nsb gas processing

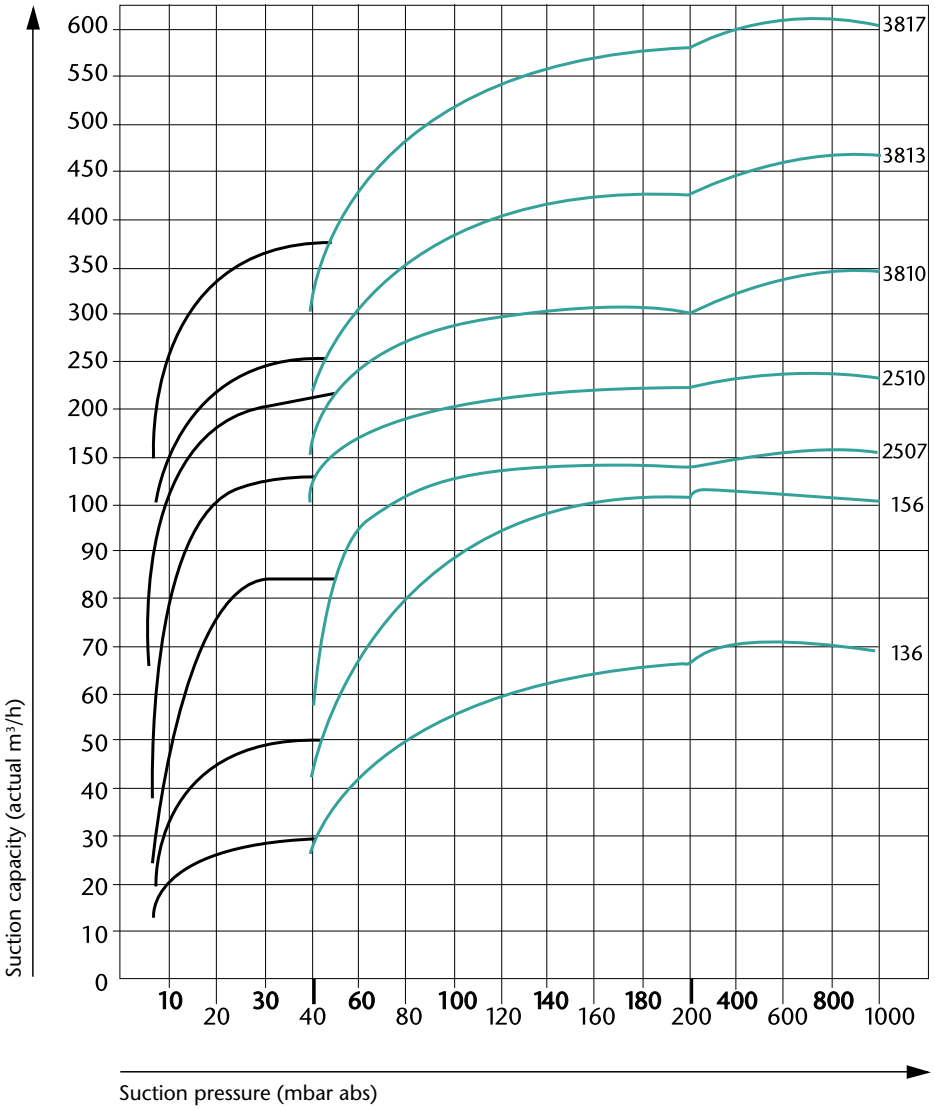
APOVAC®
Vacuum Systems

with closed ring-liquid loop for the suction and recovery of gases and vapours

APOVAC = Anti POllution VACuum

CE Ex PED

APOVAC Vacuum systems with closed ring-liquid loop for the suction and compression of gases and vapours, for the recovery of solvents in clean and reusable state, for the neutralisation of acidic gases without polluting the environment. Suction capacity up to 600 m³/h. Without gas ejector for vacuum down to 40 mbar or 6 mbar if used with gas ejector.



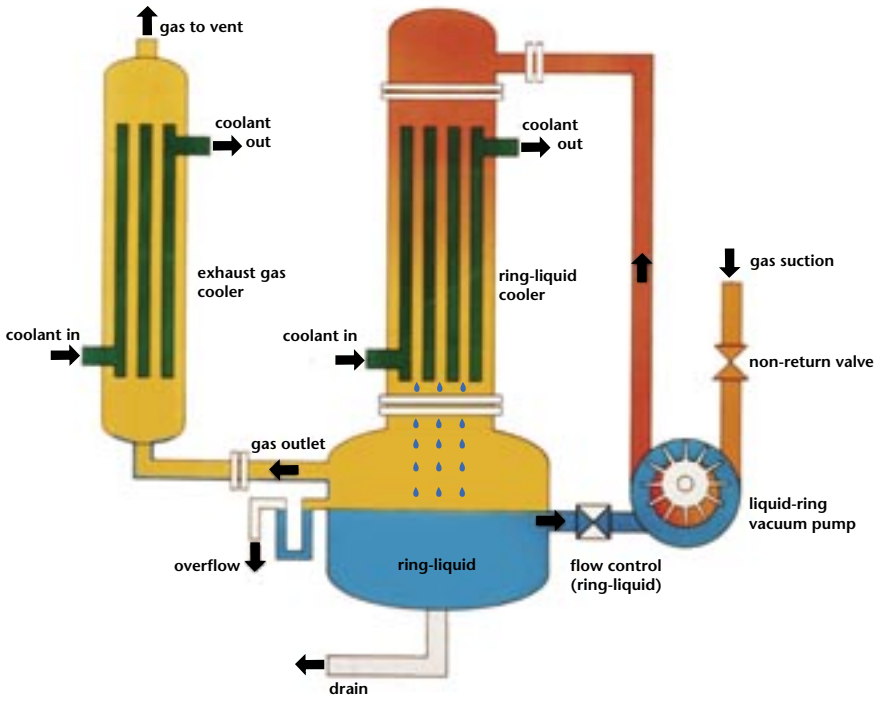
Performance curves show suction volume at given suction pressure with tolerance of 10 % at following conditions:
- Evacuating dry air at 20 °C
- Discharge pressure to 1200 mbar
- Ring-liquid: water 15 °C
- Motor 50 Hz

= Performance curves **with** gas ejector
= Performance curves **without** gas ejector

Technical data

Type	Ring-liquid circulation	Coolant at Δt = 3 °C	Standard motors IP 54	Explosion-proof motors EEx e IIT3	Nominal speed	Weight with pump and motor
	m³/h	m³/h	KW	KW	min⁻¹	Kg
136	0.25	0.5	2.2	2.5	3000	170
156	0.50	1.0	4.0	4.6	3000	200
2507	1.0	2.0	5.5	6.8	1500	390
2510	1.1	2.0	7.5	10.0	1500	440
3810	2.5	5.0	11.0	13.2	1000	1070
3813	2.7	6.0	15.0	16.5	1000	1070
3817	3.2	7.0	18.5	20.0	1000	1140

Description of the Vacuum System



Vacuum System with closed Ring-liquid loop

Design

The APOVAC system consists of a ring-liquid tank, distributor head, ring-liquid cooler, exhaust gas cooler (condenser) and liquid-ring vacuum pump, type PMH, PMZF or PMZE. Other design features are:

- Various motor protection options
- Mechanical shaft seal according to DIN 24960, standard
- Vertical one-pass shell and tube type ring-liquid cooler
- Connections for utilities with standard welding neck flanges
- The unit completely assembled on common base frame

Method of Operation

Incondensible gas, vapour and condensate evacuated from a process operation are drawn into the suction branch of the liquid-ring vacuum pump. Ring-liquid is provided from the APOVAC tank. The liquid-ring pump can operate with most liquids. In the closed loop APOVAC system, the process liquid/condensate is normally used as ring-liquid. It serves as a sealing liquid and also as a means of removing the heat which is generated in the pump. The liquid-ring pump itself is an excellent direct condenser, with a condensation temperature equal to that of the ring-liquid temperature.
Further condensation is achieved in the ring-liquid cooler by using coolant with low temperature. The specially designed ring-liquid cooler cools the associated gas and remaining vapour as well as the ring-liquid/condensate. A distributor head ensures optimum distribution of the liquid over the cooling surfaces.
Ring-liquid and condensate are collected in the tank. Temperature difference between coolant at inlet and ring-liquid in tank is around 3 °C. Incondensible gases saturated with vapour are discharged through the exhaust gas branch. Further condensation may be achieved in an exhaust gas condenser (optional). Resulting condensate also flows to the ring-liquid tank.

Ring-liquid

Any liquid compatible with the construction materials and available as condensate from the process may be used as ring-liquid. In addition, the ring-liquid may be selected to suit the process, e.g. caustic soda solution for neutralising acidic vapours or concentrated sulphuric acid for the compression of chlorine gas.

Standard Version

The standard version of the APOVAC system consists of:

- Ring-liquid tank with connections for filling, draining, overflow, exhaust gas, thermometer and level probe
- Ring-liquid cooler with distributor head
- Complete assembly on a base frame with associated liquid-ring vacuum pump, including all internal pipework together with discharge pipe, ring-liquid pipe with flow control valve and flow indicator/switch, vacuum control pipe with hand-operated valve and non-return valve on the pump inlet branch.

Accessories

Gas ejector with internal bypass, exhaust gas condenser, flow meter, level sight glass, level monitoring and control, overflow siphon, ring-liquid thermometer etc. Application-related instrumentation and control equipment are provided in accordance with individual process requirements for local or remote operation.

Features & Advantages

Features

The liquid-ring vacuum pump and the APOVAC system operate oil-free and do not contaminate the process liquid. There is no practical limit to the amount of liquid which can be passed into the system.
The completely closed ring-liquid loop with no direct contact between coolant and ring-liquid, ensures that no coolant contamination occurs.
Ring-liquid may be chosen according to the process. Solvent vapours can be condensed and recovered. Corrosive, toxic and offensively smelling gases or vapours can be neutralized.
The coolers may be operated with separate coolants at different temperatures and thus partial condensation is possible. The APOVAC systems are specially suited for wet processes in the chemical, pharmaceutical, petrochemical and related industries.
Due to the cold compression of gases the APOVAC systems are ideal for handling flammable or explosive gases.

Advantages

Modest space requirements
Simple installation
Rugged and reliable; minimum maintenance
Built to withstand pressure surges up to 10 bar abs.
Material execution with low ferrite content according to standards of European chemical industries
Smooth and quiet running
Standard operating temperature range -30 °C to +110 °C
Provision for insulation for high- or low-temperature applications
Available with Conformity Declaration acc. to PED (Module H) and with ATEX certificate.

You save costs on

- **Solvents**
- **Effluent treatment**
- **Coolant treatment**
- **Exhaust gas treatment**
- **Energy**

Depending on the process, significant savings may be achieved with APOVAC systems through shorter cycle times, e.g. in drying operations. Furthermore, additional savings on inert gases can be achieved when the APOVAC systems are used as a recirculating vacuum/compressor system (APOREC).
These operational benefits ensure short return on investment.

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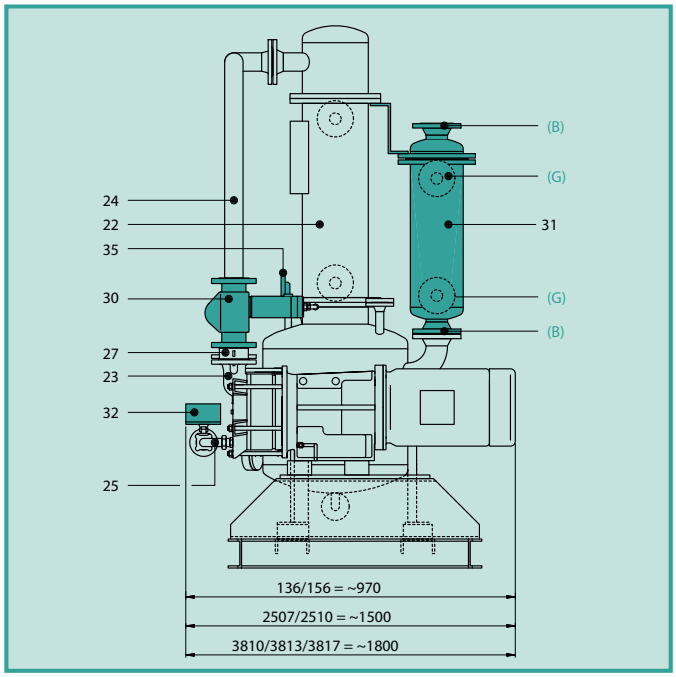
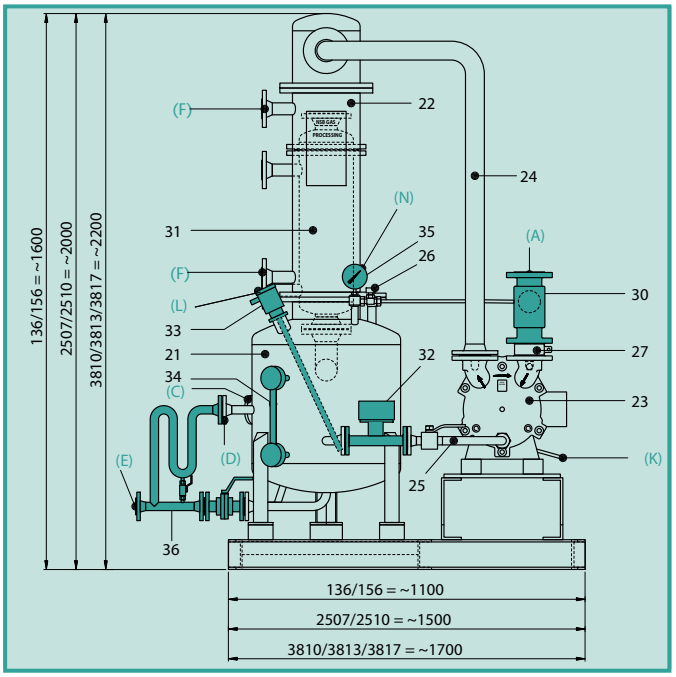
Dimensions





Standard execution

21 Ring-liquid tank
22 Ring-liquid cooler
23 Liquid-ring vacuum pump
24 Discharge pipe
25 Ring-liquid pipe with valve
26 Manually operated vacuum control valve
27 Non-return valve

Accessories

30 Gas ejector with integrated bypass
31 Exhaust gas condenser
32 Flow indicator with switch
33 Level probe
34 Level sight glass
35 Ring-liquid thermometer
36 Siphon with valves

Options

Cold barriers/insulation
Magnetic level indication
Coolant control
Vacuum level control

Table of Connections

	APOVAC 136 + 156		APOVAC 2507 + 2510		APOVAC 3810 + 3817	
	DN / PN	Standard	DN / PN	Standard	DN / PN	Standard
(A) Suction branch	Ø 48.3 x 2.6 * 40 / 16 **	DIN 2642 DIN 2633	65 / 16	DIN 2633	80 / 16	DIN 2633
(B) Gas discharge	40 / 16	DIN 2633	80 / 16	DIN 2633	100 / 16 ***	DIN 2633
(C) Filling	25 / 16	DIN 2633	25 / 16	DIN 2633	25 / 16	DIN 2633
(D) Overflow	25 / 16	DIN 2633	25 / 16	DIN 2633	25 / 16	DIN 2633
(E) Drain	25 / 16	DIN 2633	25 / 16	DIN 2633	25 / 16	DIN 2633
(F) Coolant in/out	25 / 16	DIN 2633	40 / 16	DIN 2633	50 / 16	DIN 2633
(G) Coolant in/out	25 / 16	DIN 2633	40 / 16	DIN 2633	50 / 16	DIN 2633
(K) Leak pipe from mechanical seal	Ø12 x 1.5		Ø12 x 1.5		Ø12 x 1.5	
(L) Level probe	G 1½ "		G 1½ "		G 1½ "	
(N) Thermometer	G 1½ "		G 1½ "		G 1½ "	

* For execution without gas ejector
** For execution with gas ejector
*** 3817 = DN 125

Construction Materials
- Stainless steel DIN 1.4435 (SS 316 L)
- Other materials on request e.g. hastelloy, with lining or FDA-approved materials

Subject to dimensional and design alterations

APOVAC®

the vacuum system that always pays off, can be adapted individually to any special application

APOVAC-System, Type 3817, with spray condenser in the suction line

APOVAC-System, Type 2510, with pre-condenser and exhaust gas cooler

APOVAC-System, Type 136, for the degassing of polymers

APOVAC-System, Type 2510, with two vaccum pumps

APOVAC-System, Type 156, supplied with control panel

Commonly used ring-liquids in APOVAC systems

Alcohols

methanol	CH_4O
ethanol	CH_2H_6O
propanol	C_3H_8O
butanol	$C_4H_{10}O$
hexanol alcohol	$C_6H_{14}O$
octanol	$C_8H_{18}O$
ethylen glycole	$C_2H_6O_2$
glycerine	$C_3H_8O_3$
cyclo hexanol	$C_6H_{12}O$
benzyl alcohol	C_7H_8O

Aromatics

benzene	C_6H_6
toluene	C_7H_8
ethyl benzene	C_8H_{10}
styrene	C_8H_8
xylene	C_8H_{10}

Aqueous solutions

water	H_2O
caustic soda	NaOH
sulphuric acid (conc.)	H_2SO_4

Phenoles

phenole	C_6H_6O

Ketones

acetone	C_3H_6O
methyl ethyl ketone	C_4H_8O

Others

ethyl acetate	$C_4H_8O_2$
hexane	C_6H_{14}
methylene chloride	CH_2CI_2
tetrahydrofurane	C_4H_8O

Principal Applications

- Process support and solvent recovery in wet processes
- Emission control, minimizing exhaust gas treatment
- Handling of toxic or corrosive gases

Major Processes

- Drying under vacuum or pressure
- Filtration
- Distillation
- Reaction
- Crystallization
- Concentration
- Degassing

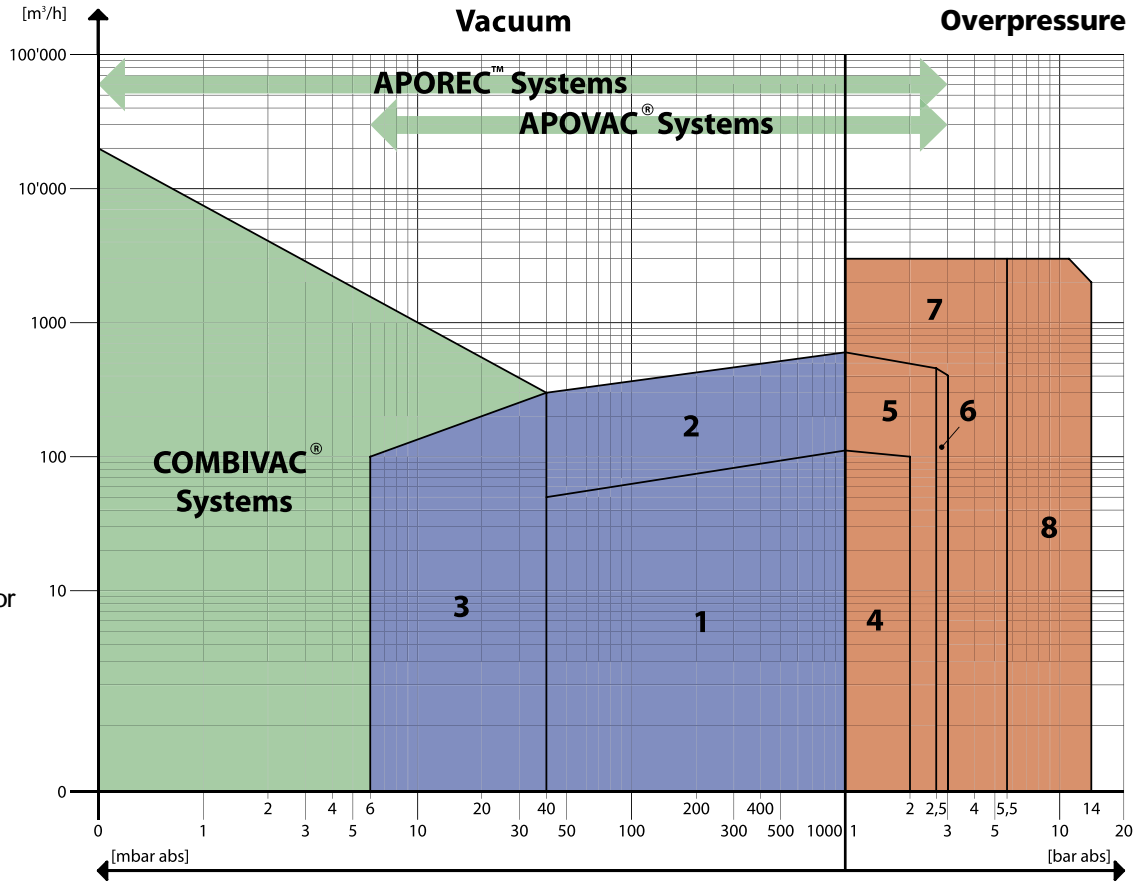
Typical Products and Industries

- Chemicals
- Pharmaceuticals
- Food industries
- Agrochemicals
- Petrochemicals
- Metallurgy

We also supply:

Liquid-ring vacuum pumps
Liquid-ring compressors
Gas ejectors
COMBIVAC units with roots blowers
Application-related instrumentation and control equipment
Engineering and service

Product Overview



1 PMH 122-156
2 PMZE/F 2507-3817
3 Pumps with gas ejector
4 PMK 122-156
5 PMZK 2507-3817
6 PMZE 2510-3817
7 SB 1-Compressor
8 SB 2-Compressor

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