

The next largest performance factor K=9,76 acc. to table will then be chosen and size DN 100 is the result. Motive flow mtr = 47,8 m³/h water (acc. to table)

Operation under increased counter-pressure:

Liquid jet vacuum ejectors can be operated at a counter-pressure above atmospheric pressure. Such operating conditions can occur when the resistances after the ejector are increased by long pipelines or filters. To ensure a safe operation the motive pressure must be at least 4 bar.

Surmounting a higher counter-pressure is connected to an increase in evacuation time. The increase in time in comparison to normal operation may be taken from the diagram in Fig. 8.

Size	Size	Performance	Motive flow (m³/h) at motive pressure (bara)			
Thread	**Flange**	**Factor K**	**4**	**5**	**6**	**7**
G ¾	20	0,4	1,7	1,9	2,1	2,3
G 1	25	0,6	2,7	3	3,4	3,6
G 1¼	32	1	4,3	4,9	5,4	5,9
G 1½	40	1,56	6,7	7,6	8,5	9,2
G 2	50	2,44	10,5	12	13,2	14,4
	65	3,87	17,2	19,5	21,6	23,5
	80	6,25	27	30,5	33,8	36,8
	100	**9,76**	42	**47,8**	53	57,5
	125	15,5	67	76	84	91
	150	25	108	122	135	147

Required order data:

Determine factor K in acc. with the above given example.

Indicate your motive pressure.

Choose your material and connection type acc. to the tables given on pages 8 and 9.

Factor K: ______

Motive pressure: ______

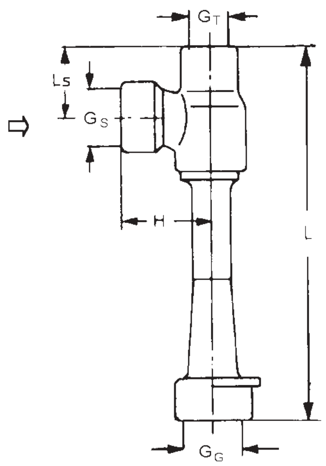
Material: ______

Connection type: ______

Type 164
Material: Cast Iron

Type 162
Material: Bronze

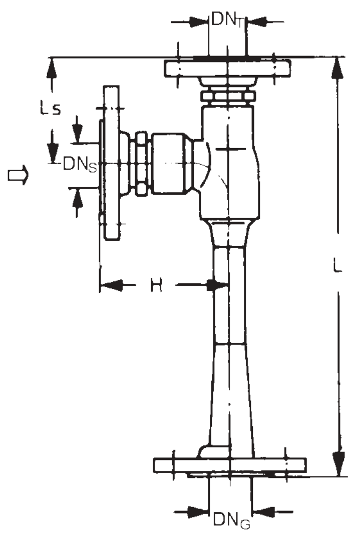
G_T / DN_T = Motive connection
G_S / DN_S = Suction connection
G_G / DN_G = Mixed flow connection



Connection female thread G ¾ - G 2 ISO 228

Typ 164 (CI) / ***Typ 162 (Bronze)**

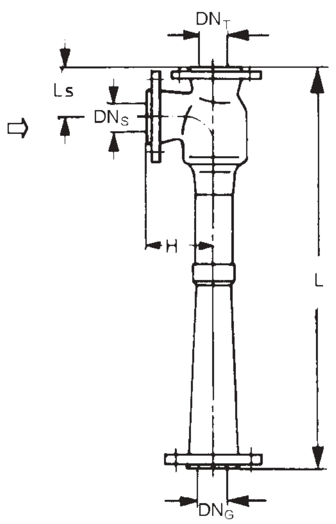
	Connection nominal widths			Construction size in mm			Weight
Factor K	G_G	G_S	G_T	L	L_S	H	in kg
0,40	G 3/4	G 3/4	G 1/2	230/*235	40	50	1,5
0,60	G 1	G 1	G 3/4	285/*281	45	60	2,5
1,00	G 1 1/4	G 1 1/4	G 1	360	50	70	2,8
1,56	G 1 1/2	G 1 1/2	G 1 1/4	430	60	75	4
2,44	G 2	G 2	G 1 1/2	530	70	75	6,2



Flanged connection DN 20 - 50 DIN 2501

Typ 164 (CI) / ***Typ 162 (Bronze)**

	Connection nominal widths			Construction size in mm			Weight
Factor K	DN_G	DN_S	DN_T	L	L_S	H	in kg
0,40	20	20	15	253/*235	78/*65	91/*75	3,8
0,60	25	25	20	306/*281	68/*70	103/*85	5
1,00	32	32	25	373/*354	93/*75	115/*95	7,5
1,56	40	40	32	447/*427	105/*85	122/*101	9
2,44	50	50	40	546/*525	117/*95	123/*101	12,6



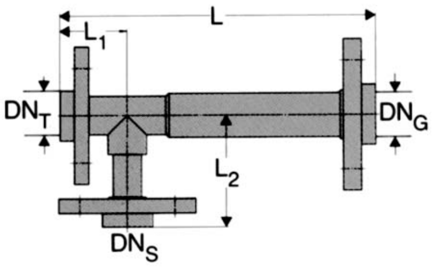
Flanged connection DN 65 - 150 DIN 2501

Typ 164 (CI) und Typ 162 (Bronze)

	Connection nominal widths			Construction size in mm			Weight
Factor K	DN_G	DN_S	DN_T	L	L_S	H	in kg
3,87	65	50	50	620	70	115	13
6,25	80	65	65	765	85	125	20
9,76	100	80	80	948	108	140	29
15,50	125	100	100	1205	140	150	48
25,00	150	125	125	1440	160	170	68

G_T / DN_T = Motive connection
G_S / DN_S = Suction connection
G_G / DN_G = Mixed flow connection

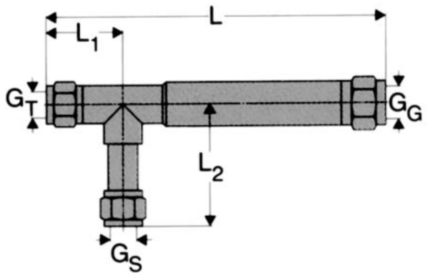
Typ 168
Materials: PVC, PP, PVDF



Flanged connection (loose flange) DN 20 - DN 100 DIN 2501

Material PVC Typ 168-52
Material PP Typ 168-56
Material PVDF Typ 168-58

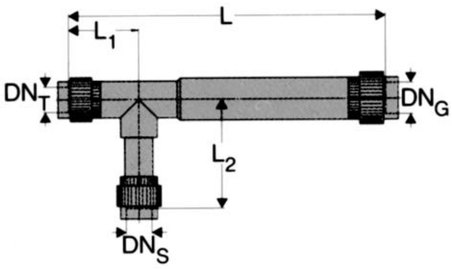
	Connection nominal widths			Construction size in mm			Weight
Factor K	DN_G	DN_S	DN_T	L	L1	L2	in kg
0,40	20	15	15	222	49	79	0,6
0,60	25	20	20	273	58	85	0,8
1,00	32	25	25	343	67	92	1,3
1,56	40	32	32	427	83	111	2,2
2,44	50	40	40	526	98	118	3,1
3,87	65	50	50	655	118	129	4,5
6,25	80	65	65	817	136	142	6,7
9,76	100	80	80	1010	160	160	11,8



Connection by threaded socket G 3/4 - G 2

Material PVC Typ 168-53

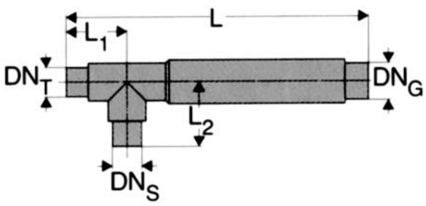
	Connection nominal widths			Construction size in mm			Weight
Factor K	G_G	G_S	G_T	L	L1	L2	in kg
0,40	G 3/4	15	15	236	56	86	0,3
0,60	G 1	20	20	287	65	92	0,5
1,00	G 1 1/4	25	25	357	74	99	0,9
1,56	G 1 1/2	32	32	443	90	118	1,7
2,44	G 2	40	40	548	107	127	2,8



Adhesive connection with union DN 20 - DN 50

Material PVC Typ 168-54

	Connection nominal widths			Construction size in mm			Weight
Factor K	DN_G	DNS_S	DN_T	L	L1	L2	in kg
0,40	20	G 1/2	G 1/2	250	62	92	0,25
0,60	25	G 3/4	G 3/4	305	73	100	0,4
1,00	32	G 1	G 1	377	84	109	0,75
1,56	40	G 1 1/4	G 1 1/4	464	100	128	1,5
2,44	50	G 1 1/2	G 1 1/2	569	119	138	2,45



Connection by threaded socket G 3/4 - G 2

Material PVC Typ 168-53

	Connection nominal widths			Construction size in mm			Weight
Factor K	DN_G	DN_S	DN_T	L	L1	L2	in kg
0,40	20	15	15	210	43	73	0,2
0,60	25	20	20	261	52	79	0,3
1,00	32	25	25	329	61	86	0,6
1,56	40	32	32	411	75	103	1,2
2,44	50	40	40	510	90	110	2
3,87	65	50	50	639	110	121	3,3
6,25	80	65	65	799	128	134	5,3
9,76	100	80	80	989	150	150	10,2

Programme

Jet ejectors

Steam, gas, water jet ejectors	for creating of vacuum, conveying, compressing and mixing of gases, liquids and solids
Steam jet vacuum ejectors	single and multi-stage, with direct contact condenser or surface condenser for suction pressures from 0.002 mbar
Steam jet thermocompressors	for evaporation plants and paper drying equipment
Steam jet ventilators	Waste gas mixing jets
Steam jet liquid ejectors, Steam jet heater, Steam jet heater Type ORK	
Gas jet gas compressors	
Water jet liquid eductors, Water jet vacuum ejectors, Water jet ventilators, Water jet solids ejectors	Gravel pumps
Water jet condensers	self-priming

Vacuum and heat processing

Evaporating units for the textile industry	single and multi-stage with or without thermocompressor
Steam jet cooling systems	for cold water production by partial evaporation
Surface condensers, Direct contact condensere	for process plants and steam turbines

Körting Hannover AG
Bereich S
Strahlpumpen
Vakuumtechnik

Badenstedter Str. 56
D-30453 Hannover
Postfach 91 13 63
D-30433 Hannover

Telefon: +49 511 2129-0
Telefax: +49 511 2129-223
Internet: http://www.koerting.de
E-Mail: s@koerting.de

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