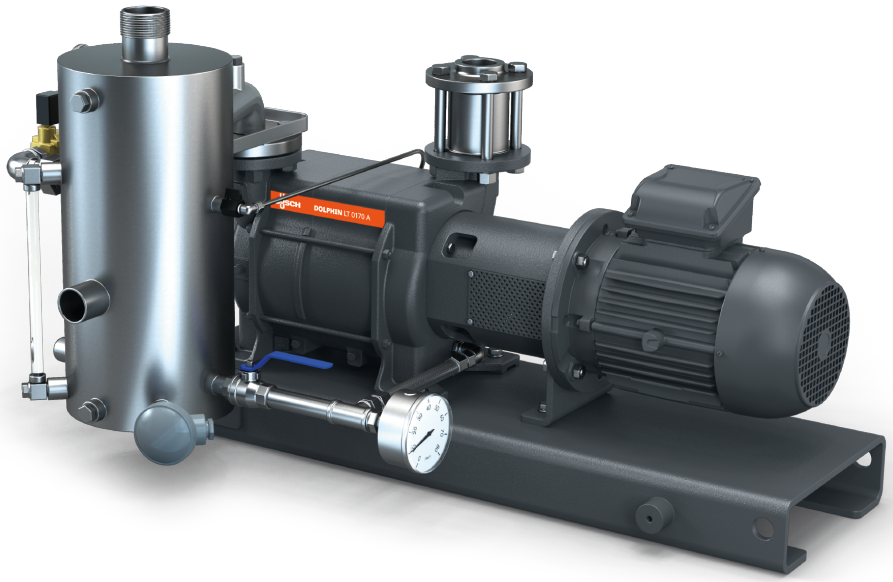
VACUUM SOLUTIONS

DOLPHIN VL Systems

Liquid Ring Vacuum Pumps
VL 0100 A, VL 0130 A, VL 0170 A, VL 0180 A, VL 0220 A, VL 0270 A,
VL 0320 A, VL 0430 A, VL 0510 A, VL 0530 A, VL 0630 A, VL 0750 A, VL 0800 A

Instruction Manual Supplement



Get technical data, instruction manuals, service kits

VACUUM APP

CE UKCA EAC

0870233816 | -0001_en-US | Original instructions

9/23/2022

Table of Contents

1 Safety

Prior to handling the machine, this instruction manual should be read and understood. If anything needs to be clarified, please contact your Busch representative.

Read this manual carefully before use and keep for future reference.

This instruction manual remains valid as long as the customer does not change anything on the product.

The machine is intended for industrial use. It must be handled only by technically trained personnel.

Always wear appropriate personal protective equipment in accordance with the local regulations.

The machine has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain, as described in the following chapters and in accordance with the chapter Intended Use. This instruction manual highlights potential hazards where appropriate. Safety notes and warning messages are tagged with one of the keywords DANGER, WARNING, CAUTION, NOTICE and NOTE as follows:

DANGER

... indicates an imminent dangerous situation that will result in death or serious injuries if not prevented.

WARNING

... indicates a potentially dangerous situation that could result in death or serious injuries.

CAUTION

... indicates a potentially dangerous situation that could result in minor injuries.

NOTICE

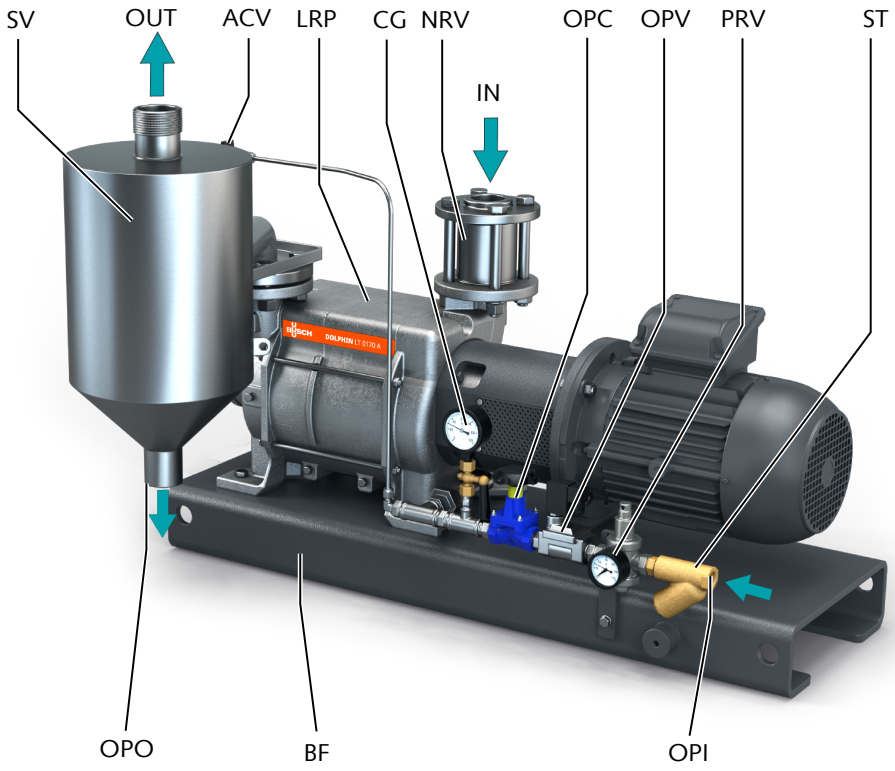
... indicates a potentially dangerous situation that could result in damage to property.

NOTE

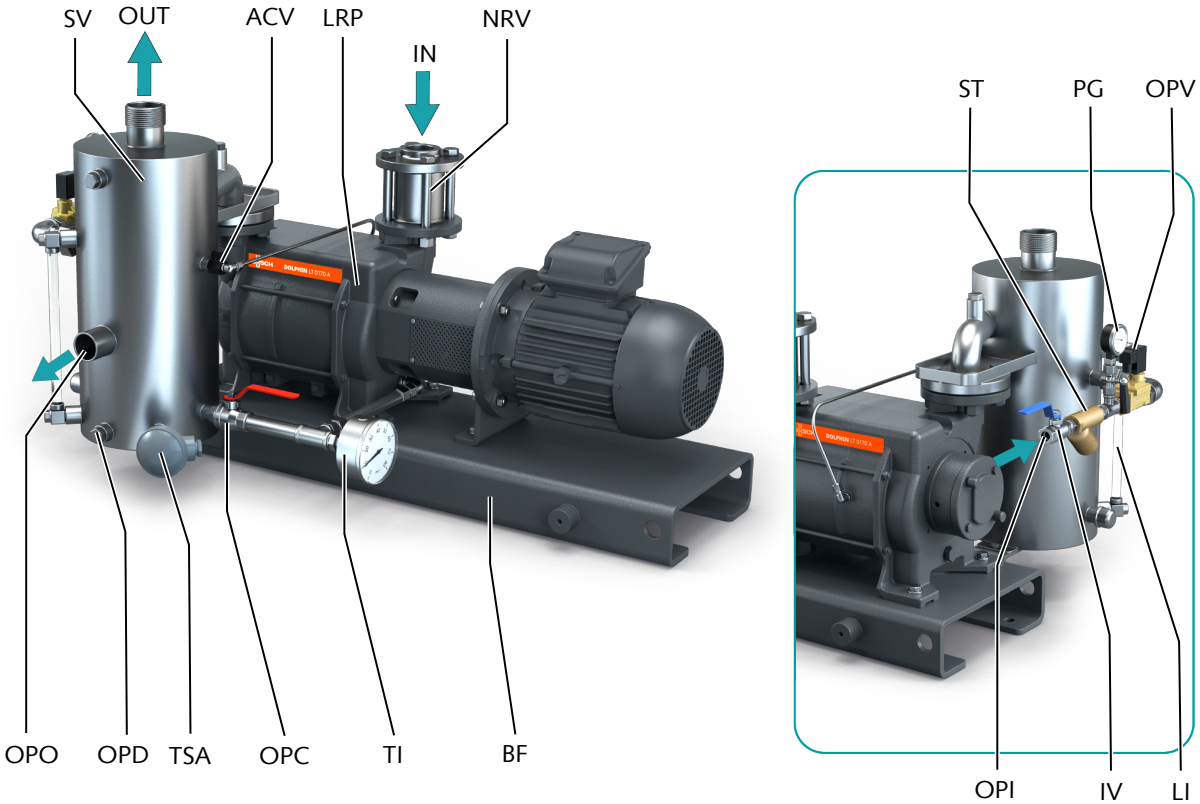
... indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

2 Product Description

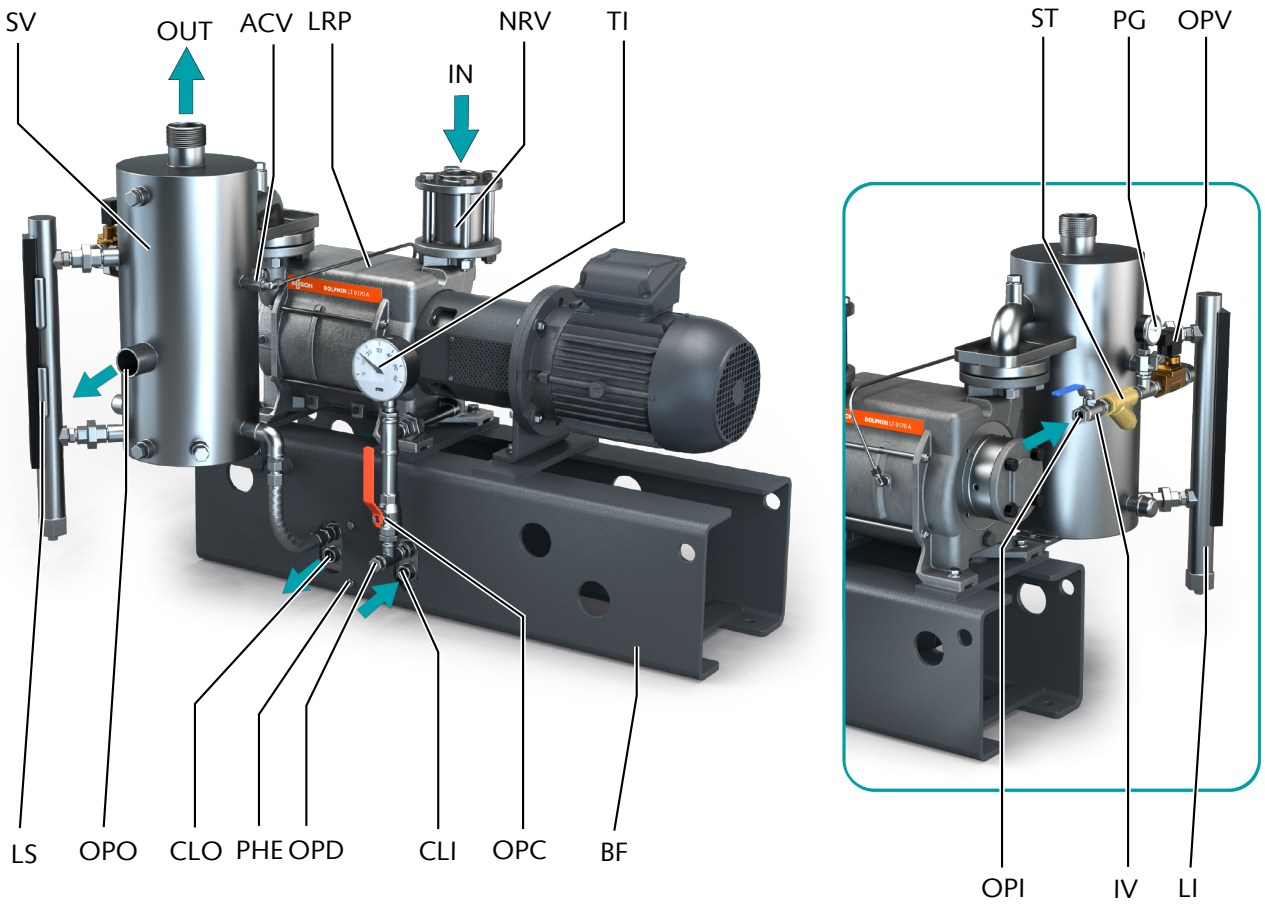
Once through system



Partial recovery system



Total recovery system



Description			
ACV	Anti-cavitation valve	BF	Base frame
CG	Compound pressure gauge	CLI	Cooling liquid inlet
CLO	Cooling liquid outlet	IN	Suction connection
IV	Fresh liquid isolation valve	LI	Level indicator
LRP	Liquid ring vacuum pump	LS	Level switch
OPC	Operating liquid control valve	OPD	Operating liquid drain
OPI	Operating liquid inlet	OPO	Operating liquid outlet / overflow
OPV	Operating liquid solenoid isolation valve	OUT	Discharge connection
PG	Pressure gauge	PRV	Pressure reducing valve
PHE	Plate heat exchanger	NRV	Non return valve (suction)
ST	Y-strainer / operating liquid filter	SV	Separator vessel
TI	Temperature indicator	TSA	Resistance thermometer (PT100)

NOTICE

Drainage of the operating liquid.

- Dispose in compliance with applicable regulations.

NOTE

Illustrations

In this instruction manual the illustrations may differ from the machine appearance.

NOTE

Technical term.

In this instruction manual, we consider that the term ‘machine’ refers to the ‘VL System’.

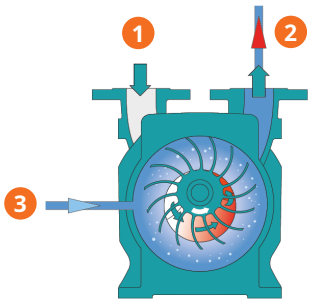
NOTE

Instruction manual supplement.

This document is a supplement to the DOLPHIN LM and LT liquid ring vacuum pump instruction manual whose content remains valid.

2.1 Operating Principle

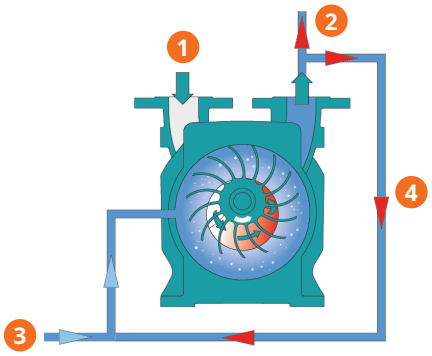
2.1.1 Once-Through Operation



Description			
1	Process inlet (IN)	2	Gas discharge (OUT)
3	Operating liquid inlet (OPI)		

Continuous flow liquid system does not recover the operating liquid which flows out of the separator drain having been separated from the discharge gases which vent separately.

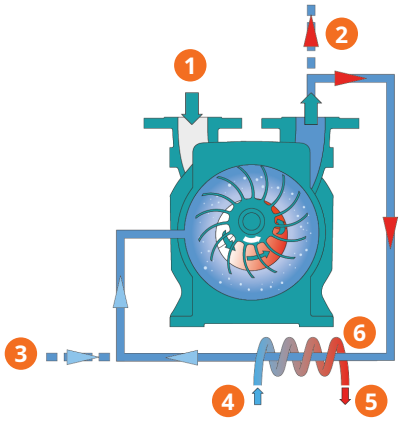
2.1.2 Partial Recovery (Open Circuit)



Description			
1	Process inlet (IN)	2	Gas discharge (OUT)
3	Operating liquid inlet (OPI)	4	50% of operating liquid liquid recovered

Partial recirculation liquid system reduces the consumption of fresh liquid by recovering and recirculating 50% of the operating liquid. Fresh operation liquid is added to the system via the separator makeup connection to maintain constant operating liquid temperature to the vacuum pump.

2.1.3 Total Recovery (Closed Circuit)



Description			
1	Process inlet (IN)	2	Gas discharge (OUT)
3	Topping-up operating liquid	4	Cooling water inlet (CWI)
5	Cooling water outlet (CWO)	6	Heat exchange (HE)

Total recirculation liquid system recovers all of the operating liquid which is cooled by a heat exchanger.

2.2 VL System Description

The VL system description is written on the system's nameplate. It is defined as in the following example:

Description			
1	VL = Compact liquid ring vacuum system	2	Size of the vacuum pump
3	Design status of vacuum pump	4	M = Single stage (LM) vacuum pump, T = Two stage (LT) vacuum pump
5	K = Cast iron construction / 316 stainless steel, M = 316 stainless steel throughout	6	O = Once through liquid system, P = Partial recirculation liquid system, T = Total recirculation liquid system (plate heat exchanger), S = Total recirculation liquid system (shell and tube exchanger)
7	Motor reference	8	M = Standard seals (Viton), P = Chemical seals (PTFE/FFKM seals and elastomers)
9	X = System suitable for non-hazardous area, E = ATEX system		

2.3 Start Controls

The machine comes without start controls. The control of the machine is to be provided in the course of installation.

2.4 Control Concept

2.4.1 Once Through Operation

Operating liquid is continuously supplied to the system whilst it is operating via the inlet pipe. The process gas and operating liquid are discharged from the vacuum pump together into the separator vessel (SV) where they are separated. The gas leaves through the discharge connection and the operating liquid through the operating liquid outlet connection at the bottom of the separator.
At the operating liquid inlet the Y-strainer (ST) prevents particles greater than 0.1 mm entering the vacuum pump.

The pressure reducing valve (PRV) reduces the operating liquid supply pressure to 1 bar(g) maximum. The solenoid valve (OPV) is linked in to the site control (provided by others) to open and close with the start and stopping of the vacuum pump to prevent flooding the vacuum pump when stopped.

Operating liquid control valve (OPC) allows the operating liquid flow rate to be regulated for optimum performance of the system, with compound pressure gauge (CG) indicating the operating liquid pressure at the vacuum pump inlet.
The suction non-return valve (NRV) prevents operating liquid from flowing back into the process when the system stops under vacuum.

2.4.2 Partial Recovery (Open Circuit)

Approximately 50% of the operating liquid is recirculated within the system whilst additional liquid is added via the fresh liquid line to maintain the liquid temperature. The process gas and operating liquid are discharged from the vacuum pump together into the separator vessel (SV) where they are separated. The gas leaves through the discharge connection, whilst the operating liquid level is maintained as excess liquid drains from the separator overflow connection (OPO). The level indicator (LI) provides visual indicator of the liquid level in the system.
Through the site control system (by others) the operating liquid temperature is monitored by resistance thermometer (TSA1) opening and closing the solenoid valve (OPV) to allow fresh cooler liquid into the system. Recommended temperature variation around the set point for switching is 3°C.
At the operating liquid inlet the Y-strainer (ST) prevents particles greater than 0.1 mm entering the vacuum pump.
The manual fresh liquid isolation valve (IV) allows the system liquid inlet to be isolated whilst the strainer is cleaned.
Operating liquid control valve (OPC) allows the operating liquid flow rate to be regulated for optimum performance of the system.
Suction non return valve (NRV) prevents operating liquid from flowing back into the process when the system stops under vacuum.

2.4.3 Total Recovery (Closed Circuit)

All the operating fluid is recirculated within the system allowing liquid other than water to be used as the operating liquid. Constant liquid temperature in the system is maintained by a heat exchanger with a separate cooling liquid supply. The process gas and operating liquid are discharged from the vacuum pump together into the separator vessel (SV), where they are separated. The gas leaves through the discharge connection whilst high operating liquid level (condensing suction load) is prevented by excess liquid draining from the separator overflow connection (OPO).
Through the site control system (by others) the operating liquid level is increased by the solenoid valve (OPV) opening with low level signal from the low level switch. Valve closes on signal from the high level switch. The level indicator (LI) provide visual indication of the liquid level in the system. At the operating liquid inlet the strainer (ST) prevents particles greater than 0.1 mm entering the vacuum pump.
The manual fresh liquid isolation valve (IV) allows the system liquid inlet to be isolated whilst the Y-strainer is cleaned.
Operating liquid control valve (OPC) allows the operating liquid flow rate to be regulated for optimum performance of the system.
Suction non return valve (NRV) prevents operating liquid from flowing back into the process when the system stops under vacuum.

3 Transport

WARNING

Suspended load.

Risk of severe injury!

- Do not walk, stand or work under suspended loads.

WARNING

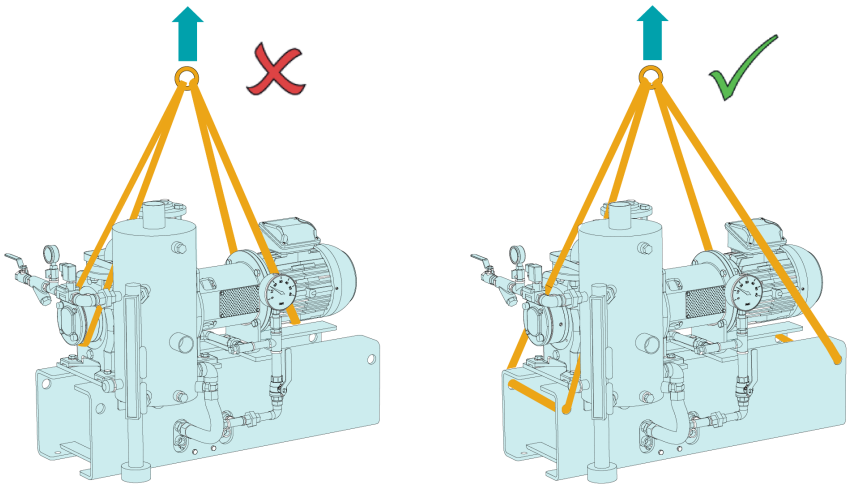
Lifting the VL system incorrectly.

Risk of severe injury!

Risk of damage to the machine!

- Do not lift the entire system by the vacuum pump and the motor.

- Check the machine for transport damage.
- To find out the weight of the machine, refer to the chapter *Technical Data* [➔ 29] or the name-plate (NP).
- Use appropriate slings.
- When disassembling the system lift each component separately.
- Make sure to comply with the suitable lifting method which is described in each instruction manual of the separate machine.



Different lifting variants are possible.

4 Storage

NOTICE

Storage temperature below +5°C.

Risk of damage to the machine!

- Drain the operating liquid from the machine and the system before storage.
- Or add an anti-freeze solution.

After testing, all Busch DOLPHIN vacuum pumps are vented and drained.

5 Installation

5.1 Installation Conditions

NOTICE

Use of the machine outside of the permitted installation conditions.

Risk of premature failure!

Loss of efficiency!

- Take care that the installation conditions are fully complied with.

- Make sure that the environment of the machine is not potentially explosive.

If there is Ex(o) sign written on the nameplate:

- Please refer to the ATEX supplement for additional safety information.

- Make sure that the ambient conditions comply with the *Technical Data* [➔ 29].
- Make sure that the environmental conditions comply with the protection class of the motor.
- Make sure that the installation space or location is protected from weather and lightning.
- Make sure that the installation space or location is vented such that sufficient cooling of the machine is provided.
- Make sure that cooling air inlets and outlets of the motor fan are not covered or obstructed and that the cooling air flow is not affected adversely in any other way.
- Make sure that enough space remains for maintenance work.
- Make sure that the machine is placed or mounted horizontally on a flat surface.
- Make sure that all provided covers, guards, hoods, etc. are mounted.

If the machine is installed at an altitude greater than 1000 meters above sea level:

- Contact your Busch representative, the motor should be derated or the ambient temperature limited.

5.2 Connecting Lines / Pipes

- Remove all protective covers before installation.
- Make sure that the connection lines cause no stress on the machine‘s connection; if necessary use flexible joints.
- Make sure that the line size of the connection lines over the entire length is at least as large as the connections of the machine.

In case of long connection lines it is advisable to use larger line sizes in order to avoid a loss of efficiency. Seek advice from your Busch representative.

NOTICE

Ingress of foreign objects.

Risk of damage to the machine!

If the inlet gas contains foreign solid particles:

- Install a suitable inlet screen (smaller than 0.1 mm mesh size) upstream of the machine.

CAUTION

Restriction of the separator vent.

Will cause back pressure and possible separator failure.

- The separator vent piping should not be restricted as separator vessel is not pressure rated.

NOTICE

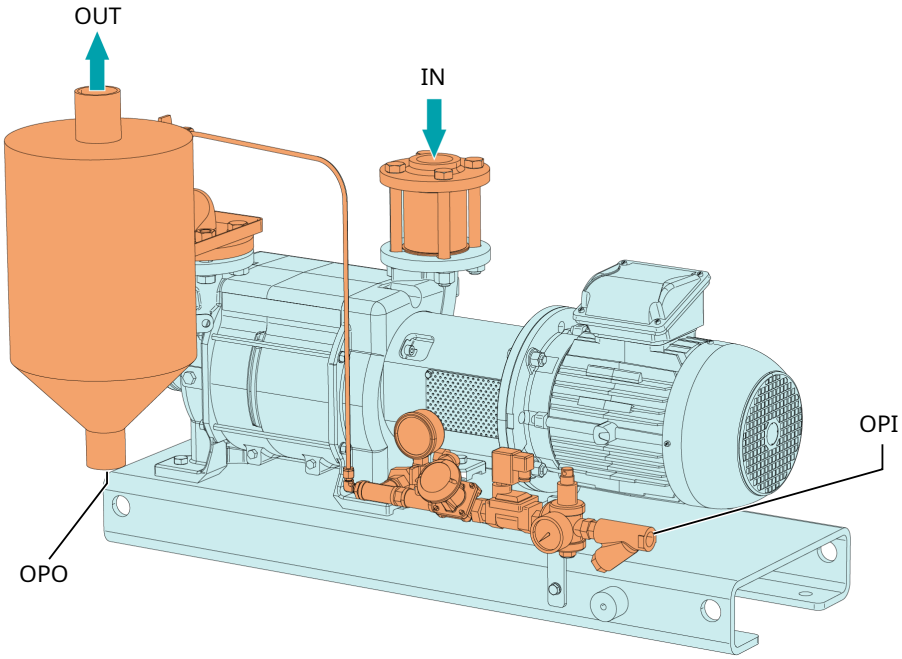
Discharge gas flow obstructed.

Risk of damage to the machine!

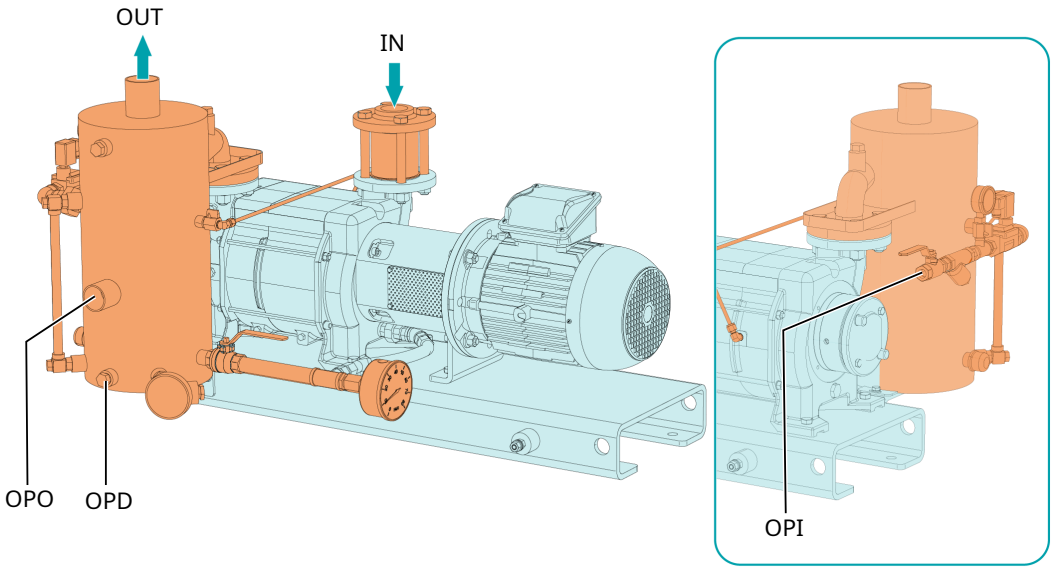
- Make sure that the discharged gas will flow without obstruction. Do not shut off or throttle the discharge line or use it as a pressurized air source.

5.2.1 Operating Liquid Connection

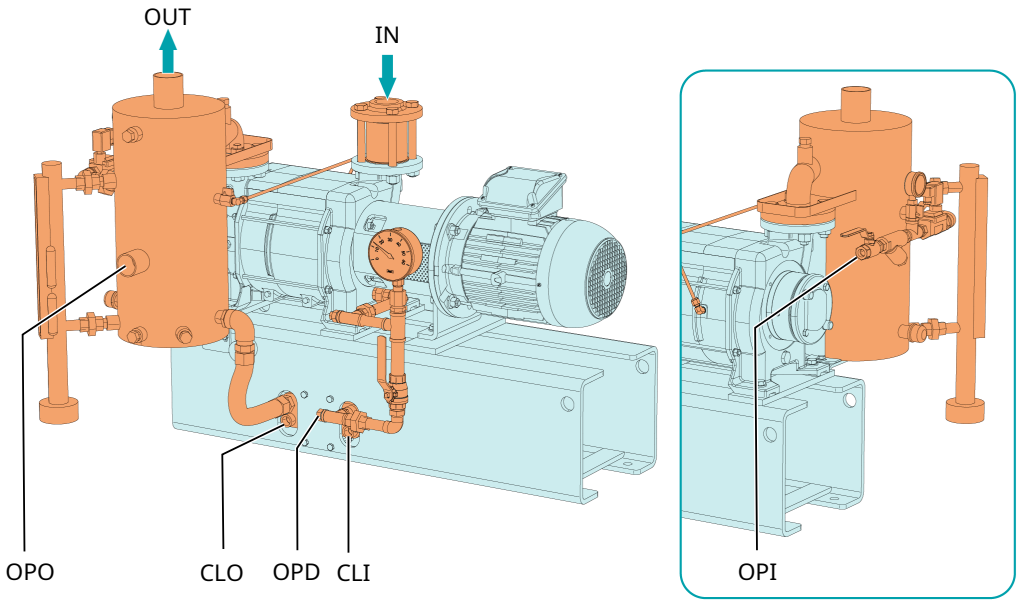
DOLPHIN VL 0100-0800 A Once through



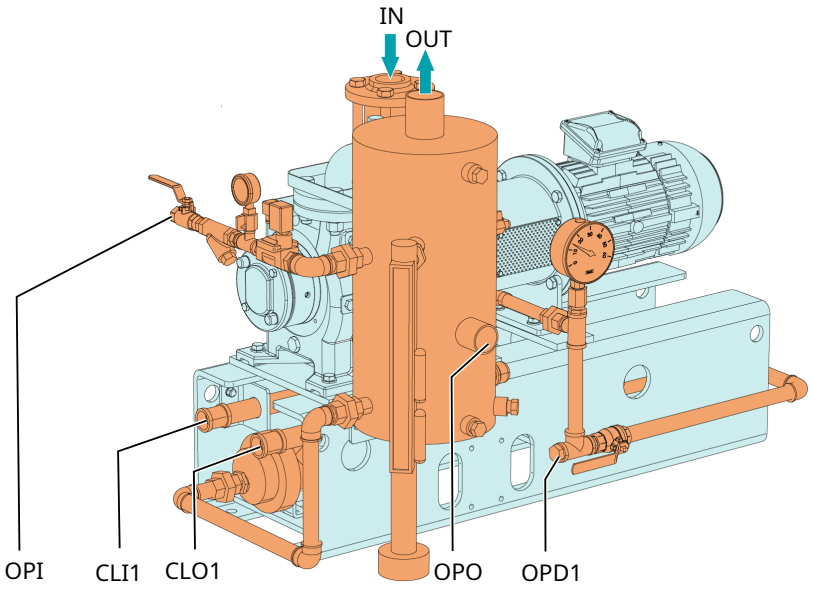
DOLPHIN VL 0100-0800 A Partial recovery



DOLPHIN VL 0100-0800 A Total recovery - Plate heat exchanger



DOLPHIN VL 0100-0800 A Total recovery - Shell and tube heat exchanger



Connection size:

Machine type	IN	OUT	OPO	OPI	OPD	CLO	CLI	OPD1	CLI1	CLO1
VL 0100 - 0270 A	G1 ½	R2	R1 ½	G½	G½	G½	G½	G½	G1	G1
VL 0320 - 0530 A	G2	R3	R2	G½	G¾	G¾	G¾	G1	G1	G1
VL 0630 – 0800 A	G2 ½	R4	R2	G½	G¾	G¾	G¾	G1	G1	G1

- Make sure that the cooling liquid complies with the requirements, see *Technical Data* [➔ 29].

6 Electrical Connection

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

CURRENT PROTECTION OF THE CUSTOMER INSTALLATION:

DANGER

Missing current protection.

Risk of electrical shock.

- Current protection according to EN 60204-1 must be insured by the customer on its installation.
- The electrical installation must comply with the applicable national and international standards.

NOTICE

Electromagnetic compatibility.

- Make sure that the motor of the machine will not be affected by electric or electro- magnetic disturbance from the mains, if necessary seek advice from Busch.
- Make sure that the EMC of the machine is compliant with the requirements of your supply network system, if necessary provide further interference suppression (EMC of the machine, see *EU Declaration of Conformity* [➔ 34] or *UK Declaration of Conformity* [➔ 35]).

6.1 Machine delivered without Control Box or Variable Speed Drive (VSD)

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

- Make sure that the power supply for the motor is compatible with the data on the nameplate of the motor.
- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of isolation default.
  - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- Provide a lockable disconnect switch or an emergency stop switch on the power line so that the machine is completely secured in case of an emergency situation.

- Provide a lockable disconnect switch on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1 for the motor.
- Connect the protective earth conductor.
- Electrically connect the motor.

6.2 Machine delivered with a Variable Speed Drive (Option)

- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of isolation default.
  - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- If the variable speed drive is not equipped with a lockable disconnect switch, provide it on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1.
- Connect the protective earth conductor.

NOTICE

Incorrect connection.

Risk of damage to the variable speed drive!

- The wiring diagrams given below are typical. Check the connection instructions/diagrams.

6.3 Wiring Diagram Three-Phase Motor

NOTICE

Incorrect direction of rotation.

Risk of damage to the machine!

- Operation in the wrong direction of rotation can destroy the machine in a short time! Prior to start-up, ensure that the machine is operated in the right direction.

NOTICE

Incorrect direction of rotation.

Risk of damage to the vacuum system!

- Operating the vacuum system with the rotation in the wrong direction can result in the operating liquid flowing back to the vacuum system. Prior to start-up, check for correct direction of rotation.

If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

6.4 Electrical Connection of the Monitoring Devices

NOTE

The accessories below are considered as standard.

If other specific components should be used, refer to the instruction manual of the accessory in question.

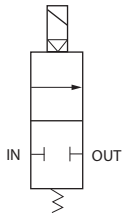
6.4.1 Wiring Diagram Solenoid Valve

Part no. : VZS/0.50/DW/M/V1

Supplier reference : Model CLO3EB13T
Pilot Diaphragm

Electrical data :
U_i = 24 VDC ; P_i = 5.5 W ; IP 65

Contact: Normally closed



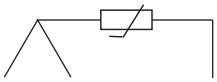
In : IN
Out : OUT
Coil de-energised : IN and OUT close
Coil energized : IN to OUT

6.4.2 Wiring Diagram Resistance Thermometer

Part no. : TS/2745

Supplier reference : H&B Sensors
PRT Probe 3 wire Class B

Electrical data :
4 ... 20 mA > -50 ... + 250 °C



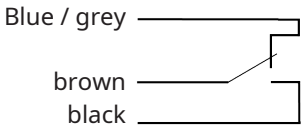
3 WIRE PT100 CLASS B
TO BS EN 60751

6.4.3 Wiring Diagram Level Switches

Part no. : 0652700908
Supplier reference :
WIKA: BGU-1 PVC

Electrical data :
Maximum switching capacity: 230V; 40VA; 1A / DC 230V; 20W; 0.5A

IP 65, Integral 1m PVC cable provided with each switch



7 Commissioning

CAUTION

During operation the surface of the machine may reach temperatures of more than 70°C.

Risk of burns!

- Avoid contact with the machine during and directly after operation.

NOTICE

The machine is running without operating liquid system.

Will ruin the machine in short time!

- Prior to commissioning, the operating and cooling liquid system must be connected and open.

- Make sure that the installation conditions (see Installation Conditions) are met.

Before operating the machine:

1. Fill with operating liquid by opening the solenoid valve until the level is at the vacuum pump shaft center – overflow on separator. Ensure operating liquid control valve is open during this process.
2. Check the operation of all automatic valves before start up.

- Switch on the machine.
- Make sure that the maximum permissible number of starts does not exceed the recommendation from the motor manufacturer.

After a few seconds of operation:

- Turn on/activate the operating (and cooling) liquid system device.
- Make sure that the operating conditions comply with the *Technical Data* [➔ 29] or the Operating Limits.

As soon as the machine is operated under normal operating conditions:

- Measure the motor current and record it as reference for future maintenance and trouble-shooting work.

7.1 Preventing Cavitation

NOTICE

Cavitation.

Risk of damage to the machine!

If you hear crackling noise:

- Control the pressure.

At very low pressures and sufficiently high temperatures the operating liquid can locally transfer into the vapor phase, creating bubbles within the operating liquid. As the pressure rises towards the outlet slot the bubbles collapse. This process is called cavitation.

In case of bubbles that have been located on surfaces the operating liquid cannot intrude the cavity left by the bubble equally from all directions. Instead the inflowing liquid hits the surface with high speed. This causes erosion, which can destroy the machine rapidly. The formation of bubbles also deteriorates the pump performance. Cavitation is clearly audible by its crackling noise.

The working pressure of the vacuum pump shall therefore be sufficiently above the vapor pressure of the operating liquid. In particular the pressure control in the vacuum system must by no means be achieved by throttling or even closing of the suction line!

The vapor pressure of the operating liquid and consequently the ultimate pressure can be reduced by cooling. However, this increases the cooling water flow considerably. In most cases the low ultimate pressure is not required and cavitation shall be avoided by means of vacuum limitation rather than cooling.

The machine is fitted with anti-cavitation line and valve (ACV). When cavitation is observed, open the valve to bleed gas into the vacuum pump to reduce cavitation.

8 Maintenance

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

WARNING

Machines contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

CAUTION

Hot surface.

Risk of burns!

- Prior to any action requiring touching the machine, let the machine cool down first.

- Shut down the machine and lock against inadvertent start up.
- Turn off the operating liquid system.
- Vent the connected lines to atmospheric pressure.

If necessary:

1. Drain the operating liquid
2. Disconnect all connections

8.1 Maintenance Schedule

The maintenance intervals depend very much on the individual operating conditions. The intervals given below are considered as starting values which should be shortened or extended as appropriate. Particularly harsh applications or heavy duty operation, such as high dust loads in the environment or in the process gas, other contamination or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

Interval	Maintenance work
Monthly	• Check the machine for liquid leaks - in case of leaks have the machine repaired (contact Busch). • Check gauges are functioning – replace if damaged.
Yearly	• Clean Y-strainer. • Clean inlet screen if installed. • Drain and clean level indicator. • Flush and clean heat exchanger. • Check function of electrical control devices.

9 Overhaul

WARNING

Machines contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

NOTICE

Improper assembly.

Risk of premature failure!

Loss of efficiency!

- Any dismantling of the machine that goes beyond anything that is described in this manual should be done by Busch authorized technicians.

In case of the machine having conveyed gas that was contaminated with foreign materials which are dangerous to health:

- Decontaminate the machine as much as possible and state the contamination status in a ‘Declaration of Contamination’.

Busch will only accept machines that come with a completely filled in and legally binding signed ‘Declaration of Contamination’ (form downloadable from *www.buschvacuum.com*).

10 Decommissioning

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

CAUTION

Hot surface.

Risk of burns!

- Prior to any action requiring touching the machine, let the machine cool down first.

- Shut down the machine and lock against inadvertent start up.
- Disconnect the power supply.
- Vent the connected lines to atmospheric pressure.
- Disconnect all connections.

If the machine is going to be stored:

- See Storage.

10.1 Dismantling and Disposal

- Separate special waste from the machine.
- Dispose of special waste in compliance with applicable regulations.
- Dispose of the machine as scrap metal.

11 Spare Parts

NOTICE

Use of non-Busch genuine spare parts.

Risk of premature failure!

Loss of efficiency!

- The exclusive use of Busch genuine spare parts and consumables is recommended for the correct functioning of the machine and to validate the warranty.

Spare parts	Description	Part no.
Coupling spare for: VL 0100 A VL 0130 A VL 0170 A VL 0180 A VL 0220 A VL 0270 A VL 0320 A VL 0430 A VL 0510 A VL 0530 A	Intended for standard IEC motor installations 1x coupling flexible insert	867.0/HRC110
Coupling spare for: VL 0630 A VL 0750 A VL 0800 A	Intended for standard IEC motor installations 1x coupling flexible insert	867.0/HRC150
Heat exchanger for: VL 0100 A VL 0130 A VL 0170 A VL 0180 A VL 0220 A VL 0270 A	Intended for all applications 1x plate type heat exchanger – stainless steel, braised plates	HX/2706
Heat exchanger for: VL 0320 A VL 0430 A VL 0510 A VL 0530 A VL 0630 A VL 0750 A VL 0800 A	Intended for all applications 1x plate type heat exchanger – stainless steel, braised plates	HX/2708
Heat exchanger service kit for: VL 0100 A VL 0130 A VL 0170 A VL 0180 A VL 0220 A VL 0270 A	Intended for shell and tube heat exchanger (Standard seal version) 2x End cover seals	0990 700 563

Spare parts	Description	Part no.
Heat exchanger service kit for: VL 0320 A VL 0430 A VL 0510 A VL 0530 A VL 0630 A VL 0750 A VL 0800 A	Intended for shell and tube heat exchanger (Standard seal version) 2x End cover seals	0990 700 564
Heat exchanger service kit for: VL 0100 A VL 0130 A VL 0170 A VL 0180 A VL 0220 A VL 0270 A	Intended for shell and tube heat exchanger (Chemical version) 2x End cover seals	0990 701 078
Heat exchanger service kit for: VL 0320 A VL 0430 A VL 0510 A VL 0530 A VL 0630 A VL 0750 A VL 0800 A	Intended for shell and tube heat exchanger (Chemical version)	0990 701 080

If other parts are required:

- Contact your Busch representative.

12 Troubleshooting

Problem	Possible Cause	Remedy
The machine does not start.	The motor is not supplied with the correct voltage.	• Check the power supply.
	Corrosion between the rotor and the housing.	• Eliminate by use of anti-corrosion liquid. • Repair the machine (contact Busch).
	Solid foreign matter has entered the machine.	• Remove the solid foreign matter or repair the machine (contact Busch). • Install an inlet screen if necessary.
	Ice in the machine, the operating liquid has frozen.	• Carefully warm up the machine. • Defrost the operating liquid.
	The motor is defective.	• Replace the motor.
The machine runs very noisily or rattles.	The operating liquid level is too high.	• Adjust the regulating valves to drain the pump down to center line.
	Density or viscosity of the operating liquid too high.	• Check Operating Liquid Settings. • Provide a different operating liquid or a stronger drive motor.
	The machine runs in the wrong direction.	• Check the direction of rotation, see *Wiring Diagram Three-Phase Motor* [➔ 17].
	Defective bearings.	• Repair the machine (contact Busch).
	The vacuum pump cavitates (periodic formation and collapsing of steam bubbles in the operating liquid).	• Consult the chapter Preventing Cavitation. • Adjust cooling liquid flow rate to reduce the temperature of the operation liquid.
	Worn coupling element.	• Check the coupling and repair it if necessary.

Problem	Possible Cause	Remedy
The machine runs too hot.	Insufficient air ventilation.	• Make sure that the cooling of the machine is not impeded by dust/dirt. • Clean the fan cowling, the fan, the ventilation grill and the cooling fins of the motor.
	Ambient temperature too high.	• Observe the permitted ambient temperature, see *Technical Data* [➔ 29].
	Temperature of the process gases at the inlet too high.	• Observe the permitted gas inlet temperature, see *Technical Data* [➔ 29].
	Insufficient gas transfer.	• Introduce a suitable inert gas or air via the anti-cavitation connection.
	Partial blockage in the suction, discharge or pressure line.	• Remove the blockage.
	Operating liquid not cooled sufficiently by the heat exchanger.	• Check cooling liquid flow *Technical Data* [➔ 29]. • Clean heat exchanger. • Reduce cooling liquid temperature.
The machine does not reach the usual pressure on the suction connection.	Suction or discharge lines too long or section diameter too small.	• Use larger diameter or shorter lines. • Seek advice from your local Busch representative.
	The operating liquid is too warm. (the characteristic curves are based on 15°C warm water as operating liquid, with higher temperatures the achieved pressure and the flow rate deteriorate)	• Adjust cooling liquid flow rate to reduce the temperature of the operating liquid. • Check heat exchanger for blockage. • Check cooling liquid supply temperature and flow *Technical Data* [➔ 29].
	Partial clogging in the suction, discharge or pressure line.	• Remove the blockage.
	If an inlet screen is installed, it can be partially clogged.	• Clean the inlet screen.
	Leakage occurring in the system.	• Check the joints are sealed sufficiently.
Separator liquid level not maintained.	Partial blockage in the liquid outlet/overflow line.	• Remove the blockage.
	Control switch operation.	• Check switch to solenoid valve control. • Check switch operation – replace if damaged. • Check solenoid valve operation – replace if damaged.
	Y-strainer clogged.	• Clean the Y-strainer screen.

13 Technical Data

		VL 0100 A	VL 0180 A	VL 0270 A
Pumping speed (50Hz / 60Hz)*	m^3/h	82 / 98	144 / 180	220 / 267
Ultimate pressure (50Hz / 60Hz)*	hPa (mbar) abs.	130 / 130		
Maximum overpressure (50Hz / 60Hz)	bar(g)	0.5 / 0.5		
Nominal motor rating IEC (50Hz / 60Hz)	kW	2.2 / 3.0	4.0 / 5.5	5.5 / 7.5
Nominal motor speed (50Hz / 60Hz)	min^{-1}	1450 / 1750		
Permitted motor speed range	min^{-1}	1000 ... 1780 (~34 ... 60 Hz)		
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤70 / ≤71		
Design pressure	bar(g)	0.5		
Design temperature	°C	120		
Max. allowable gas inlet temperature	°C	Gas dry ► 120		
		Gas saturated ► 100		
Ambient temperature range	°C	5 ... 40		
Relative humidity	at 30 °C	90%		
Ambient pressure		Atmospheric pressure		
Cooling liquid flow rate – plate heat exchanger	m^3/h	0.63 / 0.86	1.15 / 1.58	1.58 / 2.15
Cooling liquid flow rate – shell and tube heat exchanger	m^3/h	0.78-1.00 / 1.08-1.30	1.32-1.37 / 2.10-2.16	2.05-2.41 / 3.42-3.67
Maximum cooling liquid pressure	bar(g)	10		
Min. operating liquid density	g/cm^3	0.83		
Max. operating liquid viscosity	cP	20		
Instrument electrical supply		24 VDC		
Weight – Once through (50Hz Europe / 50 & 60Hz multi-voltage)	kg	177 / 185	179 / 223	221 / 247
Weight – Partial recovery (50Hz Europe / 50 & 60Hz multi-voltage)	kg	179 / 187	181 / 225	224 / 250
Weight – Total recovery, plate heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	205 / 213	210 / 254	252 / 278
Weight – Total recovery, shell and tube heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	225 / 233	230 / 274	272 / 298

		VL 0530 A	VL 0800 A
Pumping speed (50Hz / 60Hz)*	m^3/h	440 / 556	722 / 867
Ultimate pressure (50Hz / 60Hz)*	hPa (mbar) abs.	130 / 130	
Maximum overpressure (50Hz / 60Hz)	bar(g)	0.5 / 0.5	
Nominal motor rating IEC (50Hz / 60Hz)	kW	11.0 / 15.0	18.5 / 22.0
Nominal motor speed (50Hz / 60Hz)	min^{-1}	1450 / 1750	
Permitted motor speed range	min^{-1}	1000 ... 1780 (~34 ... 60 Hz)	1000 ... 1780 (~34 ... 60 Hz)
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤72 / ≤73	≤75 / ≤76
Design pressure	bar(g)	0.5	
Design temperature	°C	120	
Max. allowable gas inlet temperature	°C	Gas dry ► 120	
		Gas saturated ► 100	
Ambient temperature range	°C	5 ... 40	
Relative humidity	at 30 °C	90%	
Ambient pressure		Atmospheric pressure	
Cooling liquid flow rate – plate heat exchanger	m^3/h	1.89 / 2.92	2.58 / 4.3
Cooling liquid flow rate – shell and tube heat exchanger	m^3/h	3.06-3.81 / 4.68-4.91	4.44-5.88 / 8.22-9.12
Maximum cooling liquid pressure	bar(g)	10	
Min. operating liquid density	g/cm^3	0.83	
Max. operating liquid viscosity	cP	20	
Instrument electrical supply		24 VDC	
Weight – Once through (50Hz Europe / 50 & 60Hz multi-voltage)	kg	397 / 444	461 / 508
Weight – Partial recovery (50Hz Europe / 50 & 60Hz multi-voltage)	kg	418 / 465	486 / 533
Weight – Total recovery, plate heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	458 / 505	524 / 571
Weight – Total recovery, shell and tube heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	486 / 533	552 / 599

		VL 0130 A	VL 0170 A	VL 0220 A
Pumping speed (50Hz / 60Hz)*	m^3/h	105 / 128	144 / 165	203 / 232
Ultimate pressure (50Hz / 60Hz)*	hPa (mbar) abs.	33 / 33		
Maximum overpressure (50Hz / 60Hz)	bar(g)	0.5 / 0.5		
Nominal motor rating IEC (50Hz / 60Hz)	kW	3.0 / 4.0	4.0 / 5.5	5.5 / 7.5
Nominal motor speed (50Hz / 60Hz)	min^{-1}	1450 / 1750		
Permitted motor speed range	min^{-1}	1000 ... 1780 (~34 ... 60 Hz)		
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤70 / ≤71		
Design pressure	bar(g)	0.5		
Design temperature	°C	120		
Max. allowable gas inlet temperature	°C	Gas dry ► 120		
		Gas saturated ► 100		
Ambient temperature range	°C	5 ... 40		
Relative humidity	at 30 °C	90%		
Ambient pressure		Atmospheric pressure		
Cooling liquid flow rate – plate heat exchanger	m^3/h	0.86 / 1.15	1.15 / 0.95	0.95 / 1.29
Cooling liquid flow rate – shell and tube heat exchanger	m^3/h	1.03-1.13 / 1.34-1.42	1.34-1.65 / 2.10-2.26	1.87-2.10 / 2.53-3.42
Maximum cooling liquid pressure	bar(g)	10		
Min. operating liquid density	g/cm^3	0.83		
Max. operating liquid viscosity	cP	20		
Instrument electrical supply		24 VDC		
Weight – Once through (50Hz Europe / 50 & 60Hz multi-voltage)	kg	195 / 218	202 / 246	239 / 264
Weight – Partial recovery (50Hz Europe / 50 & 60Hz multi-voltage)	kg	196 / 219	203 / 247	241 / 266
Weight – Total recovery, plate heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	225 / 248	234 / 278	276 / 301
Weight – Total recovery, shell and tube heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	245 / 268	254 / 298	296 / 321

		VL 0320 A	VL 0430 A	VL 0510 A
Pumping speed (50Hz / 60Hz)*	m^3/h	265 / 320	361 / 426	430 / 510
Ultimate pressure (50Hz / 60Hz)*	hPa (mbar) abs.	33 / 33		
Maximum overpressure (50Hz / 60Hz)	bar(g)	0.5 / 0.5		
Nominal motor rating IEC (50Hz / 60Hz)	kW	7.5 / 11.0	11.0 / 15.0	11.0 / 15.0
Nominal motor speed (50Hz / 60Hz)	min^{-1}	1450 / 1750		
Permitted motor speed range	min^{-1}	1000 ... 1780 (~34 ... 60 Hz)		
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤72 / ≤73		
Design pressure	bar(g)	0.5		
Design temperature	°C	120		
Max. allowable gas inlet temperature	°C	Gas dry ► 120		
		Gas saturated ► 100		
Ambient temperature range	°C	5 ... 40		
Relative humidity	at 30 °C	90%		
Ambient pressure		Atmospheric pressure		
Cooling liquid flow rate – plate heat exchanger	m^3/h	1.89 / 2.24	1.89 / 2.92	2.58 / 2.92
Cooling liquid flow rate – shell and tube heat exchanger	m^3/h	2.53-2.58 / 3.47-3.60	3.06-3.36 / 4.78-5.22	4.16-4.38 / 5.22-5.85
Maximum cooling liquid pressure	bar(g)	10		
Min. operating liquid density	g/cm^3	0.83		
Max. operating liquid viscosity	cP	20		
Instrument electrical supply		24 VDC		
Weight – Once through (50Hz Europe / 50 & 60Hz multi-voltage)	kg	364 / 432	415 / 462	429 / 477
Weight – Partial recovery (50Hz Europe / 50 & 60Hz multi-voltage)	kg	384 / 452	435 / 482	449 / 497
Weight – Total recovery, plate heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	412 / 480	477 / 524	491 / 539
Weight – Total recovery, shell and tube heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	440 / 508	495 / 552	519 / 567

		VL 0630 A	VL 0750 A
Pumping speed (50Hz / 60Hz)*	m^3/h	500 / 578	617 / 710
Ultimate pressure (50Hz / 60Hz)*	hPa (mbar) abs.	33 / 33	
Maximum overpressure (50Hz / 60Hz)	bar(g)	0.5 / 0.5	
Nominal motor rating IEC (50Hz / 60Hz)	kW	15.0 / 22.0	18.5 / 30.0
Nominal motor speed (50Hz / 60Hz)	min^{-1}	1450 / 1750	
Permitted motor speed range	min^{-1}	1000 ... 1780 (~34 ... 60 Hz)	
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤75 / ≤76	
Design pressure	bar(g)	0.5	
Design temperature	°C	120	
Max. allowable gas inlet temperature	°C	Gas dry ► 120	
		Gas saturated ► 100	
Ambient temperature range	°C	5 ... 40	
Relative humidity	at 30 °C	90%	
Ambient pressure		Atmospheric pressure	
Cooling liquid flow rate – plate heat exchanger	m^3/h	2.58 / 3.61	3.18 / 4.5
Cooling liquid flow rate – shell and tube heat exchanger	m^3/h	4.44-5.16 / 6.12-7.56	5.16-6.78 / 7.86-10.92
Maximum cooling liquid pressure	bar(g)	10	
Min. operating liquid density	g/cm^3	0.83	
Max. operating liquid viscosity	cP	20	
Instrument electrical supply		24 VDC	
Weight – Once through (50Hz Europe / 50 & 60Hz multi-voltage)	kg	518 / 593	606 / 639
Weight – Partial recovery (50Hz Europe / 50 & 60Hz multi-voltage)	kg	540 / 615	628 / 661
Weight – Total recovery, plate heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	577 / 652	671 / 704
Weight – Total recovery, shell and tube heat exchanger (50Hz Europe / 50 & 60Hz multi-voltage)	kg	595 / 680	698 / 732

* Pumping speed and ultimate pressure based on 12°C cooling liquid temperature and water as the operating liquid. Higher cooling liquid and so operating liquid temperatures will reduce the pumping speed and increase the ultimate pressure that can be achieved.

14 EU Declaration of Conformity

This Declaration of Conformity and the CE-markings affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the CE-marking.

The manufacturer

Busch GVT Ltd.
Westmere Drive, Crewe Business Park
Crewe, Cheshire, CW1 6ZD
United Kingdom

declares that the machine: DOLPHIN VL 0100 A; DOLPHIN VL 0130 A; DOLPHIN VL 0170 A; DOLPHIN VL 0180 A; DOLPHIN VL 0220 A; DOLPHIN VL 0270 A; DOLPHIN VL 0320 A; DOLPHIN VL 0430 A; DOLPHIN VL 0510 A; DOLPHIN VL 0530 A; DOLPHIN VL 0630 A; DOLPHIN VL 0750 A; DOLPHIN VL 0800 A

fulfill(s) all the relevant provisions from EU directives:

- 'Machinery' 2006/42/EC
- 'Electromagnetic Compatibility' (EMS) 2014/30/EU
- 'RoHS' 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment (incl. all related applicable amendments)

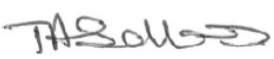
and comply(-ies) with the following designated standards that have been used to fulfill those provisions:

Standards	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN IEC 61000-6-2 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN IEC 61000-6-4 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments
ISO 21940-1 : 2019	Mechanical vibration – Rotor balancing

Legal person authorized to compile the technical file
and authorized representative in the EU
(if the manufacturer is not located in the EU):

Busch Dienste GmbH
Schauinslandstr. 1
DE-79689 Maulburg

Crewe, 16.04.2021



Tracey Sellars, General Director

15 UK Declaration of Conformity

This Declaration of Conformity and the UKCA-markings affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the UKCA-marking.

The manufacturer

Busch GVT Ltd.
Westmere Drive, Crewe Business Park
Crewe, Cheshire, CW1 6ZD
United Kingdom

declares that the machine: DOLPHIN VL 0100 A; DOLPHIN VL 0130 A; DOLPHIN VL 0170 A; DOLPHIN VL 0180 A; DOLPHIN VL 0220 A; DOLPHIN VL 0270 A; DOLPHIN VL 0320 A; DOLPHIN VL 0430 A; DOLPHIN VL 0510 A; DOLPHIN VL 0530 A; DOLPHIN VL 0630 A; DOLPHIN VL 0750 A; DOLPHIN VL 0800 A

fulfill(s) all the relevant provisions from UK legislations:

- Supply of Machinery (Safety) Regulations 2008
- Electromagnetic Compatibility Regulations 2016
- Restriction of the use of certain hazardous substances in Electrical and Electronic Equipment Regulations 2021

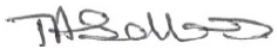
and comply(-ies) with the following designated standards that have been used to fulfill those provisions:

Standards	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN IEC 61000-6-2 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN IEC 61000-6-4 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments
ISO 21940-1 : 2019	Mechanical vibration – Rotor balancing

Legal person authorized to compile the technical file
and importer in the UK
(if the manufacturer is not located in the UK):

Busch GVT Ltd
Westmere Drive, Crewe Business Park
Crewe, Cheshire - UK

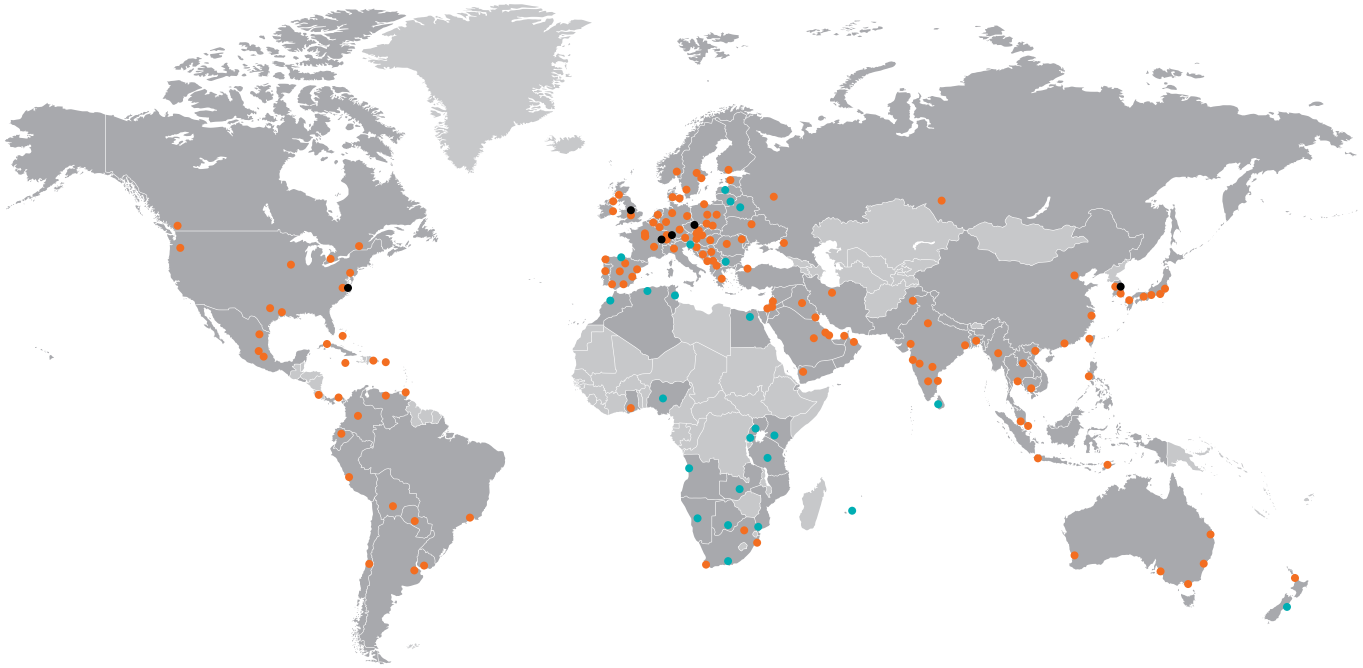
Crewe, 16.04.2021



Tracey Sellars, General Director

Busch
Vacuum Solutions

With a network of over 60 companies in more than 40 countries and agencies worldwide, Busch has a global presence. In every country, highly competent local personnel delivers custom-tailored support backed by a global network of expertise. Wherever you are. Whatever your business. We are there for you.



Busch companies and Busch employees Local representatives and distributors Busch production site

www.buschvacuum.com

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