

Operation Manual (EN)
Translation of the german original manual

Laboratory-Vacuum-Systems

Ultimate pressure < 2 mbar

Models:

- ▶ unregulated
LVS 600 T
- ▶ manual regulated
LVS 601 T
LVS 602 T
- ▶ automatic regulated
LVS 610 T
LVS 611 T
- ▶ ecoflex
LVS 610 T ef
LVS 610 T ef extern
- ▶ economic
LVS 610 T en



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- **Instructions for certification - Laboratory-Vacuum-Systems LVS -**
for use in Zone 2 in accordance with device category 3 per ATEX Directive 2014/34/EU
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- **EC Declaration of Conformity**

1 Important Information

1.1 General Information

The Laboratory-Vacuum-Systems conform to the:

2006 / 42 / EC	Machinery Directive
2014 / 30 / EU	Electromagnetic Compatibility Directive
2014 / 34 / EU	ATEX Guideline for use in potentially explosive atmospheres, Appendix III

The CE sign is located on the rating plate. Observe the binding national and local regulations when fitting the pump into installations.

Our products are sold worldwide and can therefore be equipped with the typical national plugs and for the various voltages. You will find more information about the available pump designs on our web page in the internet.

1.2 Target Groups

This Operating Manual is intended for the personnel planning, operating and maintaining Laboratory-Vacuum-Systems. This group of people includes:

- Designers and fitters of vacuum apparatus,
- Employees working on commercial laboratory and industrial vacuum technology applications and
- Service personnel for laboratory-vacuum-systems.

The personnel operating and maintaining the laboratory vacuum systems must have the technical competence required to perform the work that has to be done.

The user must authorize the operating personnel to do the work that has to be done.

The personnel must have read and understood the complete Operating Manual before using the laboratory-vacuum-systems.

The Operating Manual must be kept at the place of use and be available to the personnel when required.

1.3 Intended Use

- The laboratory-vacuum-system may only be operated under the conditions stated
 - in the "Technical Data" section,
 - on the type plate, and
 - in the technical specification for the order concerned.
- Laboratory-vacuum-systems are approved for extracting, pumping and compressing gases and vapours. If these gases and vapours are toxic or explosive, then the user must observe the currently valid safety regulations for this application. Special types of diaphragm pumps are available for aggressive and explosive gas mixtures.
- Laboratory-vacuum-systems are intended for generating vacuums with ultimate pressures of around 2 mbar.
- The in-built diaphragm pump has been designed to have high resistance to aggressive gases.


1.4 Use for an Unauthorized Purpose

It is forbidden to use the pump for applications deviating from the technical data stated on the type plate or the conditions stated in the supply contract, or to operate it with missing or defective protective devices.

Important Information

1.5 Safety Devices


Measures such as the following are for the safety of the operating personnel:

- electrical connection with a protective conductor (operating mode S1) and an earthing plug,
- Motor protection switch (thermal),
- "Hot Surface" label on the pump body - warning notice 
- motor hood on the motor fan and
- glass components with a transparent plastic coating which protects them against bursting and cracking

The laboratory-vacuum-system must not be operated without these elements.

1.6 Meaning of the Warning notes

Take note of the warning notices. They are in the following box:

	CAUTION ! / WARNING !
Hazard which may lead to serious injuries or material damage.	

1.7 Product Standards, Safety Regulations

Laboratory-Vacuum-Systems meet the following product standards:

DIN EN ISO 12100:2011-03	Safety of machinery - General principles for design - Risk assessment and risk reduction
DIN EN ISO 13857:2008-06	Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs
DIN EN 1012-2:2011-12	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps
DIN EN ISO 2151:2009-01	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
DIN EN 60204-1:2014-10	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
DIN EN 61000-6-2:2011-06 DIN EN 61000-6-4:2011-09	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments Part 6-4: Generic standards - Emission standard for industrial environments
DIN EN 61010-1/A1:2015-04	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
DIN EN 50110-1:2014-02	Operation of electrical installations
DIN EN 1127-1:2011-10	Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology
DIN EN 13463-1:2009-07 DIN EN 13463-5:2011-10	Non-electrical equipment for use in potentially explosive atmospheres - Part 1: Basic method and requirements Part 5: Protection by constructional safety 'c'
Directive 2012/19/EU	Electrical and electronics - old devices (WEEE)
Directive 2011/65/EU	Dangerous materials in electrical and electronics devices (RoHS II)
China - RoHS II	Environment protection law - China 2016-01


The following additional safety regulations apply in the FR Germany:

DGUV Regulation 1	Accident prevention regulations, principles of prevention
DGUV Regulation 3	Safety and testing of electrical equipment and equipment
DGUV Rule 100-500	Operation of work equipment
DGUV Information 213-850	Safe working in laboratories

Observe the standards and regulations applying in your country when you use the laboratory-vacuum-systems.

2 Basic Safety Instructions

2.1 General Information

	CAUTION !
Warning notices must be observed. Disregarding them may lead to damage to health and property.	

The Laboratory-Vacuum-Systems must be operated by personnel who can detect impending dangers and take action to prevent them from materialising.

The user/operator is responsible for correct installation and safe operation.

Prevent condensate collecting in the pump. When pumping vapours which tend to condense please ensure that the pump is at operating temperature and that the gas ballast valve is open when the pump is switched on.

If there is more than one load on one LVS, they must be separated by check valves.

After finishing work with the diaphragm pump, run it for about 10 minutes with an open gas ballast valve.

The manufacturer or authorized authorised workshops will only service or maintain the Laboratory-Vacuum-System system if it is accompanied by a fully completed damage report. Precise information about the contamination (also negative information if necessary) and thorough cleaning of the Laboratory-Vacuum-Systems are legally binding parts of the contract.

Contaminated Laboratory-Vacuum-Systems and their individual parts must be disposed of in accordance with the legal regulations.

The local regulations apply in foreign countries.


2.2 Electricity

The Laboratory-Vacuum-Systems are supplied for operating mode S1. Please note that the testing must be repeated in accordance with DIN EN 0105, DIN EN 0702 and DGUV Regulation 3 in case of portable devices.

The local regulations apply in foreign countries.

Please note the following when connecting to the electrical power supply system:

- The electrical power supply system must have a protective connector according to DIN IEC 60364-4-41.
- The protective connector must not have any breaks.
- The connecting cable must not be damaged.
- All interfaces are under low voltage according to DIN 0100-410.


	CAUTION !
Switch off the device before the communication interfaces are connected or disconnected!	

Basic Safety Instructions

2.3 Mechanical Systems

Improper use can lead to injuries or material damage. Observe the following instructions:

- Only operate the Laboratory-Vacuum-Systems with hoses of the specified dimensions.
- The maximum permissible pressure of 1 bar at the suction connection must not be exceeded.
- Hazardous substances must be separated out as far as this is technically possible before they reach the pump.
- External mechanical stresses and vibrations must not be transmitted to the pump. Only use flexible laboratory hoses for connecting Laboratory-Vacuum-Systems.
- The overpressure generated at the pressure port must not exceed 1 bar.
- The pump must not be used to suck up fluids. Lay the exhaust pipe so that it slopes downwards, so allowing condensate to flow out of the pump. Collect the condensate and dispose of it in an environmentally compatible manner.

	CAUTION !
Solid particles in the pumping medium impair the pumping action and can lead to damage. Prevent solid particles penetrating into the pump.	

When handling glass vessels, pay attention to:

- Only use glass vessels with a plastic coating for splinter protection.
- Only use vessels which are suitable for use with vacuums (e.g. round-bottomed flasks). We recommend that only glass components supplied by the manufacturer are used. Do not use Erlenmeyer flasks.
- Before each evacuation, check glass vessels for damage which might impair their strength, replace them if any such damage is found.
- Do not heat glass vessels on one side only.
- Retardation of the boiling of the gases to be pumped can lead to a sudden pressure increase. Prevent retardation of boiling by means of suitable measures (e.g. turbulent agitation).

2.4 High Temperatures

The diaphragm pump may heat up as a result of the temperature of the gas being pumped and through compression heat.

Prevent the following maximum permissible temperatures from being exceeded + 40 °C for the environment and the gas to be pumped.

The motor for single phase alternating current is protected against overload by an integrated motor protection switch.

2.5 Hazardous Substances

The operating company bears the responsibility for the use of the Laboratory-Vacuum-System.

Hazardous and harmful substances must be effectively prevented from escaping.

Ensure that all lines and connections are leak tight.

Handle exhaust gases in accordance with the requirements of the emission protection regulations.

Do not operate the Laboratory-Vacuum-System without a separator and without a emission condenser. The separator can only be emptied after the apparatus has been vented.

Dispose the condensate in an environmentally compatible manner!

The emission condenser has a safety valve. The air evacuation duct with hose must be kept clear and lead into a suitable air evacuation duct. Throttling the air evacuation duct can damage the valves of the diaphragm pump.

Hazardous substances in the gases to be pumped can cause personal injuries and property damage. Pay attention to the warning notices for handling hazardous substances.

The local regulations apply in foreign countries.

Combustible Gases

Examine before switching on whether that can form gas combustible gas/air mixtures which can be promoted! Also perform this test with a number of loads connected to one LVS.

Consider the regulations of the guideline 1999/92/EC.

Explosive gases

The diaphragm pumps of the series MPC are certified according to ATEX guidelines 2014/34/EU, device category 3, valid for the gas contacting parts (interior) of the pump.

Aggressive gases

A diaphragm pump of the series MPC is used for extracting vapours and aggressive gases. The warranty shall lapse if the LVS is used with diaphragm pumps from other manufacturers.

Especially aggressive gases have to be explicitly checked for material resistance as described in *chapter 3.1.2* and, if necessary, modified.

Poisonous gases

Use a separator when pumping poisonous or harmful gases. Prevent such substances from leaking out of the appliance or pump. Treat these substances according to the applicable environmental protection regulations.

The diaphragm pump, control valves and hose lines can be damaged by poisonous or aggressive gases.

Test the strength and leak-tightness of the connecting lines and the connected apparatus. Prevent environmental poisons, e.g. mercury, getting into the diaphragm pumps.

Fulfil the requirements, for example:

- German Hazardous Substances Regulation (GefStoffV) of 01. December 2010
- Regulations 2016/1179/EU
(classification, packaging and identification of hazardous sub-stances),
- Manufacturer's safety data sheets on hazardous substances.

Description

3 Description

3.1 Design and Function

3.1.1 Laboratory-Vacuum-Systems

The Laboratory-Vacuum-Systems are supplied as a ready-mounted unit.

The chemical-resistant diaphragm pump (4) with gas ballast valve (17) is fitted to the base plate of the column (3) and attached on the suction-side to the separator (7) to protect the pump from foreign matter and on the pressure-side to the emission condenser (6) to recover the condensate. This ensures that hazardous substances are separated out. The safety valve on the emission condenser protects against an impermissibly high operating pressure on the outgoing air end.

The complete vacuum controller, with sensor, venting valve and power unit (5), is fitted in the column (3). The LVS 610 T ef, order no. 115254-04, is an exception. In this case, the vacuum controller is available as an external device for installation in laboratory furniture, see chapter 3.1.4. The manually regulated LVS-variant does not have a controller.

All exposed glass components (6, 7) are coated with transparent plastic as protection against bursting. The emission condenser is supplied with insulation.

The power switch (12) and the plug for the power cable (11) as well as the membrane pump (10), the PC (13) control lead (14), inert gas (16) and the water valve (option) (15) are located on the right of the column.

The LVS types are specially preconfigured according to model.

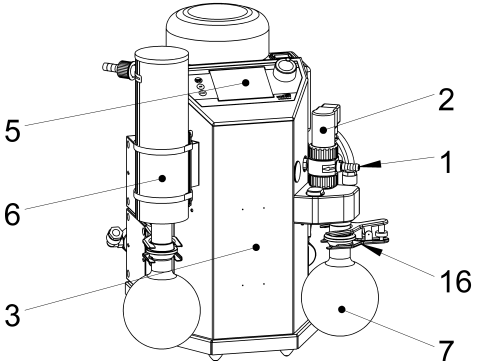
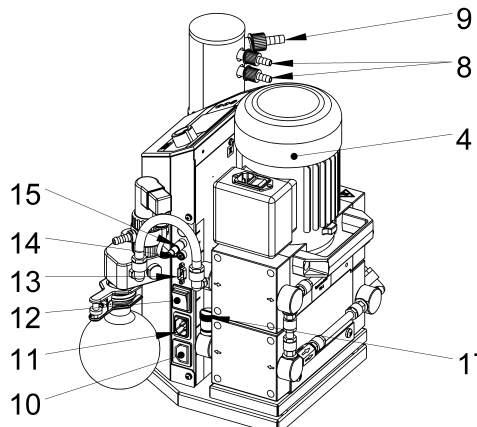
1	Pressure side connection hose nozzle for hose DN8	
2	Control valve (LVS - automatically regulated)	
3	Column complete on swivelling foot	
4	Diaphragm pump MPC 601 T	
5	Vacuum controller 521 (in the column or extern)	
6	Emission condenser KD 500/5 insulated at the pressure side with safety valve and cooling water connections	
7	Separator (round-bottomed flask) suction side	
8	Cooling water (feed flow/back flow)	
9	Connection outgoing air hose nozzle for hose DN8	
10	Connection pump (pump)	
11	Connection non-heating device power cable (main in)	
12	Main switch (power)	
13	Connection PC (RS 232)	
14	Connection control cable LVS - automatically regulated (sensor)	
15	Connection water valve	
16	Connection inert gas	
17	Gas ballast valve	

Fig. 1a LVS 610 T – Front view

Fig. 1b LVS 610 T – Rear view

3.1.2 Diaphragm pump

► Design:

The diaphragm pump consists of a pump body and a drive motor.

The pump body consists of a drive shaft and four pump heads. Each pump head contains the diaphragm and the work valves. The two pump heads are arranged opposite each other. In a three-stage (T) diaphragm pump, the two pump heads are connected in parallel, two further pumps in series.

The pump heads are driven via an eccentric shaft with a connecting rod.

► Function:

Motor, eccentric shaft and connecting rod set the diaphragms in stroke movement. This changes the size of the space between the diaphragms and pump head (pump chamber). Increasing the size of the pump chamber opens the inlet valve while the outlet valve is closed (intake process). Decreasing the size of the pump chamber ejects the gas through the outlet valve.

The valves are actuated by the gas being pumped. A large proportion of fluid in the diaphragm pump minimizes the pumping efficiency.

► Materials of the medium-affecting pump parts:

Component	Materials
Seal	EPDM
Screw fitting / Connecting elements	PP, PVDF
Valve	PEEK
Diaphragm	Elastomer + PTFE layer
Vacuum hose	PTFE
Connection head / pump head	PTFE with carbon-fibre reinforcing ^{*)}

^{*)} electrically conductive (with manufacturer's certificate of electrical conductivity)
Material resistance to aggressive media see: Publisher Hoppenstedt Publishing (18. September 2007)

► Gas ballast:

When condensable vapours are pumped, they may be compressed above the saturated vapour pressure and condense.

Opening the gas ballast valve (17) in the suction line of the last pump stage allows air to flow into the pump chamber. This prevents condensation and flushes the pump clear.

Operation leads to increasing the ultimate pressure and the operating temperature.

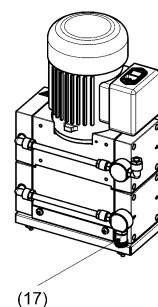


Fig. 2 Diaphragm pump MPC 601 T

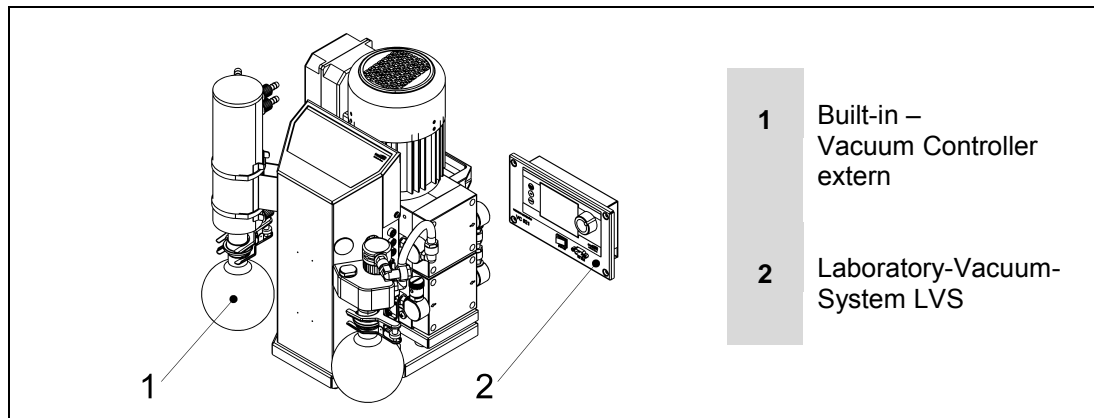
Description

3.1.3 Vacuum Controller 521, intern



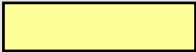

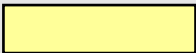
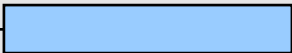
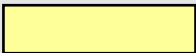
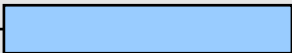
In the case of controlled models for Laboratory-Vacuum-Systems LVS, the vacuum controller, complete with sensor, venting valve and power unit, is fitted in the device column. The operating and display elements are on the top surface of the column.
(Description and operation see *chapter 6*, Technical data see *chapter 4.3.1*)

3.1.4 Built-in – Vacuum Controller 521 ef, extern

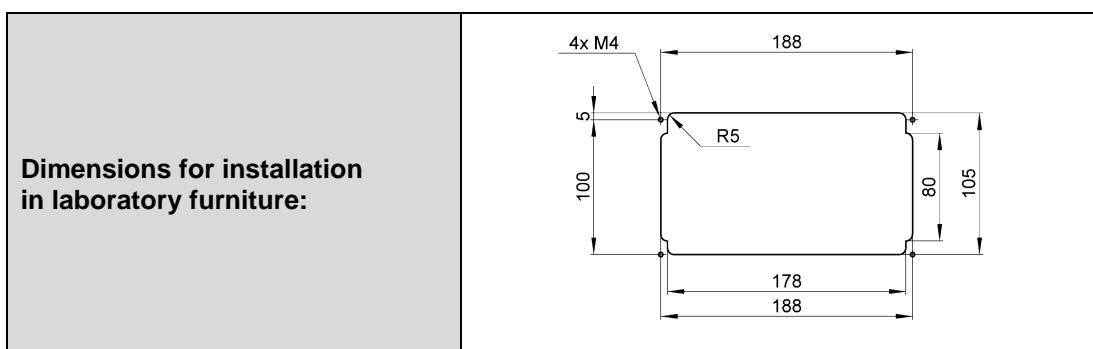
The **LVS 610 T ef** (Order no. 115254-04) is equipped with an **external** vacuum controller for installation in, for example, laboratory furniture.
Over the cable to the device, the electrical connection is made.



► Electrical Installation - Built-in – Vacuum Controller 521 ef extern:

K1 Sensor + Venting valve	
on the pump - rear panel	Controller
 4 m 	
Coupling plug 5 pole	Order no. 600052-06
K2 24 V DC + Water valve	
on the pump - rear panel	Controller
 4 m 	
Coupling plug 4 pole	Order no. 600052-06
K3 Frequency converter	
on the frequency converter - motor	Controller
 4 m 	
Coupling plug 4 pole	Order no. 600052-06
K4 Fill level sensor <i>option</i>	
on sensor fill level	Controller
 4 m 	
	Order no. 600052-06

It has the same function as the LVS with a standard assembly. It is operated, as similarly described, via an externally installed controller. On the controller is the on / off power switch and the RS 232 interface. (see also chapter 9.4)



3.2 Overview of the LVS variants

Part	Laboratory-Vacuum-Systems LVS						
	Pierce per LVS						
	600 T	601 T	602 T	610 T	611 T	610 T ef	610 T en
Suction side connections for hose DN 8	1 un-regulated	1 manually regulated	2 manually regulated	1 automatically regulated	1 automatically + 1 manually regulated	1 ecoflex regulated	1 economic regulated
Control valve	-	-	-	1	1	-	-
Column complete	1	1	1	1	1	1	1
Diaphragm pump	1	1	1	1	1	1	1
Vacuum controller 521	-	-	-	1 (cv)	1 (cv)	1 (ef)	1 (en)
Emission condenser	-	1	1	1	1	1	1
Separator	2	1	1	1	1	1	1
Pressure side connection for hose DN 8	1	1	1	1	1	1	1
Frequency changer	-	-	-	-	-	1	-
Special variants, additional with:							
- Dial gauge digital	-	1	-	-	-	-	-
- Clamping ring screw A 10 (netvac 1)	-	1	-	1	-	1	1
- Built-in Controller 521	-	-	-	-	-	1	-

3.3 Areas of Application

The Laboratory-Vacuum-Systems is intended for:

- vacuum filtration, vacuum distillation and vacuum drying
- use in physical and chemical laboratories in trade and industry
- pumping and compressing neutral and aggressive gases and vapours
- generating a vacuum up to an ultimate pressure of < 2 mbar

Special designs:

- Special LVS can be supplied after consultation with the manufacturer or for a corresponding supply contract
- Motors for different voltages

3.4 Scope of Delivery

The scope of delivery is specified in the supply contract.

Description

3.5 Examples of application

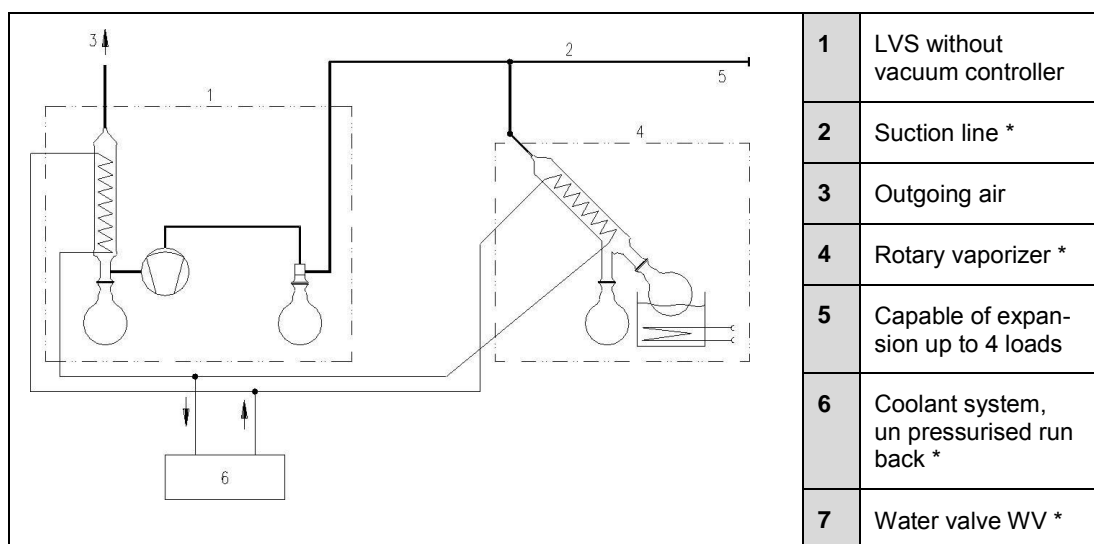


Fig. 3 Example of application - LVS manually regulated

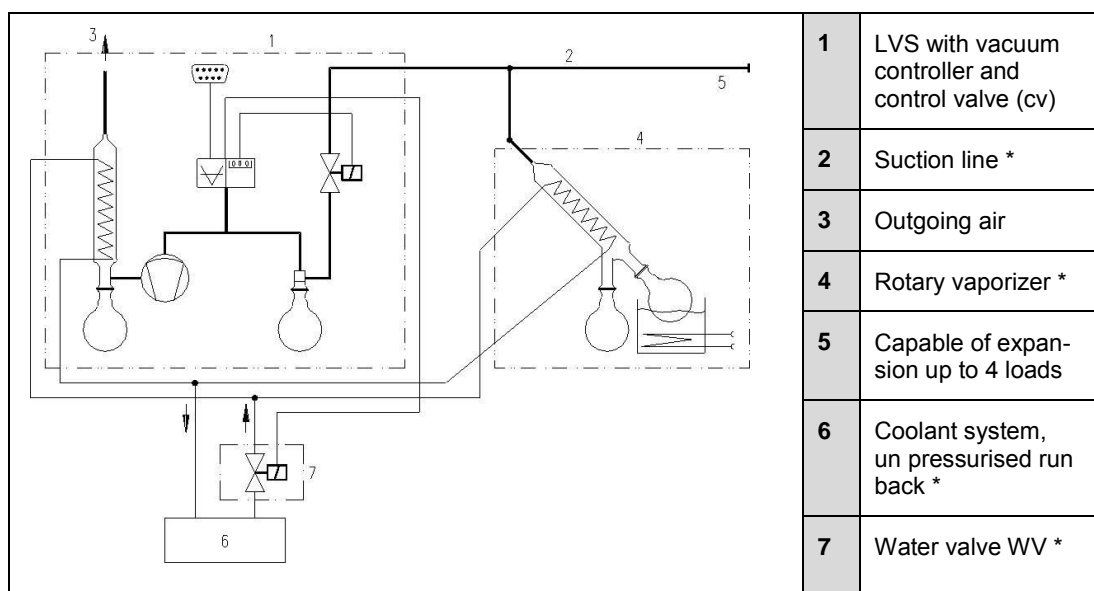


Fig. 4 Example of application – LVS „cv“ (Control valve) automatically regulated

* Not included in the scope of delivery

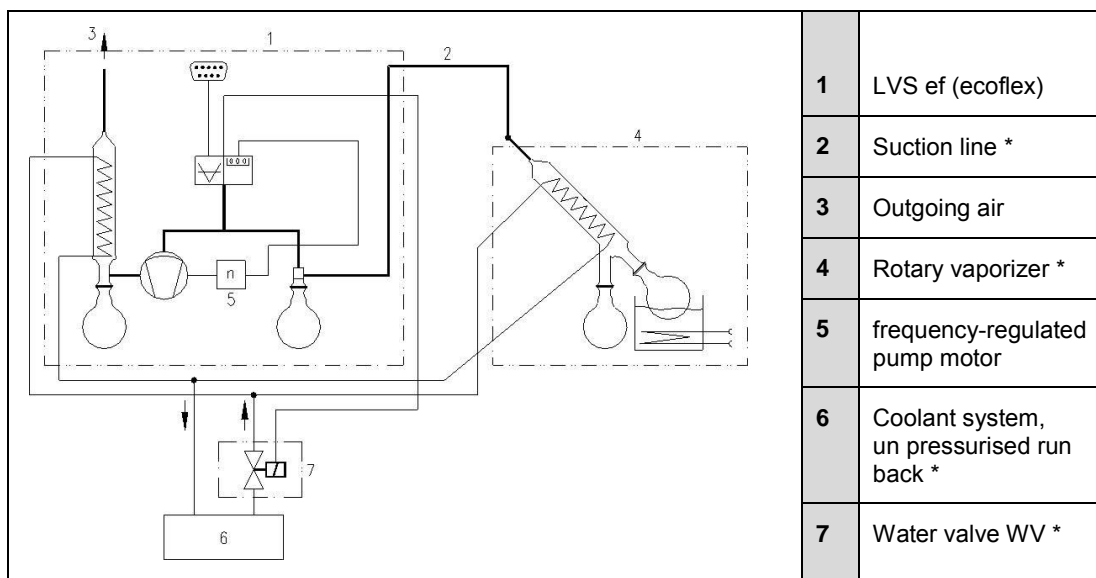


Fig. 5 Example of application – LVS „ef“ ecoflex

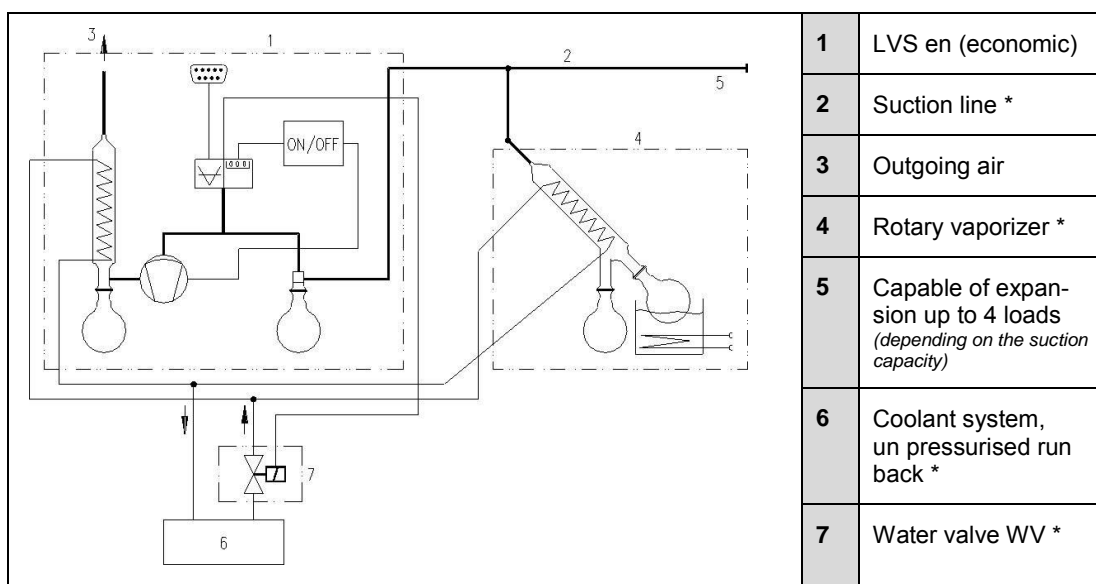


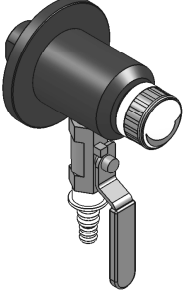
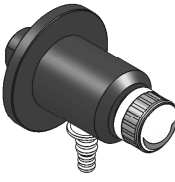


Fig. 6 Example of application – LVS „en“ economic

	CAUTION !
<p>The economic Laboratory-Vacuum-System "LVS ... en" is suitable for slow processes and central laboratory supplies using a large hysteresis (< 50 mbar). When installing the switch interval of the diaphragm pump is to be checked. In practical applications the time-out must be at least 0.5 minutes. The integrated pressure monitor guarantees immediate activation of the vacuum generator when required. This ensures continuous readiness of the vacuum system in the laboratory.</p>	

Description

3.6 Accessories

The use of chemical-resistant vacuum connections „**netvac +**“ is recommended for extending the application range of a vacuum generator to several workstations.

	netvac +		
	Set BC1 - 63	Order no. 700563	<i>for mounting on wood furniture</i>
	Set BC2 - 63	Order no. 700563-01	<i>for mounting on sheet metal wall</i>
	<p>with integrated FFKM-Check valve, Dosing valve, Hose nozzle and Ball valve</p> <p>Area of application: Laboratory Suction connection: Hose DN 8-10 Connection thread: 1/4" - outside Material of valve body: Polypropylene (PP) Dimensions (W/D/H): Ø 69 / 161 / 82mm Mounting hole: Ø 25 to Ø 35 mm</p>		
	netvac +		
	Set BC1 - 62	Order no. 700562	<i>for mounting on wood furniture</i>
	Set BC2 - 62	Order no. 700562-01	<i>for mounting on sheet metal wall</i>
	<p>with integrated FFKM-Check valve, Dosing valve and Hose nozzle</p> <p>Area of application: Laboratory Suction connection: Hose DN 8-10 Connection thread: 1/4" - outside Material of valve body: Polypropylene (PP) Dimensions (W/D/H): Ø 69 / 69 / 82 mm Mounting hole: Ø 25 to Ø 35 mm</p>		
	Vacuum Control-Box		
	VCB 521 cv	Order no. 600053	
	<p>Table model as digital, chemical-resistant vacuum regulator. With integrated sensor, airing -, control- and check valve.</p> <p>Connection vacuum apparatus: DN 8 Connection vacuum pump: DN 8 Connection inert gas: DN 4 Connection water valve: Binder plug 4-pole 24V DC</p>		
	Operating software „WELCH-Control 521“		
	on CD	Order no. 620637	
	to connect the vacuum controller to the PC		

	Water valve	
	WV 2	Order no. 700300-02
	<p>2 way water flow valve for the demand-responsive cooling water supply, mounting possible in any direction.</p> <p>Input: G 3/4 inch sleeve nut Output: Hose nozzle for hose inside diameters 8 mm</p>	
	Hose nozzle with FKM - O-Ring	
	DN 10	Order no. 710955
	<p>Material: PP Male thread: 1/4"</p>	
	Inlet fitting	
	DN 16 KF	Order no. 710116
	<p>Material: PP Male thread: 1/4"</p>	
	Vacuum hose	
	10 / 8x1	Order no. 828332
	<p>Material: PTFE Please state the length you want to order!</p>	
	Vacuum hose	
	18 / 8x5	Order no. 828310-4
	<p>Material: Rubber, red Please state the length you want to order!</p>	
	Mains connection cable IEC with plug	
	Type 12 (CH)	Order no. 825877
	<p>for LVS ... in 230 V</p>	

4 Technical Data

4.1 View of device and dimensions

The main dimensions are identical for all types stated here.

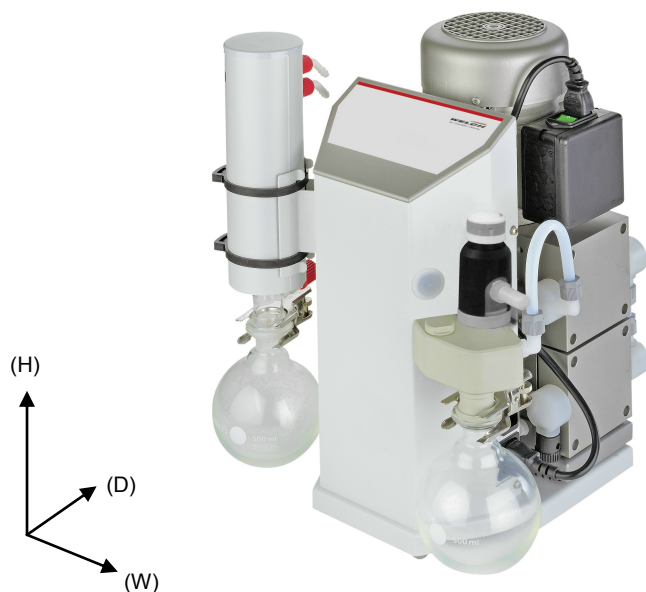


Fig. 7 View of device (type LVS 601 T), dimensions see chapter 4.3

4.2 Intake Pressure / Pumping Speed – Diagram

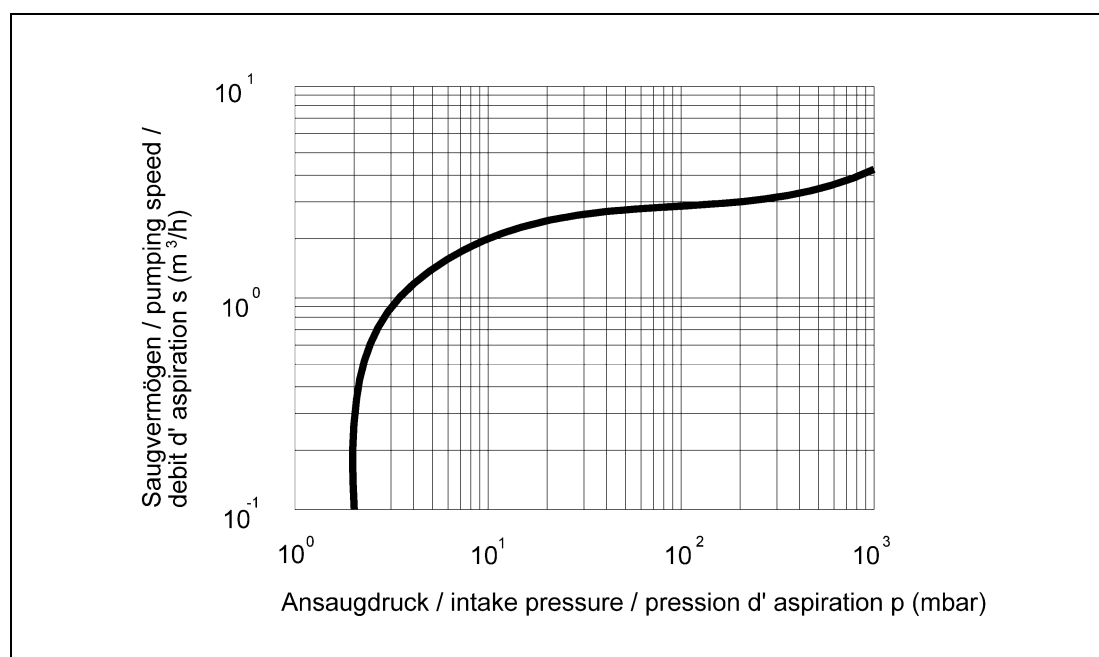




Fig. 8 Intake Pressure / Pumping Speed – Diagram

4.3 Device data

4.3.1 Laboratory-Vacuum-Systems

Parameter	Unit	LVS				
		600 T	601 T	602 T	610 T	611 T
Pumping speed 50/60 Hz DIN 28432 at speed of 1500 rpm	m ³ / h	4.5 / 4.9				
Ultimate pressure at speed of 1500 rpm	mbar	< 2				
Ultimate pressure with gas ballast at speed of 1500 rpm		9				
Max. inlet pressure		1				
Max. outlet pressure	bar	1				
Intake and pressure ports	-	Hose nozzle DN 8 for hose inside diameter 8 mm				
Ambient temperature	°C	+ 10 to + 40				
Max. Operating gas temperature		+ 40				
Bearing	-	maintenance-free				
Reference surface sound pressure level DIN EN ISO 2151	dB (A)	< 44				
Voltage / Frequency (different data upon customer request)	V, Hz	230, 50/60 (115, 50/60) (generally with motor protection switch, switch and cable)				
Motor power	W	370				
Operating mode	-	S 1				
Motor / Type of protection DIN EN 60529		IP 54				
Motor / Class of insulation DIN EN 600034-1		F (160°C)				
Type Examination Certificate no.	-	WELCH_ATEX_03-01				
Designation EX		 II 3G IIC T3 X (internal Atm. only)				
Dimensions (W/D/H)	mm	360 / 310 / 395	360 / 310 / 445			
Weight	kg	23.2	23.4	23.2	23.4	23.2
Order numbers for :						
230 V <i>inclusive mains connection cable IEC with plug CEE, UK</i> - LVS ... - LVS ... with dial gauge digital - LVS ... netvac 1	-	115051	115057	115053	115054	115055
		-	115057-10	-	-	-
		-	115057-02	-	115054-03	-
115 V <i>inclusive mains connection cable IEC with plug US</i> - LVS ... - LVS ... with dial gauge digital - LVS ... netvac 1	-	115051-01	115057-01	115053-01	115054-01	115055-01
		-	115057-11	-	-	-
		-	115057-03	-	-	-
100 V <i>inclusive mains connection cable IEC with plug J</i> - LVS ... - LVS ... with dial gauge analog	-	115051-05	115057-05	115053-05	115054-05	115055-05
		-	115057-12	-	-	-

Technical Data

Parameter	Unit	LVS 610 T ef	LVS 610 T en
Pumping speed 50/60 Hz DIN 28432 at speed of 1500 rpm	m ³ / h	4.9	4.5 / 4.9
Ultimate pressure at speed of 1500 rpm	mbar	< 2	
Ultimate pressure with gas ballast at speed of 1500 rpm		9	
Max. inlet pressure	bar	1	
Max. outlet pressure		1	
Intake and pressure ports	-	Hose nozzle DN 8 for hose inside diameter 8 mm	
Ambient temperature	°C	+ 10 to + 40	
Max. Operating gas temperature		+ 40	
Bearing	-	maintenance-free	
Reference surface sound pressure level DIN EN ISO 2151	dB (A)	< 44	
Voltage / Frequency (different data upon customer request)	V, Hz	230, 50/60 (115, 50/60) (generally with motor protection switch, switch and cable)	
Motor power	W	370	
Input Frequency changer (Apparent power)	W / A	800 / 6	-
Operating mode	-	S 1	
Type of protection DIN EN 60529		IP 54	
Motor / Class of insulation DIN EN 60034-1		F (160°C)	
Type Examination Certificate no.	-	WELCH_ATEX_03-01	
Designation EX		 II3G IIC T3 X (internal Atm. only)	
Dimensions (W/D/H)	mm	360 / 310 / 445	
Weight	kg	26.8	24.7
Order numbers for LVS:			
230 V <i>inclusive mains connection cable IEC with plug CEE, UK</i> - LVS ... - LVS ... netvac 1 - LVS ... with built-in controller VC 521 extern	-	115254 115254-03 115254-04	115258 - -
115 V <i>inclusive mains connection cable IEC with plug US</i> - LVS ...		115254-01	115258-01

4.3.2 Vacuum Controller 521

Parameter	LVS 610 T LVS 611 T	LVS 610 T ef	LVS 610 T en	Unit
Sensor	integrated			
Sensor type	ceramic sensor			-
Measuring range	1 - 1100			mbar
Measuring uncertainty	< ± 0.3 % FS			
Controller				
Sensor interface :	3 conductor interface			-
- Scan frequency	10			Hz
- Resolution ADC	12			Bit
- Power supply	+ 5 stabilized			V
- Sensor signal	0.5 to 4.5 (optionally also 4..20 mA per jumper possible)			
Pressure indicator	digital and graphic			-
Switching accuracy / control accuracy	±1			digit
Switching outputs :	digital			-
- Voltage level	0; 24			V
- Control power, single	2 x 6			W
- Control power, total	24			
Switching outputs used :	3	2	3	-
- Control valve	x	-	-	
- Ventilation valve	x	x	x	
- Water valve	x	x	x	
- Pump net connection	-	-	x	
Frequency converter output :	-	analog	-	V
- Voltage level	-	0 to 10	-	
- Resolution DAC	-	8	-	
Communication interface	RS 232			-
Power consumption - controller in normal operation	max. 15 (depends upon the control power)			W
Fuse (internal controller)	5			A
Power pack	integrated			
Operating voltage	90 .. 260			V AC
Operating frequency	50 / 60			Hz
Output voltage	24			V DC
Output current	1.25			A
Output power	100			W
Entire unit				
Protective system	IP 20			-
Working temperature	15 - 40			°C
Connections				
IN/OUT: RS 232	SUB-D plug 9-pole			-
OUT: Control line for frequency changer	-	Binder socket 4-pole 0 - 10 V DC	-	
OUT: Control valve	Control valve integrated	-	-	
OUT: Water valve	Binder socket 4-pole, 24 V DC			
Connection: Inert gas	integrated, hose nozzle DN 4			

The information presented in this material is based on technical data and test results of nominal units. It is believed to be accurate and reliable and is offered as an aid to help in the selection of products. It is the responsibility of the user to determine the suitability of the product for the intended use and the user assumes all risk and liability whatsoever in connection therewith. Gardner Denver Thomas GmbH does not warrant, guarantee or assume any obligation or liability in connection with this information.

5 Assembly and Installation

5.1 Unpacking

Carefully unpack the Laboratory-Vacuum-System.

Check the system for:

- Transport damage,
- Conformity with the specifications of the supply contract (type, electrical supply data),
- Completeness of the delivery.

Please inform us without delay if there are discrepancies between the delivery and the contractually agreed scope of delivery, or if damage is detected.

Please take note of the general terms of business of the manufacturing firm.

In case of a claim under warranty, the device must be returned in packaging that is suitable for protecting it during transport.

5.2 Installation and Connection

- Set the Laboratory-Vacuum-System on a flat and horizontal surface.
- Remove the protective caps on the connections.
- Connect the intake connector of the LVS to your apparatus with vacuum hose DN 8.
- Connect the cooling water tube to the emission condenser.
- The cooling water return flow must be unpressurized.
- Connect the air exhaust to the central air exhaust system.
- Check that the connections are properly seated.
- Connect the Laboratory-Vacuum-System to the power supply. (LVS with controller extern, see chapter 3.1.3.1)

5.2.1 General instructions

Observe the basic safety instructions when using the LVS.

The pressure device regulation 2014/68/EU must be observed if devices with an overpressure of 0.5 bar or more are connected.

The pressures at the intake and exhaust sides of the diaphragm pump at the time it is switched on must correspond to the specifications of DIN 28432.

In order to avoid pumping speed losses, all the vacuum connecting hoses used should have a large nominal diameter and should be laid out so that the lengths are as short as possible. Avoid rigid connections. They must be assembled carefully in order to achieve a low leak rate.

We recommend fitting **non-return valves** (order no. 720327) for applications with several consumers.

The upstream **separator** on the intake-side serves to protect the diaphragm pump and the vacuum sensor from condensates and mechanical contamination. It must be used for an application. The level in the separator must be monitored and the separator emptied regularly. The currently valid regulations must be observed when disposing of waste. The separator on the intake-side can only be removed and emptied after the system has been vented.

The **emission condenser** enables a 100 per cent recovery of the solvents led through the vacuum pump. Cooling takes place via the DN 8 hose nipples. Ensure that the outflow is clear. The **safety valve** is located at the gas inlet. The rubber valve seal must be checked for cracks at regular intervals and exchanged when necessary. The exhaust connection is unpressurized. It can be led off through a DN 8 hose into a suitable evacuation duct. There is common solvent reclamation for all the connected systems. Mixing media must not lead to a hazard for persons, the environment or for the equipment.

Condensable vapours may only be extracted when the pump is at operating temperature. When doing so, the **gas ballast valve** should be opened and/or a quantity of air, which is to be calculated by the user, allowed to enter via the intake port valve. The pressure values may be increased when doing so. The diaphragm pump's maximum tolerance of water vapour pressure can be improved or a cleaning run can be made after finishing work by opening the gas ballast valve (this significantly reduces the pumping speed and ultimate pressure). The vacuum ducts must always be laid sloping downwards so that condensates can flow into the relevant separators.


In case of soiling by solid matter, the pump heads must be opened and the entire interior space, including valves and diaphragm, cleaned mechanically (see *chapter 7.2.1*).

5.3 Storage

The pumps are to be stored in a low-dust, interior room within the temperature range from + 5 to + 40 °C and at a relative air humidity < 90%.

Leave the protective elements on the intake and exhaust ports. Another equally good protection may be used.

5.4 Scrap Disposal

	CAUTION !
<p>The Laboratory-Vacuum-Systems must be disposed of in accordance with the 2012/19/EU guideline and the specific national regulations. Contaminated pump systems must be decontaminated according to the laws.</p>	

Operation

6 Operation

6.1 LVS without vacuum controller

Switch the device (LVS 600 T, LVS 601 T, LVS 602 T) on using the main switch. Vacuum is generated immediately and without regulation. Over the regulating valves on the LVS 602 T it is possible two customers concomitant to connect.

6.2 LVS with vacuum controller

The LVS is switched on by the rocker switch **POWER** located on the device.
The device is ready for operation after a short initializing routine, during which a signal tone sounds and all light elements light up briefly.
In the version **LVS with external controller (Order no. 115254-04)** is the on / off power switch on the controller.

6.3 Operating modes of the Controller

The following modes are available:

0 -	STOP	Controller is inactive and can be configured
1 -	Manual operation	With specification of the setpoint and, if required, lowering
2 -	Automatic operation	The setpoint is detected automatically from the pressure development
3 -	Ultimate pressure	Pumping out at maximum motor output
4 -	Self cleaning	Motor runs for 2 minutes at open ventilation valve


6.3.1 Mode 1, Manual operation

The vacuum valve is closed when the pressure reaches the setpoint. Closed-loop control between the set hysteresis and the setpoint has been started.

For **operation with a frequency converter**, an analog voltage is output, which controls the speed according to the standard tolerance. If the set pressure is not reached, the speed is automatically adjusted to the pressure loss.

If the pressure is actively lowered, after the setpoint has been reached for the first time, it is lowered still further within a settable timeframe. The number of ramps can be set up to a maximum of 3. Each ramp starts with a holding time. The setpoint then falls in one step to the defined starting pressure. The setpoint then falls to the final value over the set time.

After the last ramp, there is a waiting time until the automatic **STOP** (0 – the last set pressure is held indefinitely until **STOP** is pressed manually).

	CAUTION !
When setting the ramps make sure that the set value is greater than or equal to the starting value of the first ramp.	

The closed-loop control and hysteresis are always related to the current (reduced) setpoint. The changed setpoint always applies until the **STOP** button is pressed, then the configuration value applies once more. When the pressure reduction has finished, the control is stopped, and the system waits until the **STOP** button is pressed.

6.3.2 Mode 2, Automatic operation

After selection of the operating mode, the controller starts the evacuation. The pressure drop per minute is determined during this process. If increases during distillation by incipient boiling of the pressure, then this pressure value is taken as the setpoint and proceeds in the normal control operation.

6.3.3 Mode 3, Ultimate pressure

By pressing of the key **P min** evacuation takes place at maximum pump speed until the user presses **STOP**.

6.3.4 Mode 4, Self cleaning

The Mode "Self cleaning" is used for flushing the pump and can, if desired, also be carried out several times in succession. After a waiting period of 5 seconds, the evacuation for 2 minutes (at maximum pump power and open vent valve) is carried out. A aborting the process at any time by pressing the encoder **(4)** possible.

Self cleaning for Controller-version „cv“: The control valve (cv) remains closed when the mode **Manual** or **Automatic** the "ventilation at STOP" parameter = "0".


6.4 Monitoring by Level Sensor

If the level sensor input is activated (optional), the device goes into **STOP** status when "Tank full" is signalled.

6.5 Calibrating the Pressure Sensor

A two-point calibration is made with a comparison measurement device.

Calibration at ambient pressure:	Calibration at ultimate pressure:
- The diaphragm pump is switched off.	- The diaphragm pump is switched on.
- The venting valve is open.	- The venting valve will be closed.
- The vacuum valve is closed.	- The vacuum valve will be open.
- The ambient pressure to set.	- The ultimate pressure to set.

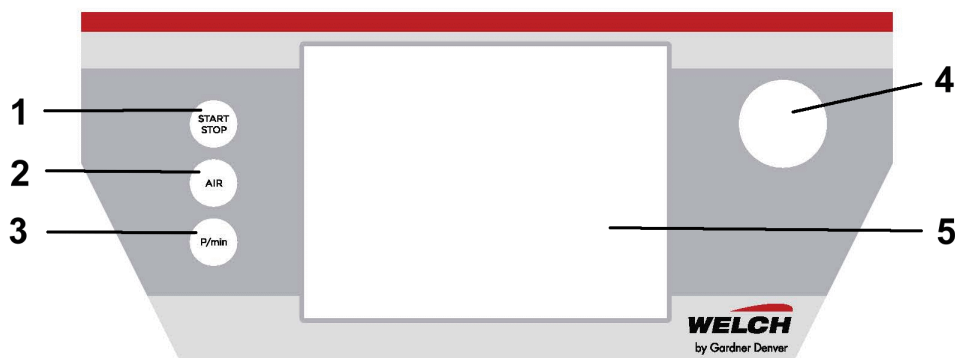


CAUTION !

Instead of measuring the pressure with a comparison measurement device, the ultimate pressure of the pump used may also be input if this is known with sufficient accuracy (take note of evacuation time).
Ensure that the set pressure is also present at the sensor.

6.6 Handling

6.6.1 Control panel



- 1 **START - STOP**
- 2 **AIR** - ventilation
- 3 **P min** - pressure drop

- 4 Encoder (turn / press)
with marking point on encoder
- 5 Display

Fig. 9 Control panel

Operation

6.6.2 Operating via Buttons and Encoder

The menu is operated with the encoder.

The menu option is selected by turning the encoder anticlockwise, and then confirmed by pressing.

A pop-up window is provided for changing numerical values. They are accepted by pressing the encoder.

The process can be cancelled by pressing **START - STOP**.

Key:	Meaning
AIR	- Switches the venting valve on if the control is inactive.
	- Opens the venting valve as long as the button remains pressed while control is active.
P min	- Starts "ultimate pressure" mode directly.
START STOP	- Starts the operating mode currently selected in the main menu and the corresponding set value.
	- Starts the operating mode manually with the currently selected setpoint in the solvent table, see <i>chapter 6.8</i> .
	- Stops the active mode
	- Cancels the input in the pop-up window.
	- Jumps back to the main menu from submenus.
Encoder:	Meaning
	- <i>Turn</i> to select the operating mode.
	- <i>Press</i> to select the setting menu for the corresponding operating mode.
	- <i>Turn</i> to select menu items.
	- <i>Press</i> to open Change pop-up window.
	- <i>Turn</i> to change values.
	- <i>Press</i> to confirm the changed value.
	- When active: <i>Turn</i> to change setpoint.
	- When active: <i>Press</i> to accept current value as setpoint.

After the current operating mode has been stopped by pressing **STOP**, the vacuum valve is closed.

The venting valve takes the selected status (Option: **AIR_ON_STOP**).

The originally selected values are retained on start.

6.6.3 Menu Guidance

After the start, the main menu appears with its 5 submenus, *which are shown below*:

- Manual
- Automatic
- Low pressure
- Configuration
- Self cleaning

Configuration: language



MAIN-MENU	
Manual	VCZ 521 <small>V 1.16</small>
Automatic	
Low pressure	
Configuration	
Self cleaning	
P = 960 mbar	

Configuration: display settings



MAIN-MENU	
Manual	VCZ 521 <small>V 1.16</small>
Automatic	
Low pressure	
Configuration	
Self cleaning	
P = 960 mbar	

Configuration	
language	VCZ 521 <small>V 1.16</small>
display settings	
pressure unit	
calibrate	
back	
P = 960 mbar	

Configuration	
language	VCZ 521 <small>V 1.16</small>
display settings	
pressure unit	
calibrate	
back	
P = 960 mbar	

language	
English	VCZ 521 <small>V 1.16</small>
Deutsch	
Français	
Español	
back	
P = 960 mbar	

display settings	
contrast	VCZ 521 <small>V 1.16</small>
brightness	
display interval	
min. pressure	
max. pressure	
back	P = 960 mbar

- Select one of the available languages
- Select contrast in the display
- Select brightness in the display
- Graphic display:
 - Number of measurements per second
 - Display of min. pressure
 - Display of max. pressure

Configuration: pressure unit



MAIN-MENU	
Manual	VCZ 521 <small>V 1.16</small>
Automatic	
Low pressure	
Configuration	
Self cleaning	
P = 960 mbar	

Configuration: calibrate



MAIN-MENU	
Manual	VCZ 521 <small>V 1.16</small>
Automatic	
Low pressure	
Configuration	
Self cleaning	
P = 960 mbar	

Configuration	
language	VCZ 521 <small>V 1.16</small>
display settings	
pressure unit	
calibrate	
back	
P = 960 mbar	

Configuration	
language	VCZ 521 <small>V 1.16</small>
display settings	
pressure unit	
calibrate	
back	
P = 960 mbar	

pressure unit	
mbar	VCZ 521 <small>V 1.16</small>
torr	
psi	
hPa	
back	
P = 960 mbar	

calibrate	
Cal. Start pressure	VCZ 521 <small>V 1.16</small>
Cal. Low pressure	
back	
P = 960 mbar	

- Select measured values for display

- Selection of the upper pressure value
- Calibration of the lower pressure value

The current value of the comparison measurement device must always be entered for calibration. The correction values are then calculated from this. It is recommended to always make both calibrations.

Self cleaning:



MAIN MENU	
Manual	VCZ 521 <small>V 1.16</small>
Automatic	
Low pressure	
Configuration	
Self cleaning	
P = 960 mbar	

Low pressure:



MAIN MENU	
Manual	VCZ 521 <small>V 1.16</small>
Automatic	
Low pressure	
Configuration	
Self cleaning	
P = 960 mbar	

MAIN MENU	
<div style="border: 1px solid black; padding: 10px; text-align: center;"> Self cleaning Attention: system is aired Start in seconds 5 Cancel with <OK> </div>	
P = 960 mbar	

MAIN MENU	
<div style="border: 1px solid black; padding: 10px; text-align: center;"> Self cleaning Cleaning in action Remaining seconds 120 Cancel with <OK> </div>	
P = 960 mbar	

- Selection self-cleaning - for flushing the pump (Process several times in succession possible)
- Starting the pump system
All control settings are ignored (P min).

Automatic:



MAIN-MENU	
Manual	VC 521 V 1.16
Automatic	
Low pressure	
Configuratio	
Self cleaning	
P = 960 mbar	

Manual:



MAIN-MENU	
Manual	VC 521 V 1.16
Automatic	
Low pressure	
Configuration	
Self cleaning	
P = 960 mbar	

Parameter for mode: Automatic			
Parameter	Value	Unit	
start graphic	----		↑ ↓
start numeric	----		
auto limit	100		
auto speed	50	%	
hysteresis	0	mbar	
auto stop time	0	sec	
No. of pressure ramps	0		
VENTILATE on STOP	0		
Auto Restart	0		
back	----		

Parameter for mode: Manual			
Parameter	Value	Unit	
start graphic	----		↑ ↓
start numeric	----		
Setpoint numeric	123	mbar	
setpoint table	123	mbar	
hysteresis	0	mbar	
auto stop time	0	sec	
No. of pressure ramps	0		
VENTILATE on STOP	0		
Auto Restart	0		
back	----		

Parameter for mode: Automatic			
Parameter	Value	Unit	
start graphic	----		↑ ↓
start numeric	----		
auto limit	100		
auto speed	50	%	
hysteresis	0	mbar	
auto stop time	0	sec	
No. of pressure ramps	1		
start cycle 1	2	mbar	
cycle time 1	600	sec	
cycle pressure 1	600	mbar	
VENTILATE on STOP	0		
Auto Restart	0		
back	----		

Parameter for mode: Manual			
Parameter	Value	Unit	
start graphic	----		↑ ↓
start numeric	----		
Setpoint numeric	123	mbar	
setpoint table	123	mbar	
hysteresis	0	mbar	
auto stop time	0	sec	
No. of pressure ramps	1		
start cycle 1	2	mbar	
cycle time 1	600	sec	
cycle pressure 1	600	mbar	
VENTILATE on STOP	0		
Auto Restart	0		
back	----		

- Select and set the displayed values.
- Values that are not required are not displayed.
Parameter display: "Hysteresis" only when operating without a FU-Motor (Factory settings!)

- Select and set the displayed values.
- Values that are not required are not displayed.
Parameter display: "Hysteresis" only when operating without a FU-Motor (Factory settings!)

6.7 Electrical parameters

6.7.1 Printed circuit board – Layout and Connections

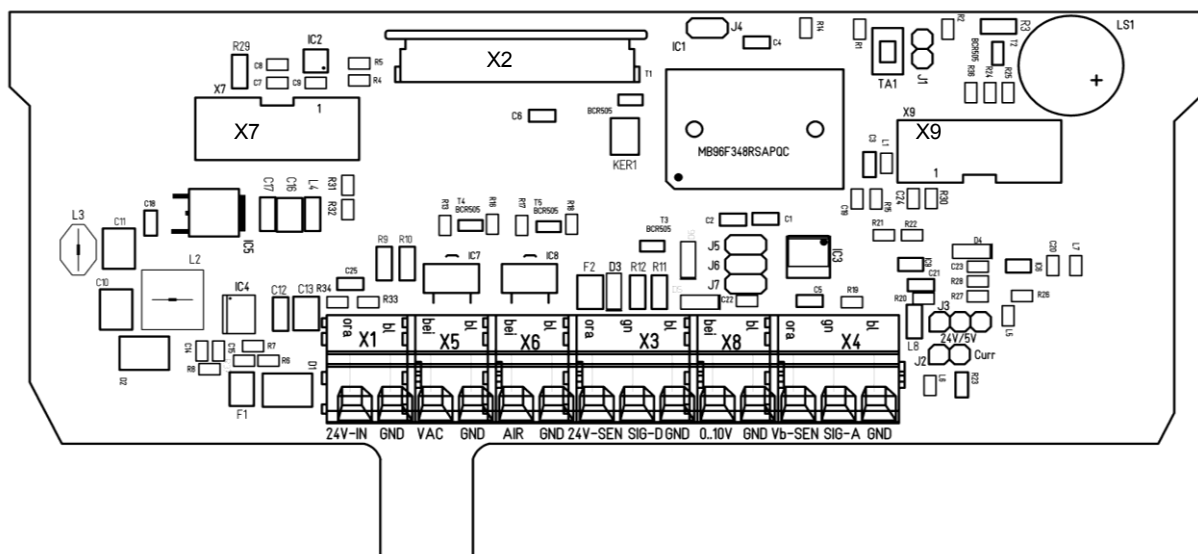


Fig. 10 Positions of components and interfaces

6.7.1.1 Electrical Interfaces

Location of interfaces, see Figure 6

The device is supplied with 24 V DC.

X1 Power supply input Spring contact clamp Wago type 236 / 2-pole

Pin no.	Function	Specification	Comment
1	GND		reverse polarity protected / blue
2	Primary power supply	24V DC \pm 10%, 1.5 A	reverse polarity protected / orange

X2 LCD Display BP320240E / INTERNAL
FFC Würth 686124144 24-pole / RM 1mm

Pin no.	Function	Specification	Comment
1	RESET		
2	/RD		
3	/WR		
4	/CS		
5	A0		
6	D0		
7	D1		
8	D2		
9	D3		
10	D4		
11	D5		
12	D6		
13	D7		
14	VDD		
15	VSS		
16	VLCD		
17	free		
18	SK/X1		
19	D0/X2		
20	D1/Y1		
21	CS/Y2		
22	INT		
23	LED+		
24	LED-		

X3 PLC input 1- Level sensor
Spring contact clamp Wago type 236 / 3-pole

Pin no.	Function	Specification	Comment
1	GND		bl
2	SENSOR 1 or PCL input 1	I in approx. 10 mA / $U_{\text{threshold}}$ approx. 13 V	gn
3	Sensor supply	Corresponds to the voltage at X1 / protected by 200 mA self-resetting circuit-breaker	orange

X4 Pressure sensor 1 input
Spring contact clamp Wago type 236 / 4-pole

Pin no.	Function	Specification	Comment
1	GND		blue
2	SENSOR 1 Signal	0..5 V or 0..20 mA	Resolution 5 mV / green
3	Sensor supply	5 V \pm 5% or Corresponds to the voltage at X1 / protected by 200 mA self-resetting circuit-breaker	Not fused / beige

The input can be configured with jumper **J2**:

- J2 open: (Default) Voltage: 0..5 V
- J2 plugged: current 0..20 mA

The sensor supply voltage can be configured with jumper **J3**:

- J3 1-2: 24 V needed for current output
- J3 2-3: 5 V (Default) needed for voltage output (depending on sensor data sheet)

X5 PLC output 1 – vacuum valve

X6 PLC output 2 – venting valve
Spring contact clamp Wago type 236 / 2-pole

Pin no.	Function	Specification	Comment
1	GND output		bl
2	Output	Corresponds to the voltage infeed at X1 / pnp max. 0.5 A	with freewheeling diode / orange

X7 RS232 to the PC
Tub plug connector, 10 pin via FB to
Sub-D-plug, 9-pin (Würth 618009221823)

Function	Pin at tub plug connector	Pin at SUB - D	Comment
RXD	3	2	
TXD	5	3	
GND	9	5	

X8 Analog output 1 – Frequency converter pump speed
Spring contact clamp Wago type 236 / 2-pole

Pin no.	Function	Specification	Comment
1	GND		bl
2	Output 1	0..10 V max. 10 mA	Resolution 2 mV / gr

X9 DEBUG / INTERNAL
Tub plug connector, 10 pin / RM 2.5mm

Pin no.	Function	Specification	Comment
1			
2			
3			
4			
5	Level converter supply	5 V \pm 5%	not fused
6			
7			
8	TXD	5 V level	
9	RXD	5 V level	
10	GND		


Operation

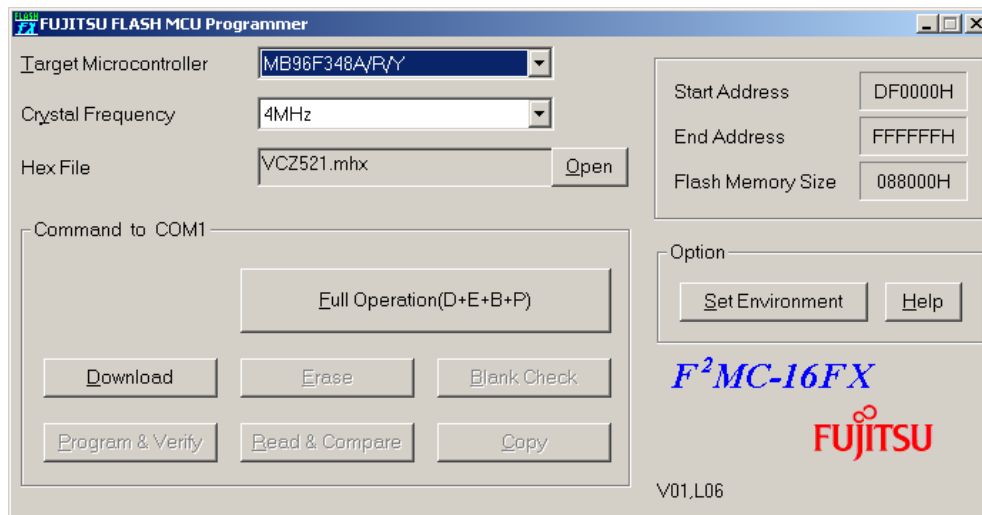
6.7.2 Software-Update

The software in the controller can be updated.

It can be re-input by the user. The Fujitsu Flash tool must be used for the Fujitsu 16FX CPU range.


The factory default settings can be made with a corresponding sequential number input again (VCZ521_XXX.mhx).

	NOTE !
The highest sequential number VCZ521_XXX.mhx is always the most current software version. (currently: VCZ521_116.mhx)	



The following steps must be carried out:


- Switch off the controller
- Call the flash program.
- Select the processor MB96F348A/R/Y
- Select the quartz frequency 4 MHz
- Select the program file
(Most Current Version = Highest Sequential Number, VCZ521_XXX.mhx)
- Select the serial interface used (Option / Set Environment)
- Start the programming with "Full Operation"
- Confirm the Box (PC) „Reset ...“ with OK
- Switch on the controller quickly (don't forget timeout of approx. 15 seconds!)
- The programming runs automatically.
- Switch off the controller again after the OK message
- Switch on the controller, and check the functions of the controller

	CAUTION !
The controller should be switched off during each interruption.	

6.8 Operation using the "WELCH-Control 521" PC program

The "WELCH-Control" enables the vacuum controller to be operated simply and easily from the PC. The program can be purchased and installed as an option.
Make the cable connection (O-Modem) between PC and controller.

PC program	Most Current Version	Order no.
WELCH-Control 521	V 1.16	620637

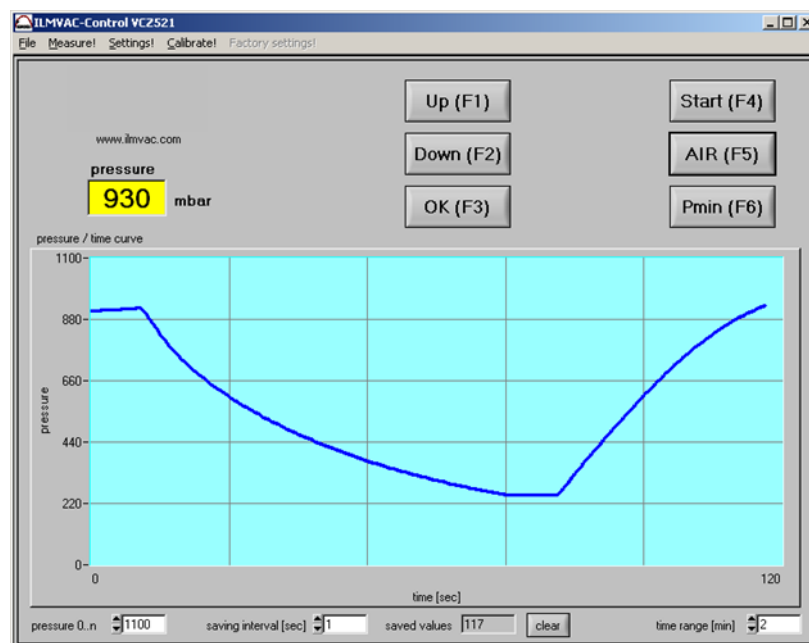
	CAUTION !
<p>1.) "WELCH-Control 521" is currently version V 1.16. 2.) Flash software is also currently version VCZ521_116.mhx. 3.) Version 1.) and 2.) need not be identical!</p>	

The program attempts to find a switched-on controller on COM1 to 20. A COM-Port 1..255 can also be defined as a command line parameter: VCZ521.EXE 2 -> select COM2
If a controller cannot be found, the program goes into offline mode.
Here, a previously saved curve can be reloaded and printed out.

Internal wiring of the controller RS 232 port

PIN	Cable colour	Connection on the main board
2	white	16 RS 232 - RXD
3	brown	17 RS 232 - TXD
5	green	18 GND
9	yellow	19 Flash - sets software update mode if on GND (18)

The following screen appears after the start:



The graph shows the pressure development. Both the chronological and the pressure display range can be set. Data can also be recorded in the PC memory, which can then be stored as an ASCII file in the "File / Save memory" menu.

Operation

In the PSI pressure range, the pressure values for the curve are multiplied by 100 to remain with integers.

The curve can be printed out by the system printer via the "File / Print curve" menu.

The buttons largely correspond to the buttons on the controller. However, the buttons cannot be held down.

- In active mode, the **AIR** button can be used with the mouse like on the controller. Pressing the mouse button opens the valve, releasing it closes the valve again. However, this only works if the mouse pointer is still on the **AIR** button.
- The **Up** and **Down** arrow buttons change the temporary setpoint in active mode.
- The **OK** button only works in active mode, and sets the current pressure as the new set value.
- The **Start** button starts or ends in the current operating mode.
- The **Pmin** button functions the same as without a controller.

The following menu items can be selected from the menu bar:

- File
- Measure!
- Settings!
- Calibrate!
- Factory settings!

6.8.1 Menu item: „File“

File	
Save settings	Saving the Settings dialog settings in a file
Load settings	Loading the Settings dialog settings from a file
Print settings	Printing out an image of the Settings dialog on the standard printer
Save memory	Saving the pressure data in a file
Load memory	Load the print data from a file
Print curve	Printing out the current pressure curve on the standard printer
Password	Changing the basic setting of the controller is password-protected. Release is given by inputting the date as a hex number. Example : 15.06.2018 = 150618 = 24C5A <i>(Required for activating the "Calibrate" and "Factory settings" menus and the direct input of pressure offset und pressure factor in the „Calibrate“ Dialog)</i>
Info	Information about the program version
Exit <ESC>	Exit program

6.8.2 Menu item: „Settings!“

File Measure! Settings! Calibrate! Factory settings!

mode
1 - manual

language
english

pressure unit
mbar

VENTILATE on STOP
OFF

Auto Restart
ON

settings

manual

setpoint 0 mbar

hysteresis 0 mbar

automatic

auto speed 50 %

auto limit 100 mbar/min

pressure drop

ramp num 1

	ramp 1	ramp 2	ramp 3
P start	2	0	0 mbar
P lower	600	20	20 mbar
T lower	600	1926	60 sec

auto stop time 0 sec

send config read config



CAUTION !

Settings not required for the selected operating mode are disabled and grayed out in the display. Appropriate error messages are displayed if the data ranges are exceeded or if inputs are illogical.

Settings required for the control behaviour of the controller:

Designation		Explanation
Software WELCH-Control 521	Control panel at the controller	
mode	MAIN MENU	1 - manual (manual pressure setting for boiling pressure)
		2 - automatic (automatic finding of the boiling pressure)
		3 - low pressure Operation without regulation
		There are only the modes meaningful for their application adjustable.
language	-	english, german, french, spain
-	Configuration, language	English, Deutsch, Français, Español
pressure unit	pressure unit	mbar, torr, psi, hPa
VENTILATE on STOP	-	ON - automatic venting after STOP is on OFF - automatic venting after STOP is off
-	VENTILATE on STOP	0 - closed
		1 - open
Auto Restart	-	OFF - no function
		ON - The program works automatically continues after power failure or shutdown.
-	Auto Restart	0 - no function
		1 - The program works automatically continues after power failure or shutdown.
manual, setpoint	setpoint	Enter a setpoint pressure value between 0 and 1100 mbar.
manual, hysteresis	hysteresis	Enter a hysteresis value between 0 and 1100 mbar.
pressure drop, ramp num	No. of pressure ramps	Number of possible ramps 1, 2, 3
P start, ramp 1 – 3	start cycle 1 – 3	in adjusted pressure value (example: mbar)
P lower, ramp 1 – 3	cycle time 1 – 3	in second absolute
T lower, ramp 1 – 3	cycle pressure 1 – 3	in adjusted pressure value absolute (example: mbar)
auto stop time	auto stop time	Hunting time in second
auto limit	auto limit	Threshold value for detecting the boiling point (selected pressure unit / min)
auto speed	auto speed	0 ... 100% Reduces the frequency of rotation / rotational speed to a percentage of the maximum speed of the pump motor in order to determine the boiling point smoothly.
read config	-	Read out current parameter values from the controller and display in the Settings dialog.
send config	-	Values changed in the Settings dialog are stored in the controller. The controller confirms reception with a signal tone.

6.8.3 Menu item: „Calibrate“

Calibration:

When **search lower point (Pmin)** is activated, evacuation is to the lower point. If the pressure does not fall any further, the value can be entered by using a comparison measurement device and confirmed with **Ok**. The system is vented and the ambient barometric pressure entered as the **upper point (Pmax)**. Do not confirm until the value has been established. If the controller is integrated in a complete system or pump system (LVS), evacuation and venting take place automatically when the stated buttons are pressed. The calculated correction values are displayed and can be stored with **save**.

	CAUTION !
Ensure that the set pressure is also present at the sensor.	

Designation		Explanation
Software WELCH-Control 521	Control panel at the controller	
Lower point	CL	at low pressure - pressure of comparison measurement device (at lowest possible pressure, e.g. 10 mbar)
Upper point	CH	at normal pressure (high) - barometric pressure

Operation

6.8.4 Menu item: „Factory settings“



Designation		Explanation
Software WELCH-Control 521	Control panel at the controller	
FU motor	not settable	analog output active
calibration allowed	not settable	✓ = present
		= not present
read	not settable	Reading the set values Confirmation of acceptance by signal tone
send	not settable	Transmission of changed values to the controller Confirmation of acceptance by signal tone

	CAUTION !
<p>These settings are adapted by the manufacturer to match the supplied configuration. The user can change the settings after inputting the password ("File" menu item).</p>	

6.9 Table of solvents

Solvent	Formula	Vacuum (mbar) for boiling point at 40 °C
Acetone	C ₃ H ₆ O	556
n-amyl alcohol, n-pentanol	C ₅ H ₁₂ O	11
Benzole	C ₆ H ₆	236
n-butanol	C ₄ H ₁₀	25
tert-butyl alcohol, 2-methyl-2-propanol	C ₄ H ₁₀ O	130
Tetrachlorometane	CCl ₄	271
Chlorobenzene	C ₆ H ₅ Cl	36
Chloroform	CHCl ₃	474
Cyclohexane	C ₆ H ₁₂	235
Diethyl ether	C ₄ H ₁₀ O	no vacuum
1, 2, -dichlorethane	C ₂ H ₄ Cl ₂	210
1, 2, -dichlorethylene (cis)	C ₂ H ₂ Cl ₂	479
1, 2, -dichlorethylene (trans)	C ₂ H ₂ Cl ₂	751
Diisopropyl ether	C ₆ H ₁₄ O	375
Dioxan	C ₄ H ₈ O ₂	107
DMF	C ₃ H ₇ NO	11
Ethanol	C ₂ H ₆ O	175
Ethyl acetate	C ₄ H ₈ O ₂	240
Heptane	C ₇ H ₁₆	120
Hexane	C ₆ H ₁₄	335
Isopropyl alcohol	C ₃ H ₈ O	137
Isoamyl alcohol, 3-methyl-1-butanol	C ₅ H ₁₂ O	14
Ethyl methyl keton	C ₄ H ₈ O	243
Methanol	CH ₄ O	337
Methylene dichloride, dichloromethane	CH ₂ Cl ₂	no vacuum
Pentane	C ₅ H ₁₂	no vacuum
n-propyl alcohol	C ₃ H ₈ O	67
Pentachlorpethane	C ₂ HCl ₅	13
1, 1, 2, 2, -tetrachloroethane	C ₂ H ₂ Cl ₄	35
1, 1, 1, -trichloroethane	C ₂ H ₃ Cl ₃	300
Tetrachloroethylene	C ₂ Cl ₄	53
THF	C ₄ H ₈ O	357
Toluol	C ₇ H ₈	77
Trichloroethylene	C ₂ HCl ₃	183
Water	H ₂ O	72
Xylol	C ₈ H ₁₀	25

Vacuum in Torr/mmHg = X mbar x 0.75

7 Maintenance and Servicing


7.1 General Requirements

Repairs of the Laboratory-Vacuum-Systems may only be performed by the manufacturer or authorized workshops.

The prerequisites are a complete and factually correct damage report, and a clean and, if necessary, a decontaminate device.

The operator may perform maintenance work to the extent indicated below:

7.2 Maintenance Performed by the User

	WARNING !
<p>Only perform the work that is described here, and that which is permitted to be done by the user. All other maintenance and service work may only be performed by the manufacturer or a dealer authorized by him. Beware of the pump parts being possibly contaminated by hazardous substances. Wear protective clothing if there is contamination.</p>	

7.2.1 Maintenance of the diaphragm pump

- Check the pump daily for unusual running noises and heat building up on the surface of the pump.
- We recommend changing the diaphragm after 10,000 operating hours. The user may specify that the exchange be made earlier, depending upon the application process.
- Check the electrical and vacuum connections daily.

Scope of permissible work:

- Loosen and remove the hoses
- Open and remove the pump heads
- Inspect the pump chambers, diaphragms and valves
- Deposits in the inside of the pump must be cleaned out
- Change the diaphragms, valves and seals

Tools required:

Tool kit: Order No. 402106, consists of:

- Order no. 826801 Pin type face wrench, adjustable, size 3,
- Order no. 826801-6 Allan key, size 4,
- Order no. 826801-5 Open spanner, size 17.

7.2.1.1 Disassembly

1. Disconnect the power supply and ensure that it cannot be switched on again.
2. Open the screw clamps (9) of the hoses (10) on the pump body with the SW 17 open spanner.
3. Remove four machine screws (1) from each connection head with an Allan key, size 4.
4. Lift off the connection head (2) and the pump head (5). The valves (3), o-rings (4) and diaphragm (7) are now freely exposed.
5. Loosen the diaphragm (7) at the strain washer (6) by turning the size 3 pin type face wrench anticlockwise.
6. Clean the valves (3), the pump head (5) and the diaphragm (7) with a soft cloth and acetone.
7. Check that the drive is in good working order.

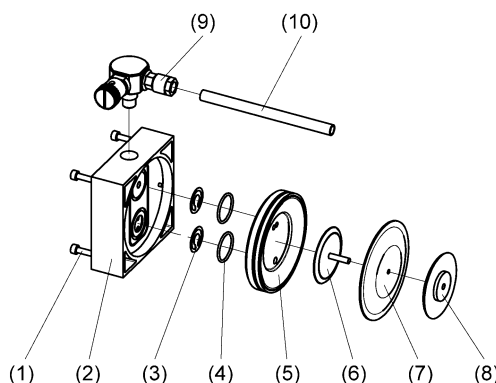



Fig. 11 Disassembly, assembly

	WARNING !
<p>Renew defective parts, if necessary! Wear protective gloves! Parts must be renewed at the intervals stated in this Operating Manual or as specified by the user internally! Do not clean with compressed air!</p>	

7.2.1.2 Assembly (see fig. 11)

1. Place the pump so that the diaphragm is lying in a horizontal position.
2. Use the size 3 pin-type face wrench to tighten the pressure disc (8), the diaphragm (7) and the strain washer (6) with the correct torque of 5 - 6 Nm.
3. Bring the connecting rod (see fig. 20) and the diaphragm (7) into the central position.
4. Replace the pump head (5).
5. Insert the valves (3) and the O-rings (4).
Ensure that they are lying completely flat. Do not insert the burred side facing the sealing surface. Align the connection head flush with the pin.
6. Tighten the four machine screws (1) symmetrically with a torque of 3 - 4 Nm.
7. Reattach the hose (10) connections with clamping ring screw fittings (9).

Maintenance and Servicing

7.2.1.3 Test

- Connect a vacuum measuring device to the intake connector and measure the ultimate pressure.
If the device is working properly, then the figure stated in the technical data must be attained within a maximum of one minute.
- The pump must not make any abnormal noises.
- Moving parts must not touch each other.

7.2.2 Maintenance of the vacuum controller


The vacuum controller is maintenance-free. In case of damage, return the device to the manufacturer or to an authorized workshop.

7.2.3 Maintenance of other components

- Empty the glass drip pan in a timely manner, observe all disposal specifications as applicable to hazardous substances.
- Screw connections must be checked for tightness and tightened when necessary.
- Check vacuum hoses for leaks and, if necessary, replace them.
- Check that the glass vessels are undamaged and if necessary replace.
- Check rubber gasket of the safety valve at the emission condenser and, if necessary, replace it.

7.3 Maintenance by the Manufacturer


Repairs and maintenance going beyond the extent of the work described in chapter 7.2 or reconditioning or modification may only be performed by the manufacturer or authorized workshops.

	WARNING !
The user shall be liable for the consequences of an incorrect damage report or a contaminated pump. The statements in the damage report are legally binding.	

7.4 Damage Report

You find the form of the damage report to the Download on our web page in the menu "service" and "Downloads". www.gardnerdenver.com/de-de/welch

If you should not have an entrance to the Internet, you can request the form also gladly with us, under phone +49 3677 604 0.

	WARNING !
Incomplete or incorrectly completed damage reports may endanger the service personnel! Provide full information about contamination, and clean the pump thoroughly before handing it over to third parties.	

8 Troubleshooting

Only manufacturing firm and authorized service workshops may work on the pump systems and their accessories during the warranty period.


Trouble	Cause	Remedy	
		by:	with:
Vacuum pump does not start	No power supply	Qualified electrician	Check electrical installation
	Motor defective	Service workshop	Exchange
	Pump body defective		Repair and/or exchange
Vacuum pump does not generate a vacuum or only an inadequate one	Connected apparatus and/or connecting elements leaking	User or Service workshop	Identify and seal the leak, replace the seals and/or hoses if necessary.
	Vacuum pump leaking		Check the hose connections between the pump heads, replace the hoses and/or fittings if necessary.
	Pump head leaking	Service workshop	Repair and/or exchange
	Diaphragm defective	User or Service workshop	Exchange of the diaphragm (see chapter 7.2)
	Valve defective		Exchange of the valve (see chapter 7.2)
	Vacuum pump dirty		General maintenance / leaning
	Valves dirty		Cleaning condensates and foreign objects out of the valves.
Running noise	Vacuum pump dirty	User or Service workshop	General maintenance / cleaning
Glass components	defective and/or leaking	User	Exchange of the glass parts or seals
Cable(s)	defective and/or brittle	Qualified electrician	Exchange of the cable(s)
No pressure indicated on the controller	No power supply	Qualified electrician	Electrical system to be checked
Controller cannot be set or programmed	Electronics / display are defective	Service workshop	Repair and/or exchange
Missing control signal	Incorrect input	User	Check the input and correct if necessary
	Controller defective	User	Switch the device off, and switch it on again after three seconds
		User or Service workshop	Replace the controller

Spare Parts Overview

9 Spare Parts Overview

The spare parts list contains all the spare parts and all the information necessary for ordering.

When ordering, please quote the description, quantity, serial number and order number!

	CAUTION !
We are not liable for any damage caused by the installation of any parts not supplied by the manufacturer.	

9.1 Service kit - Diaphragm Pump

Designation	Order no.
Service kit	402042

The service kit consists of:

Designation	Piece	Order no.
O-ring ø 12 x 2	9	829217-3
O-ring ø 25 x 2	8	829250-1
Valve	8	400656
Diaphragm	4	400732

9.2 Spare parts – Laboratory-Vacuum-Systems, unregulated + manually regulated

Spare parts view LVS 600 T, unregulated

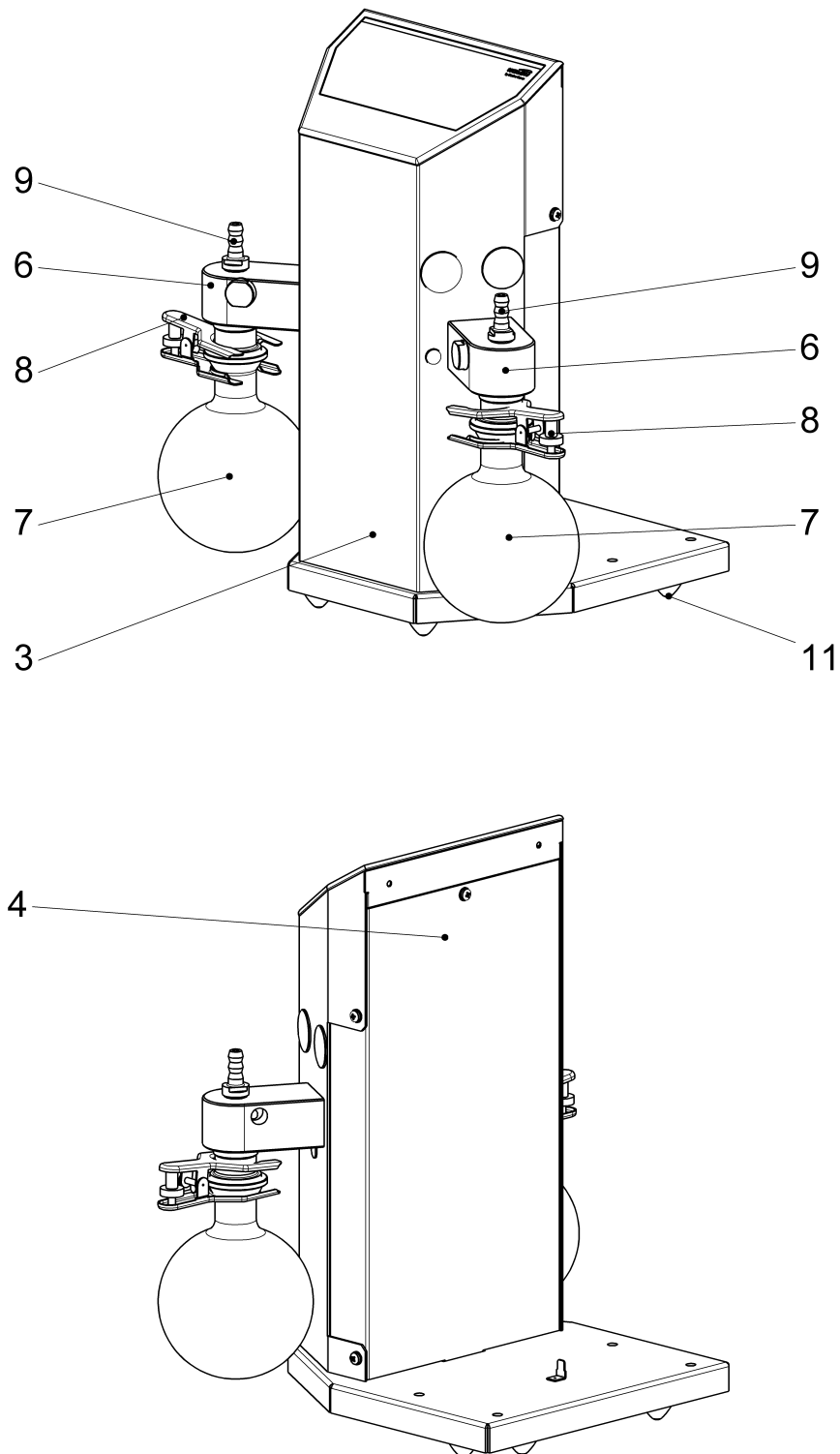


Fig. 12 Front- and rear unit - LVS unregulated (without item no. 1 and 2)

Spare Parts Overview

Spare parts view LVS 602 T, manually regulated

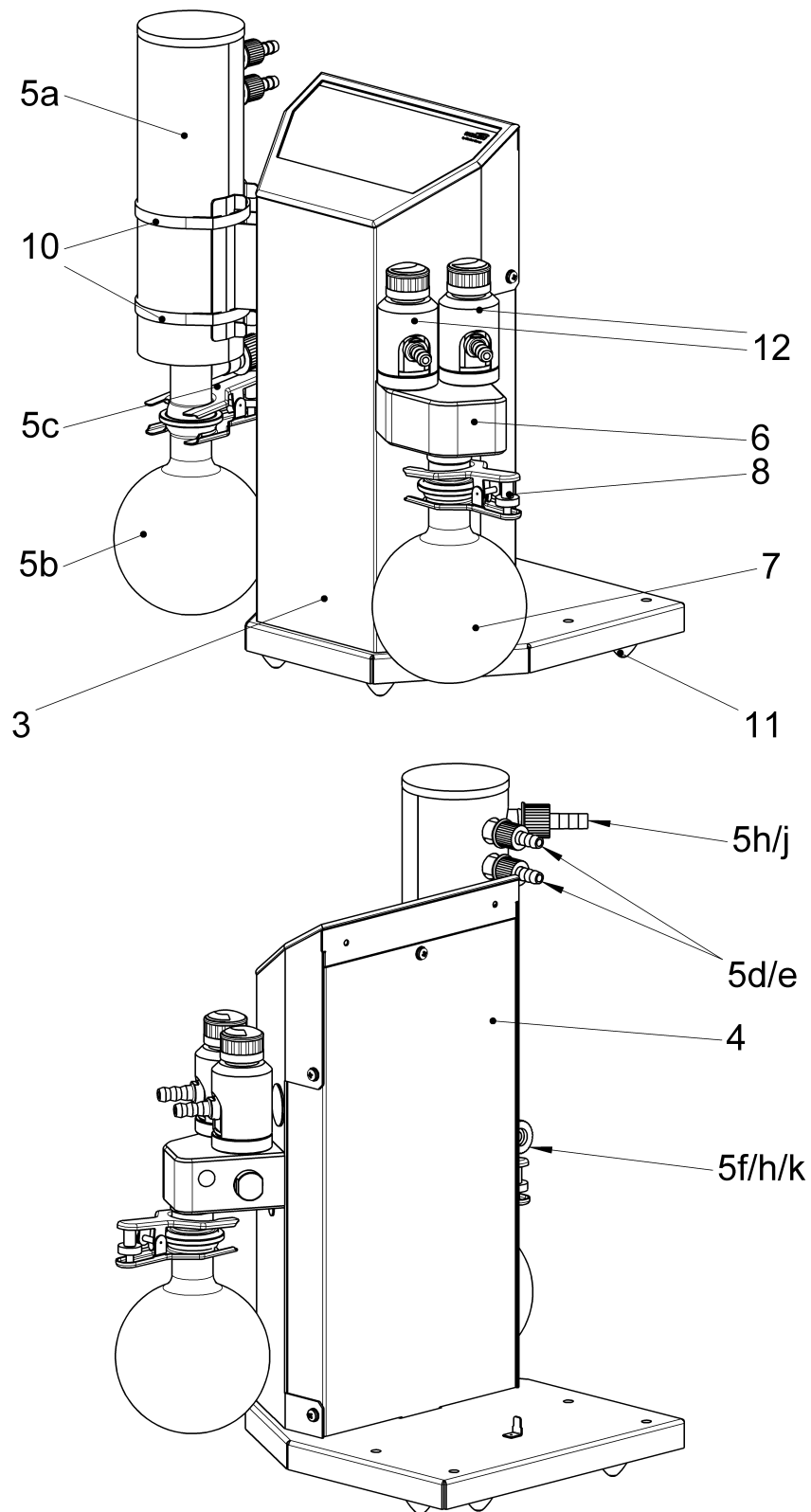


Fig. 13 Front- and rear unit - LVS manually regulated (without item no. 1 and 2)

Spare parts list - LVS 600 T unregulated, LVS 602 T manually regulated

Item no.	Designation	Piece	LVS 600 T	LVS 602 T
			Order no. 115051 115051-01 115051-05	Order no. 115053 115053-01 115053-05
			Order no.	Order no.
1	Diaphragm pump MPC 601 T (230V) (consisting of: – see chapter 9.1)	1	412743-05	412743-05
	Mains connection cable IEC + plug CEE (D)	1	825885	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878	825878
	Diaphragm pump MPC 601 T (115V) (consisting of: – see chapter 9.1)	1	412743-06	412743-06
	Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903	825903
	Diaphragm pump MPC 601 T (100V) (consisting of: – see chapter 9.1)	1	412743-09	412743-09
	Mains connection cable IEC + plug JIS (J)	1	825911	825911
2	Threaded elbow joint PVDF, 10 – ¼"	2	829984	-
		1	-	829984
3	Column 1 complete (consisting of pos.: 4 – 12)	1	115502	-
	Column 3 complete (consisting of pos.: 4 – 12)	1	-	115502-02
4	Rear panel	1	115512-02	115512-02
5	Emission condenser complete KD 500/5 (consisting of pos. 5a – 5k)	1	-	700183-08
5a	- Intensive cooler with isolation	1	-	720480
5b	- Round-bottomed flask 500 ml – KS 35	1	-	828839
5c	- Ball and socket clamp – KS 35	1	-	828845
5d	- Screw cap GL 14	2	-	828872
5e	- Hose nozzle GL 14	2	-	828872-1
5f	- Safety valve	1	-	100838-01
5g	- Vacuum hose PTFE, 10/ 8x1 (sold by the metre)	0.15 m	-	828332
5h	- Screw cap GL 18	2	-	828876
5j	- Hose nozzle GL 18	1	-	828876-1
5k	- Silicon sealing GL 18	1	-	828876-2
6	Valve seat complete	1	113528-1	113522
7	Round-bottomed flask 500 ml – KS 35	2	828839	-
		1	-	828839
8	Ball and socket clamp – KS 35	2	828845	-
		1	-	828845
9	Hose nozzle DN 8 – G ¼"	2	710798-06	-
10	Retaining strap 70 – 75 mm	2	-	824130
11	Rubber metal-pad	6	829138-1	829138-1
12	Fine control valve VVC-M2	2	-	700443-01

Spare Parts Overview

Spare parts view LVS 601 T, manually regulated

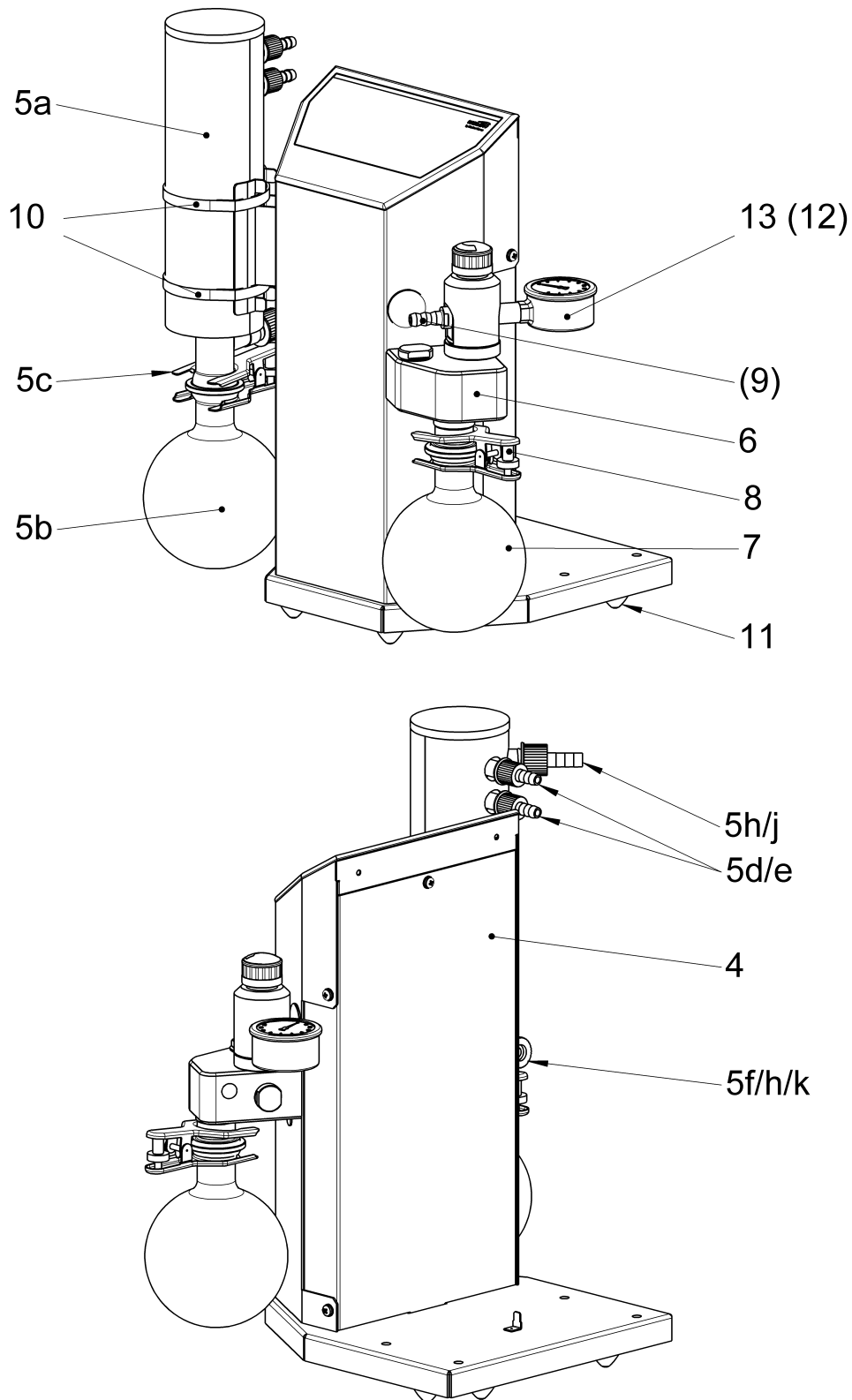


Fig. 14 Front- and rear unit – LVS manually regulated (without item no. 1 and 2)

Spare parts list - LVS 601 T, manually regulated

Item no.	Designation	Piece	LVS 601 T	LVS 601 T with dial gauge digital	LVS 601 T with dial gauge analog
			Order no. 115057 115057-01 115057-05	Order no. 115057-10 115057-11	Order no. 115057-12
			Order no.	Order no.	Order no.
1	Diaphragm pump MPC 601 T (230V) (consisting of: – see chapter 9.6)	1	412743-05	412743-05	-
	- Mains connection cable IEC + plug CEE (D)	1	825885	825885	-
	- Mains connection cable IEC + plug BS (UK)	1	825878	825878	-
	Diaphragm pump MPC 601 T (115V) (consisting of: – see chapter 9.6)	1	412743-06	412743-06	-
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903	825903	-
	Diaphragm pump MPC 601 T (100V) (consisting of: – see chapter 9.6)	1	412743-09	-	412743-09
	- Mains connection cable IEC + plug JIS (J)	1	825911	-	825911
2	Threaded elbow joint PVDF, 10 – ¼"	1	829984	829984	829984
	Threaded elbow joint with attitude taps PVDF, 10 – A10	2	-	829913-1	829913-1
3	Column 7 complete (consisting of pos.: 4 – 12)	1	115502-06	115502-24	115502-22
4	Rear panel	1	115512-02	115512-02	115512-02
5	Emission condenser complete KD 500/5 (consisting of pos. 5a – 5k)	1	700183-08	700183-08	700183-08
5a	- Intensive cooler with isolation	1	720480	720480	720480
5b	- Round-bottomed flask 500 ml – KS 35	1	828839	828839	828839
5c	- Ball and socket clamp – KS 35	1	828845	828845	828845
5d	- Screw cap GL 14	2	828872	828872	828872
5e	- Hose nozzle GL 14	2	828872-1	828872-1	828872-1
5f	- Safety valve	1	100838-01	100838-01	100838-01
5g	- Vacuum hose PTFE, 10/ 8x1 (sold by the metre)	0,15 m	828332	828332	828332
5h	- Screw cap GL 18	2	828876	828876	828876
5j	- Hose nozzle GL 18	1	828876-1	828876-1	828876-1
5k	- Silicon sealing GL 18	1	828876-2	828876-2	828876-2
6	Valve seat complete	1	113522	113523	113522
7	Round-bottomed flask 500 ml – KS 35	1	828839	828839	828839
8	Ball and socket clamp – KS 35	1	828845	828845	828845
10	Retaining strap 70 – 75 mm	2	824130	824130	824130
11	Rubber metal-pad	6	829138-1	829138-1	829138-1
12	Fine control valve VVC-M2	1	700443-01	-	-
	Fine control valve VVC-M14 with dial gauge digital	1	-	700463	-
	Fine control valve VVC-M3 with dial gauge analog	1	-	-	700444-02
13	O-Ring EPDM Ø15 x 2	1	829311-1	829311-1	829311-1

Spare Parts Overview

Spare parts list - LVS 601 T netvac 1, manually regulated

Item no.	Designation	Piece	LVS 601 T netvac 1
			Order no. 115057-02 115057-03
			Order no.
1	Diaphragm pump MPC 601 T (230V) (consisting of: – see chapter 9.6)	1	412743-05
	- Mains connection cable IEC + plug CEE (D)	1	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878
	Diaphragm pump MPC 601 T (115V) (consisting of: – see chapter 9.6)	1	412743-06
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903
2	Threaded elbow joint PVDF, 10 – ¼"	1	829984
3	Column 2 complete (consisting of pos.: 4 – 13)	1	115502-13
4	Rear panel	1	115512-02
5	Emission condenser complete KD 500/5 (consisting of pos. 5a – 5k)	1	700183-08
5a	- Intensive cooler with isolation	1	720480
5b	- Round-bottomed flask 500 ml – KS 35	1	828839
5c	- Ball and socket clamp – KS 35	1	828845
5d	- Screw cap GL 14	2	828872
5e	- Hose nozzle GL 14	2	828872-1
5f	- Safety valve	1	100838-01
5g	- Vacuum hose PTFE, 10/ 8x1 (sold by the metre)	0,15 m	828332
5h	- Screw cap GL 18	2	828876
5j	- Hose nozzle GL 18	1	828876-1
5k	- Silicon sealing GL 18	1	828876-2
6	Valve seat complete	1	113528-1
7	Round-bottomed flask 500 ml – KS 35	1	828839
8	Ball and socket clamp – KS 35	1	828845
10	Retaining strap 70 – 75 mm	2	824130
11	Rubber metal-pad	6	829138-1
13	Threaded elbow joint PVDF, 10	1	829983
	Hose connector PVDF, A10 - 8	1	829924-1
	Setting nipple PVDF, A10 – ¼"	1	829982

9.3 Spare parts – Laboratory-Vacuum-Systems, automatically regulated

Spare parts view LVS 610 T

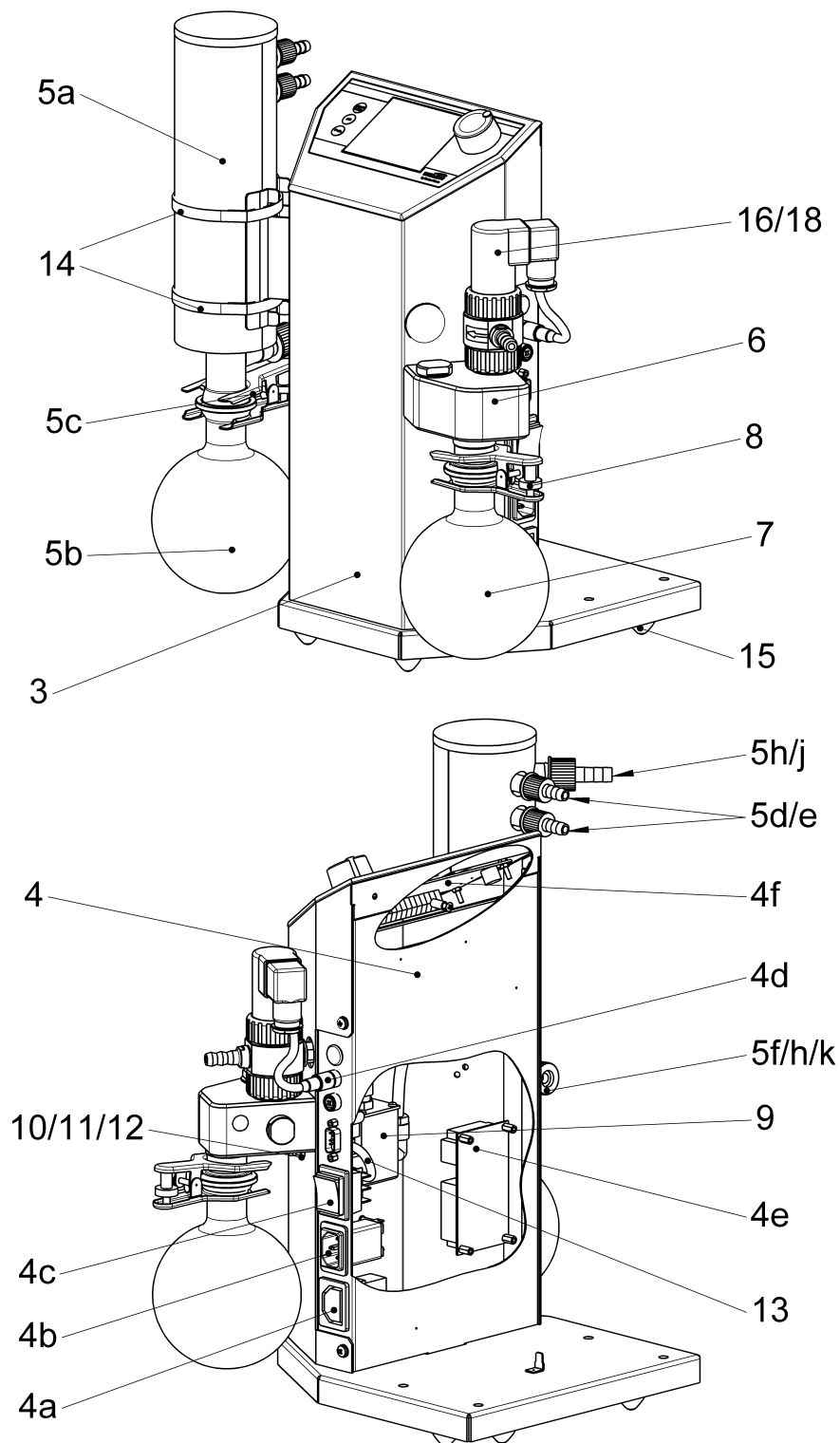


Fig. 15 Front- and rear unit - LVS automatically regulated (without item no. 1 and 2)

Spare Parts Overview

Spare parts list - LVS 610 T, automatically regulated

Item no.	Designation	Piece	LVS 610 T	LVS 610 T netvac 1
			Order no. 115054 115054-01 115054-05	Order no. 115054-03
			Order no.	Order no.
1	Diaphragm pump MPC 601 T (230V) (consisting of: – see chapter 9.6)	1	412743-05	412743-05
	- Mains connection cable IEC + plug CEE (D)	1	825885	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878	825878
	Diaphragm pump MPC 601 T (115V) (consisting of: – see chapter 9.6)	1	412743-06	-
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903	-
	Diaphragm pump MPC 601 T (100V) (consisting of: – see chapter 9.6)	1	412743-09	-
	- Mains connection cable IEC + plug JIS (J)	1	825911	-
2	Threaded elbow joint PVDF, 10 – 1/4"	1	829984	829984
3	Column 4 complete (consisting of pos.: 4 – 18)	1	115502-03	115502-14
4	Rear panel 7 complete (consisting of pos.: 4a – 4f)	1	115503-06	115503-06
4a	- Socket for non-heating apparatus	1	825274-7	825274-7
4b	- Device plug combination with system filter	1	825297	825297
4c	- Switch green 2 pole	1	825184	825184
4d	- Sub miniature round plug - flange box 4 pole	2	825277-1	825277-1
4e	- NT-switch power pack 24 V	1	827400-5	827400-5
4f	- Circuit board 521	1	827429	827429
5	Emission condenser complete KD 500/5 (consisting of pos. 5a – 5k)	1	700183-08	700183-08
5a	- Intensive cooler with isolation	1	720480	720480
5b	- Round-bottomed flask 500 ml – KS 35	1	828839	828839
5c	- Ball and socket clamp – KS 35	1	828845	828845
5d	- Screw cap GL 14	2	828872	828872
5e	- Hose nozzle GL 14	2	828872-1	828872-1
5f	- Safety valve	1	100838-01	100838-01
5g	- Vacuum hose PTFE, 10 / 8x1 (sold by the metre)	0.15 m	828332	828332
5h	- Screw cap GL 18	2	828876	828876
5j	- Hose nozzle GL 18	1	828876-1	828876-1
5k	- Silicon sealing GL 18	1	828876-2	828876-2
6	Valve seat complete	1	113522	113522
7	Round-bottomed flask 500 ml – KS 35	1	828839	828839
8	Ball and socket clamp – KS 35	1	828845	828845
9	Sensor – built-in controller	1	620052-17	620052-12
10	Screw in socket amended	1	160537	160537
11	Screw in socket	1	828791	828791
12	Distance piece M5/M5	1	160529	160529
13	Silicone hose I Ø 3 x 1.5 mm	0.2 m	H100086	H100086
14	Retaining strap 70 – 75 mm	2	824130	824130
15	Rubber metal-pad	6	829138-1	829138-1
16	Automatic valve VVC-E4	1	700425-01	-
	Automatic valve VVC-E4 + Threaded elbow joint	1	-	700425-03
18	Straight threaded joint with seal edge PVDF, 8 - 1/4"	1	829919-1	829919-1

Spare parts view LVS 611 T

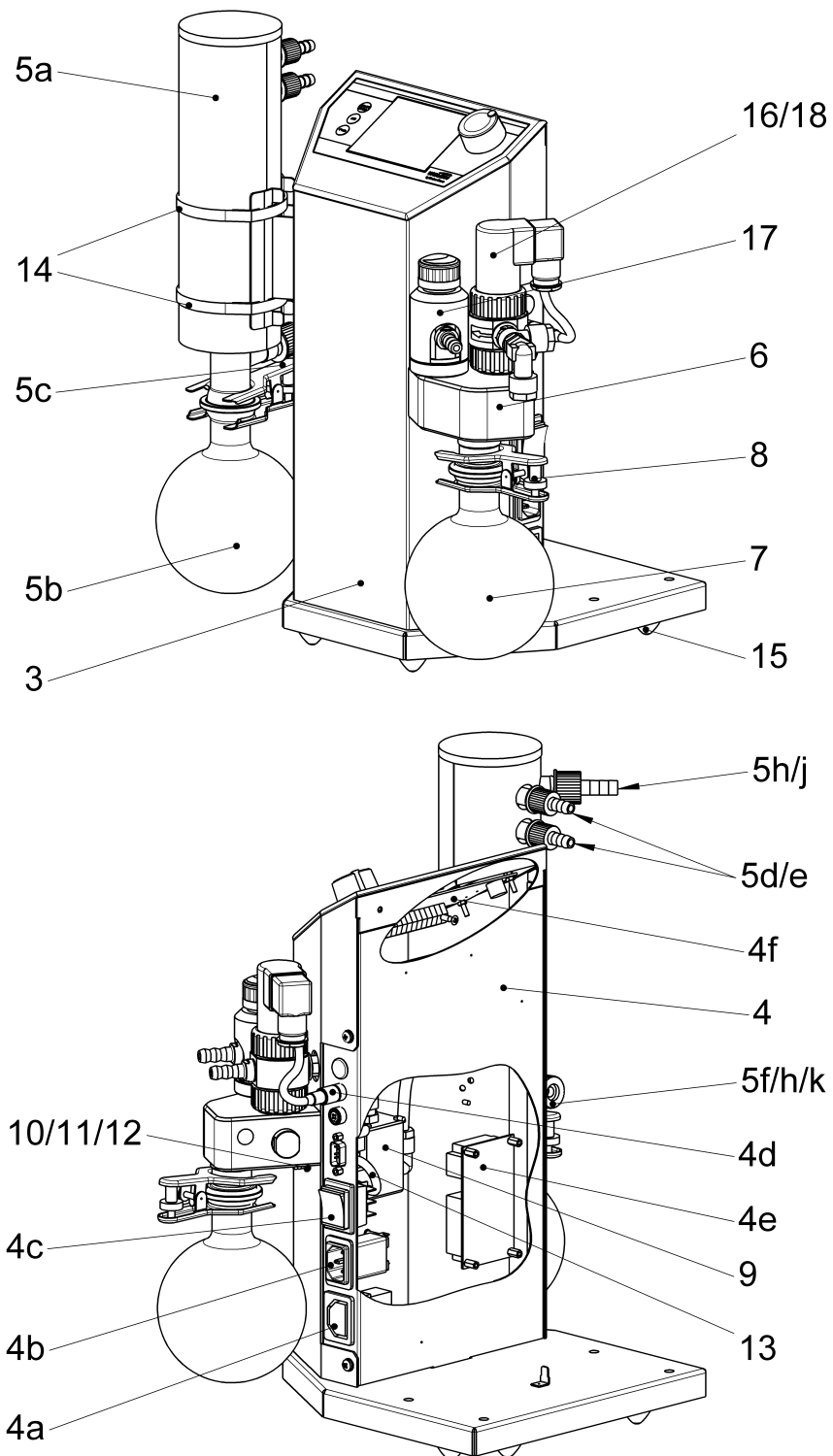


Fig. 16 Front- and rear unit - LVS automatically regulated (without item no. 1 and 2)

Spare Parts Overview

Spare parts list - LVS 611 T, automatically regulated

Item no.	Designation	Piece	LVS 611 T
			Order no. 115055 115055-01 115055-05
			Order no.
1	Diaphragm pump MPC 601 T (230V) (consisting of: – see chapter 9.6)	1	412743-05
	- Mains connection cable IEC + plug CEE (D)	1	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878
	Diaphragm pump MPC 601 T (115V) (consisting of: – see chapter 9.6)	1	412743-06
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903
	Diaphragm pump MPC 601 T (100V) (consisting of: – see chapter 9.6)	1	412743-09
	- Mains connection cable IEC + plug JIS (J)	1	825911
2	Threaded elbow joint PVDF, 10 – 1/4"	1	829984
3	Column 5 complete (consisting of pos.: 4 – 18)	1	115502-04
4	Rear panel 7 complete (consisting of pos.: 4a – 4f)	1	115503-06
4a	- Socket for non-heating apparatus	1	825274-7
4b	- Device plug combination with system filter	1	825297
4c	- Switch green 2 pole	1	825184
4d	- Sub miniature round plug - flange box 4 pole	2	825277-1
4e	- NT-switch power pack 24 V	1	827400-5
4f	- Circuit board 521	1	827429
5	Emission condenser complete KD 500/5 (consisting of pos. 5a – 5k)	1	700183-08
5a	- Intensive cooler with isolation	1	720480
5b	- Round-bottomed flask 500 ml – KS 35	1	828839
5c	- Ball and socket clamp – KS 35	1	828845
5d	- Screw cap GL 14	2	828872
5e	- Hose nozzle GL 14	2	828872-1
5f	- Safety valve	1	100838-01
5g	- Vacuum hose PTFE, 10/ 8x1 (sold by the metre)	0.15 m	828332
5h	- Screw cap GL 18	2	828876
5j	- Hose nozzle GL 18	1	828876-1
5k	- Silicon sealing GL 18	1	828876-2
6	Valve seat complete	1	113522
7	Round-bottomed flask 500 ml – KS 35	1	828839
8	Ball and socket clamp – KS 35	1	828845
9	Sensor – built-in controller	1	620052-17
10	Screw in socket amended	1	160537
11	Screw in socket	1	828791
12	Distance piece M5/M5	1	160529
13	Silicone hose I Ø 3 x 1.5 mm	0.2 m	H100086
14	Retaining strap 70 – 75 mm	2	824130
15	Rubber metal-pad	6	829138-1
16	Automatic valve VVC-E4 + Sensor connection	1	700425-02
17	Fine control valve VVC-M2	1	700443-01
18	Straight threaded joint with seal edge PVDF, 8 - 1/4"	1	829919-1

9.4 Spare parts – Laboratory-Vacuum-Systems, ecoflex

Spare parts view LVS 610 T ef

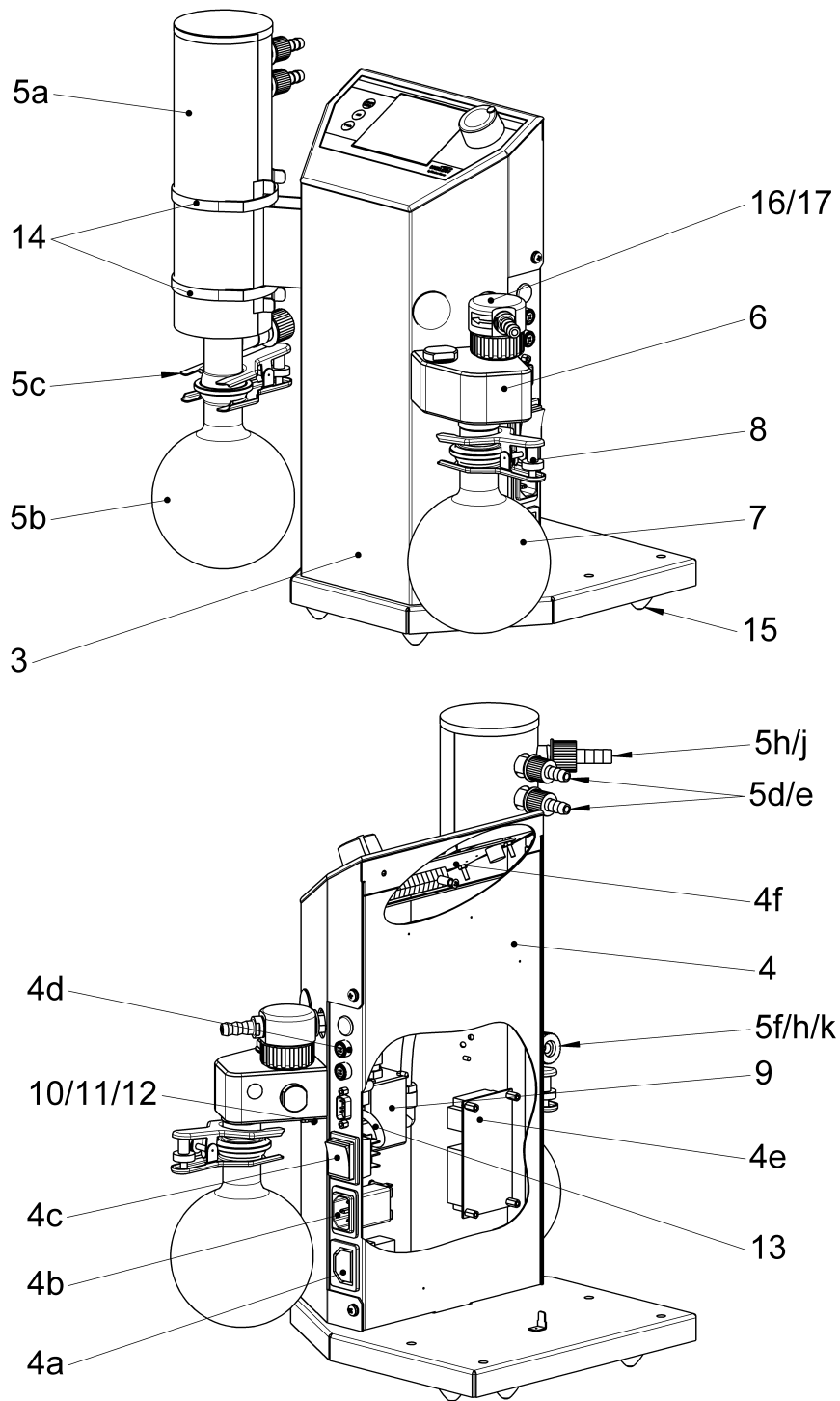


Fig. 17 Front- and rear unit - LVS 610 T ef (without item no. 1 and 2)

Spare Parts Overview

Spare parts list - LVS 610 T ef, ecoflex

Item no.	Designation	Piece	LVS 610 T ef	LVS 610 T ef netvac 1
			Order no. 115254 115254-01	Order no. 115254-03
			Order no.	Order no.
1	Diaphragm pump MPC 601 T (115/230V) (consisting of: – see chapter 9.6)	1	412943-05	412943-05
	- Mains connection cable IEC + plug CEE (D)	1	825885	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878	825878
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903	-
2	Threaded elbow joint PVDF, 10 – 1/4"	1	829984	829984
3	Column 10 complete (consisting of pos.: 4 – 17)	1	115502-09	115502-16
4	Rear panel 7 complete (consisting of pos. 4a – 4f)	1	115503-08	115503-08
4a	- Socket for non-heating apparatus	1	825274-7	825274-7
4b	- Device plug combination with system filter	1	825297	825297
4c	- Switch green 2 pole	1	825184	825184
4d	- Sub miniature round plug - flange box 4 pole	2	825277-1	825277-1
4e	- NT-switch power pack 24 V	1	827400-5	827400-5
4f	- Circuit board 521	1	827429	827429
5	Emission condenser complete KD 500/5 (consisting of pos. 5a – 5k)	1	700183-08	700183-08
5a	- Intensive cooler with isolation	1	720480	720480
5b	- Round-bottomed flask 500 ml – KS 35	1	828839	828839
5c	- Ball and socket clamp – KS 35	1	828845	828845
5d	- Screw cap GL 14	2	828872	828872
5e	- Hose nozzle GL 14	2	828872-1	828872-1
5f	- Safety valve	1	100838-01	100838-01
5g	- Vacuum hose PTFE, 10/ 8x1 (sold by the metre)	0.15 m	828332	828332
5h	- Screw cap GL 18	2	828876	828876
5j	- Hose nozzle GL 18	1	828876-1	828876-1
5k	- Silicon sealing GL 18	1	828876-2	828876-2
6	Valve seat complete	1	113522	113522
7	Round-bottomed flask 500 ml – KS 35	1	828839	828839
8	Ball and socket clamp – KS 35	1	828845	828845
9	Sensor – built-in controller	1	620052-17	620052-17
10	Screw in socket amended	1	160537	160537
11	Screw in socket	1	828791	828791
12	Distance piece M5/M5	1	160529	160529
13	Silicone hose I Ø 3 x 1.5 mm	0.2 m	H100086	H100086
14	Retaining strap 70 – 75 mm	2	824130	824130
15	Rubber metal-pad	6	829138-1	829138-1
16	Vacuum connection point VVC-M5	1	700418-02	-
	Vacuum connection point VVC-M5 + KR-A10	1	-	700418-05
17	Straight threaded joint with seal edge PVDF, 8 – 1/4"	1	829919-1	829919-1

Spare parts list - LVS 610 T ef, ecoflex – extern

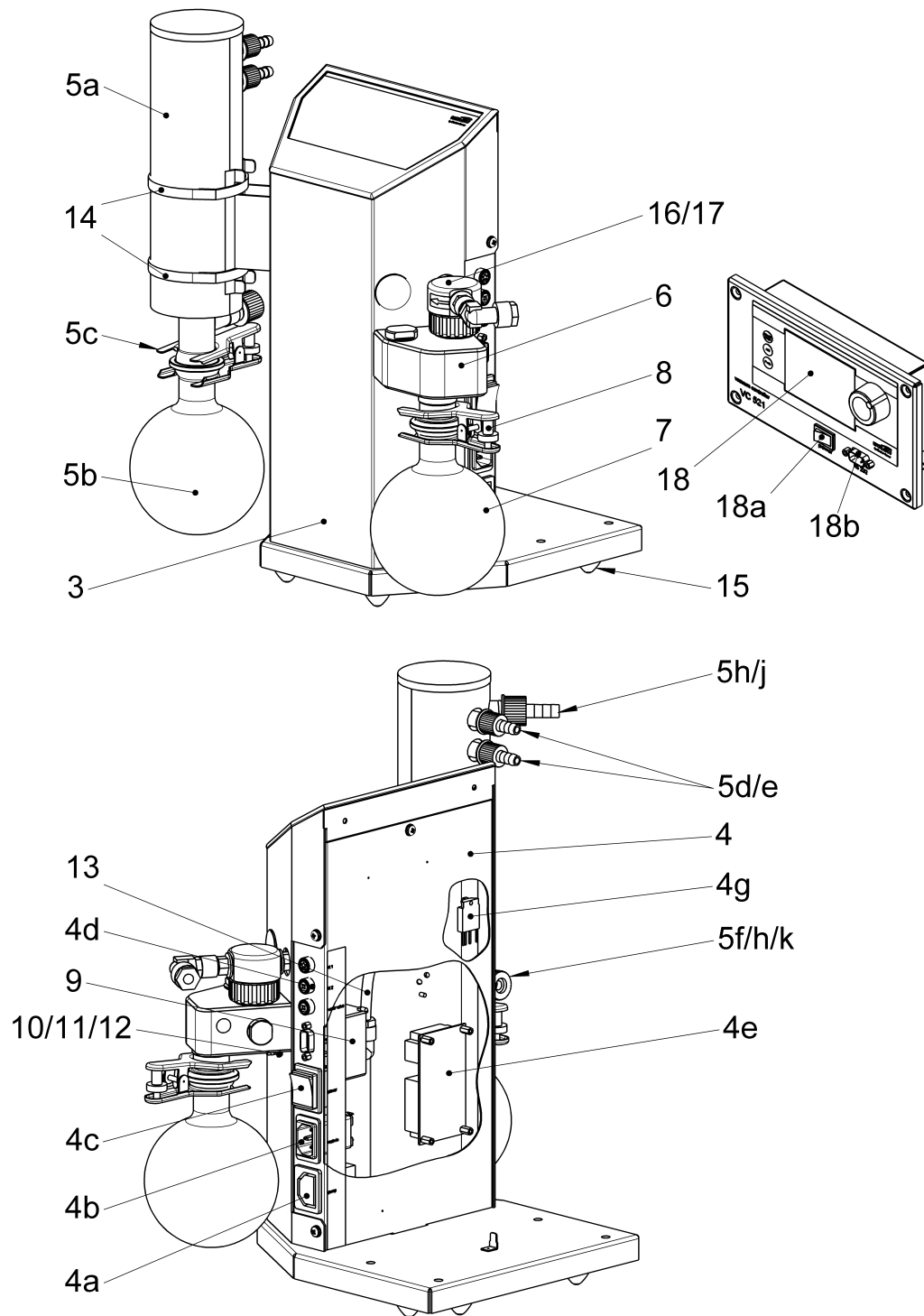


Fig. 18 Front- and rear unit - LVS 610 T ef extern (without item no. 1 and 2)

The **LVS 610 T ef extern** (order no. 115254-04) is supplied with a controller which could, for example, be installed in the rear wall of a laboratory. The installation and connection are described in *chapter 3.1.4*. This eliminates the control panel on the top of the column. It is operated from the external controller as described in the *chapter 6*.

Spare Parts Overview

Spare parts list - LVS 610 T ef, ecoflex - extern

Item no.	Designation	Piece	LVS 610 T ef extern
			Order no. 115254-04
			Order no.
1	Diaphragm pump MPC 601 T (115/230V) (consisting of: – see chapter 9.6)	1	412943-05
	- Mains connection cable IEC + plug CEE (D)	1	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878
2	Threaded elbow joint PVDF, 10 – ¼"	1	829984
3	Column 10 complete (consisting of pos. 4 – 17)	1	115502-18
4	Rear panel 10 complete (consisting of pos. 4a – 4d)	1	115503-09
4a	- Socket for non-heating apparatus	1	825274-7
4b	- Device plug combination with system filter	1	825297
4c	- Switch green 2 pole	1	825184
4d	- Sub miniature round plug - flange box 4 pole	2	825277-1
	- Sub miniature round plug - flange box 5 pole	1	825271-1
4e	- NT-switch power pack 24 V	1	827400-5
4g	- Load relay	1	825741
5	Emission condenser complete KD 500/5 (consisting of pos. 5a – 5k)	1	700183-08
5a	- Intensive cooler with isolation	1	720480
5b	- Round-bottomed flask 500 ml – KS 35	1	828839
5c	- Ball and socket clamp – KS 35	1	828845
5d	- Screw cap GL 14	2	828872
5e	- Hose nozzle GL 14	2	828872-1
5f	- Safety valve	1	100838-01
5g	- Vacuum hose PTFE, 10/ 8x1 (sold by the metre)	0.15 m	828332
5h	- Screw cap GL 18	2	828876
5j	- Hose nozzle GL 18	1	828876-1
5k	- Silicon sealing GL 18	1	828876-2
6	Valve seat complete	1	113522
7	Round-bottomed flask 500 ml – KS 35	1	828839
8	Ball and socket clamp – KS 35	1	828845
9	Sensor – built-in controller	1	620052-17
10	Screw in socket amended	1	160537
11	Screw in socket	1	828791
12	Distance piece M5/M5	1	160529
13	Silicone hose I Ø 3 x 1.5 mm	0.2 m	H100086
14	Retaining strap 70 – 75 mm	2	824130
15	Rubber metal-pad	6	829138-1
16	Vacuum connection point VVC-M5 + KR-A10	1	700418-05
17	Straight threaded joint with seal edge PVDF, 8 – 1/4"	1	829919-1
18	Built-in Controller VC 521 complete (consisting of pos. 18a – 18e)	1	600052-06
18a	- Switch green 2 pole	1	825186-3
18b	- Sub-D connector 9 pole with connection cable	1	825275-6
18c	- Sub miniature round plug – coupling plug 5 pole	1	825271
18d	- Sub miniature round plug – coupling plug 4 pole	1	825277
18e	- Sub miniature round plug – cable box 4 pole	1	825277-2

9.5 Spare parts – Laboratory-Vacuum-Systems, economic

Spare parts view LVS 610 T en

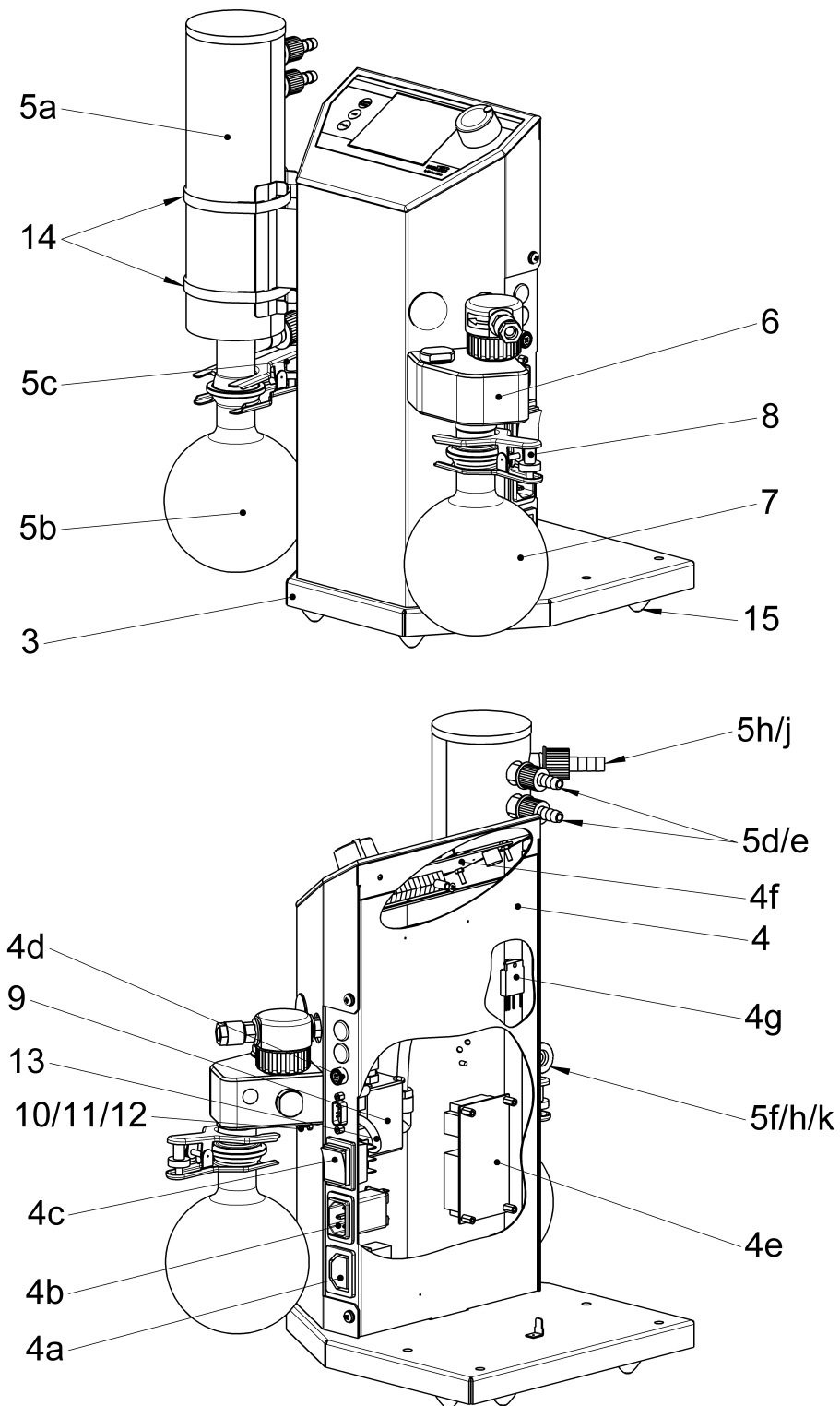


Fig. 19 Front- and rear unit - LVS 610 T en (without item no. 1 and 2)

Spare Parts Overview

Spare parts list - LVS 610 T en, economic

Item no.	Designation	Piece	LVS 610 T en
			Order no.
			115258 115258-01
			Order no.
1	Diaphragm pump MPC 601 T (230V) (consisting of: – see chapter 9.6)	1	412743-05
	- Mains connection cable IEC + plug CEE (D)	1	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878
	Diaphragm pump MPC 601 T (115V) (consisting of: – see chapter 9.6)	1	412743-06
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903
2	Threaded elbow joint PVDF, 10 – ¼"	1	829984
3	Column 11 complete (consisting of pos.: 4 – 16)	1	115502-21
4	Rear panel 8 complete (consisting of pos.: 4a – 4g)	1	115503-07
4a	- Socket for non-heating apparatus	1	825274-7
4b	- Device plug combination with system filter	1	825297
4c	- Switch green 2 pole	1	825184
4d	- Sub miniature round plug - flange box 4 pole	1	825277-1
4e	- NT-switch power pack 24 V	1	827400-5
4f	- Circuit board 521	1	827429
4g	- Load relay	1	825741
5	Emission condenser complete KD 500/5 (consisting of pos. 5a – 5k)	1	700183-08
5a	- Intensive cooler with isolation	1	720480
5b	- Round-bottomed flask 500 ml – KS 35	1	828839
5c	- Ball and socket clamp – KS 35	1	828845
5d	- Screw cap GL14	2	828872
5e	- Hose nozzle GL 14	2	828872-1
5f	- Safety valve	1	100838-01
5g	- Vacuum hose PTFE, 10/ 8x1 (sold by the metre)	0.15 m	828332
5h	- Screw cap GL 18	2	828876
5j	- Hose nozzle GL 18	1	828876-1
5k	- Silicon sealing GL 18	1	828876-2
6	Valve seat complete	1	113522
7	Round-bottomed flask 500 ml – KS 35	1	828839
8	Ball and socket clamp – KS 35	1	828845
9	Sensor – built-in controller	1	620052-17
10	Screw in socket amended	1	160537
11	Screw in socket	1	828791
12	Distance piece M5/M5	1	160529
13	Silicone hose I Ø 3 x 1.5 mm	0.2 m	H100086
14	Retaining strap 70 – 75 mm	2	824130
15	Rubber metal-pad	6	829138-1
16	Vacuum connection point VVC-M5 en	1	700418-07

9.6 Spare parts - Diaphragm pumps

Spare parts view MPC 601 T for LVS

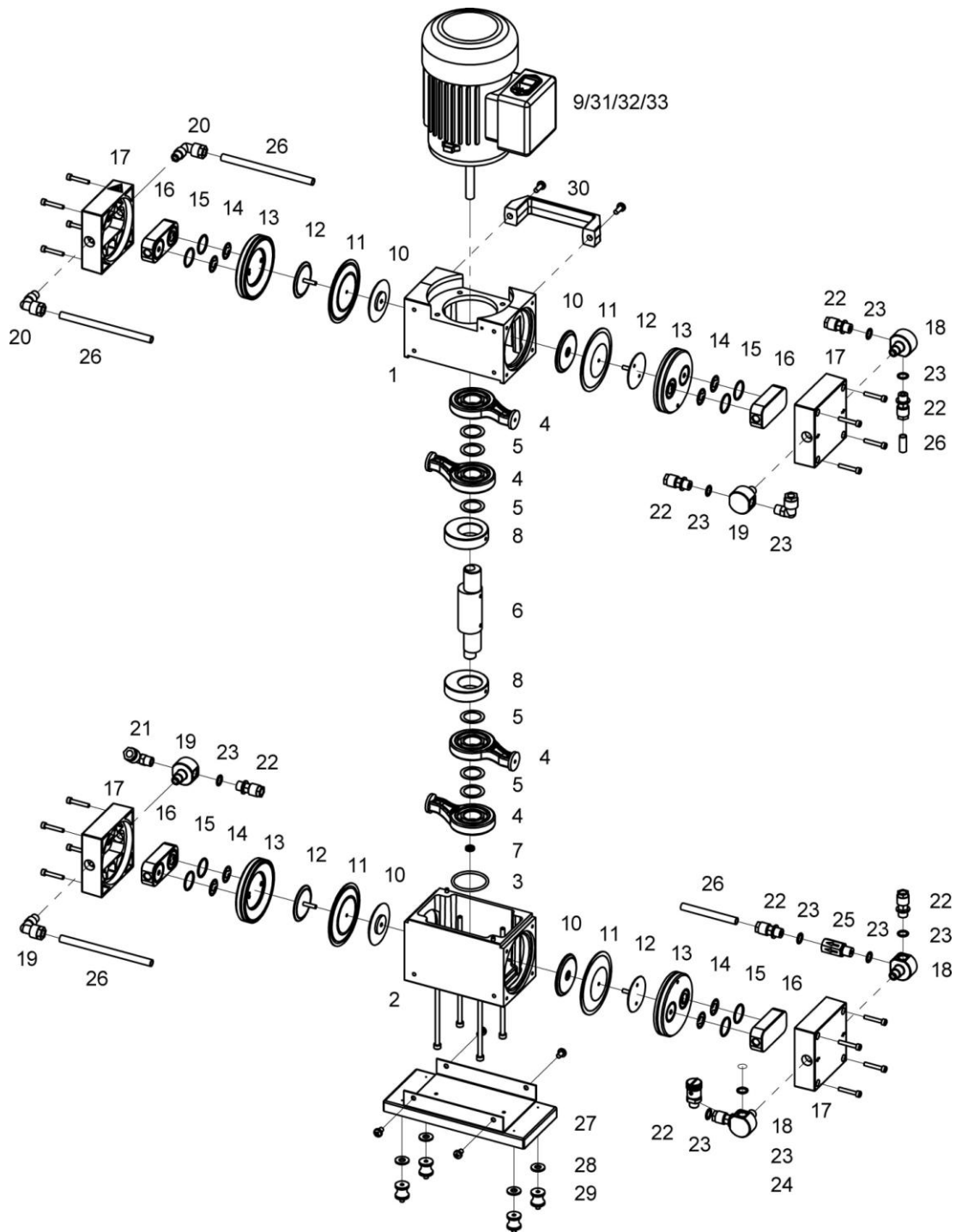


Fig. 20 Exploded view - diaphragm pump

Spare Parts Overview

Spare parts list - MPC 601 T for LVS

Item no.	Designation	Piece	230 V	115 V	100 V	115 / 230 V
			Order no. 412743-05	Order no. 412743-06	Order no. 412743-09	Order no. 412943-05
			Order no.	Order no.	Order no.	Order no.
- *)	Basic pump complete (consisting of position: 1 – 9)	1	410403	410403-01	410403-02	410403-05
1	Pump casing 1	1	410640-01	410640-01	410640-01	410640-01
2	Pump casing 2		400640-3	400640-3	400640-3	400640-3
3	O-ring Ø 47.22 x 3.53	1	829269	829269	829269	829269
-	Drive complete (consisting of position: 4 – 8)	1	400844	400844	400844	400844
4	Piston rod with ball bearing	4	400647-01	400647-01	400647-01	400647-01
5	Close tolerance spacer 25x35x1	6	824957-1	824957-1	824957-1	824957-1
6	Eccentric shaft	1	400742-1	400648	400648	400648
7	Ball bearing	1	824949-3	824949-3	824949-3	824949-3
8	Mass balance	2	400678-1	400678-1	400678-1	400678-1
9	Alternating-current motor	1	826390-1	826446-1	826446-2	-
	Alternating-current motor with frequency converter	1	-	-	-	826390-01
	AC – Axial fan	1	-	-	-	829851-3
10	Pressure washer	4	400680	400680	400680	400680
11	Diaphragm	4	400732	400732	400732	400732
12	Tensioning washer	4	400707	400707	400707	400707
13	Pump head	4	400705-02	400705-02	400705-02	400705-02
14	Valve	8	400656	400656	400656	400656
15	O-ring EPDM ø 25 x 2	8	829250-1	829250-1	829250-1	829250-1
16	PTFE insert	4	400902	400902	400902	400902
17	Connection head	4	410432	410432	410432	410432
18	Distributor 2	3	400903	400903	400903	400903
19	Distributor 4	2	400911	400911	400911	400911
20	Threaded elbow joint 10 PVDF, M12 x 1	3	829972	829972	829972	829972
21	Threaded elbow joint PVDF, 10 – ¼"	2	829984	829984	829984	829984
22	Straight threaded joint with seal edge PVDF, 10 – ¼"	7	829931	829931	829931	829931
23	O-ring EPDM ø 12 x 2	2	829217-3	829217-3	829217-3	829217-3
24	Gas ballast valve	1	400599-01	400599-01	400599-01	400599-01
25	Check valve PVDF, 8	1	829909	829909	829909	829909
26	Vacuum hose PTFE 10 / 8x1 mm	0.6 m	828332	828332	828332	828332
27	Pump bracket complete	1	115515	115515	115515	115515
28	Washer	4	112538	112538	112538	112538
29	Rubber metal-pad	4	829139	829139	829139	829139
30	Handle	1	828634	828634	828634	828634
31	Sub miniature round plug – coupling plug, 4 pole	1	-	-	-	825277
32	Cold device extension IEC	1	825882-1	825882-1	825882-1	-
33	Mains connection with firm cold device plug	1	-	-	-	825882

*) The "basic pump" module (items 1 – 9) can only be supplied complete under order number 410403, 410403-01, 410403-02 or 410403-05.

Instructions for ATEX Certification

- Laboratory-Vacuum-Systems LVS / LVSF -

for use in Zone 2 in accordance with device category 3

per ATEX Directive 2014/34/EU

« EX II 3G IIC T3X »

Internal atmospheres only

1. Type test – Effects of the ATEX Directive

Thanks to its design this device meets the requirements imposed upon devices of device group II and device category 3 in conformity with Directive 2014/34/EU of the European Parliament and Council dated 26 February 2014 on the harmonisation of the legislation and administrative regulations of the member states with regard to devices and protection systems for use in atmospheres capable of being ignited. According to the regulations for category 3, these devices are intended to be connected to apparatus in which in normal operation a mixture of gases or vapours capable of being ignited does not normally occur or with a high probability does so only seldom and briefly.

The following instructions absolutely must be observed when using these devices.

- Because of the identical construction in principle of the devices of category 2 certified by IBExU (notified body), these studies relating to the internal space are used for illustration purposes.

This certification relates to the following device models:

The certification is a type test per Directive 2014/34/EU. It relates to all the devices of the manufacturer "Gardner Denver Thomas GmbH" with the designation "EX II 3G IIC T3X."

In the specific case these are devices with the following type designations:

➤ **LVS / LVSF...**

with a diaphragm diameter the diaphragm pump of 75 mm, 95 mm and 97 mm. (Annex III)

E = one-stage:	600; 1200; 1201; 2401; 2410ef
Z = two-stage:	101; 110; 300; 301; 302; 310; 311; 320; 901; 910; 1801
T = three-stage:	201; 210; 600; 601; 602; 610; 611; 620; 1210; 1210ef
V = four-stage:	301ef

The certification relates to all versions including those that vary from the basic types.
A precondition here is that the internal area in contact with the gas has not been changed.

Key:

- LVS / LVSF - Designation
- EX - ATEX Directive 2014/34/EU
- 03 - Device category 3
- 01 - Serial number of the internal certification

Instructions for ATEX Certification

The "EX II 3G IIC T3X" certification is valid only for the internal space in contact with the medium and the transport of gases and vapours. Installation and operation of the devices in an atmosphere capable of being ignited is not permitted.

The user should note that if accessories or components are added, the use of the above-mentioned devices in plant entails recertification to ATEX. In this event, the certification of the Gardner Denver Thomas GmbH devices lapses.

According to the definition in DIN "Device Category 3", these devices are designed for use where in normal operation a mixture of gases or vapours capable of being ignited does not normally occur or with a high probability does so only seldom and briefly.

The use of built-in gas ballast valves or other devices for the intake of air to check for leaks is only permitted if this does not generate any mixtures capable of being ignited in the internal space of the device.

Restrictions on the operating conditions as a result of designating the devices with an "X" (in accordance with EN 13463-1 see Assessment of the risk of ignition).

- Devices are to be installed in such a manner that they cannot be damaged, heat is conducted away and visual monitoring is possible.
- The tolerances relating to ambient and gas intake temperatures in the operating instructions are to be observed.
- After maintenance or repair work has been carried out, the device concerned must be subjected to an appropriate inspection. The final vacuum stated in the documentation and a test on the seal of the internal space of the device are to be checked.
The tested leak rate may not be under 0.5×10^{-2} mbar x litres/sec.

2. Definition of explosive atmosphere

An atmosphere capable of being ignited is a mixture of air and combustible substances in the form of gases, vapours, mists or dust under atmospheric conditions in which, following ignition, the combustion process is transferred to the entire uncombusted mixture.

3. Area with a risk of explosion

By an area with a risk of explosion is meant an area in which the atmosphere may be capable of being ignited because of the local and operating conditions.

Note:

The allocation of hazardous areas is a matter for the user.

4. Legal requirements for the manufacturer

Directive 2014/34/EU Legal requirements for the manufacturer are set out in:

- National implementation of the EX Decree
- DIN EN 1127-1
- DIN EN 50014-x
- DIN EN 13463-x
- IEC EN 60079-x
- IEC EN 61241-x

5. Legal requirements for the operating company

Directive 1999/92/EC (ATEX 137) Legal requirements for the operating company are set out in:

- Implementation by the Operational Safety Decree
- BGR 104 and BGR 132
- TRBS 2152 /TRGS 720
- TRBS 2152-1 /TRGS 721
- TRBS 2152-2 /TRGS 722

Instructions for ATEX Certification

Key:

- (BGR - Trade association regulations
- TRBS - Technical regulations for operational safety
- TRGS - Technical regulations for hazardous substances)

6. General concepts regarding the operating company

The operating company is responsible for:

- Performing an assessment of the existing zone
- Selecting the appropriate operating equipment in the relevant device category
- Observing the installation regulations
- Ensuring compliance with safety requirements
- Producing the explosion protection document
- Observing the procedure for checking the safety measures.

7. Legal requirements

Further legal requirements are to be found in Directive 98/24/EC and Ordinance on Hazardous Substance Decree §12.

8. Surface temperature

The maximum permitted surface temperature of the devices is allocated to classes T1 to T6.

The permitted temperature for the stated temperature class T3 is 200°C.

The user must perform the assessment of the individual substances with regard to their ignition temperature on the basis of his knowledge.

9. Conformity assessment

The conformity assessment for devices of category 3 of device group II and “EX II 3G IIC T3 X” certification is conducted by the in-house Production Inspection in accordance with the specifications set out in the documentation. Individual inspections are to be conducted. A complete record of the results for every device is to be stored in the PPS system.

Maintenance and repair


After repair or maintenance work has been carried out, the pump must be subjected to an inspection. One inspection criterion is final pressure. If this is reached, it may be assumed that the leakage of the device lies within the required tolerance. This ensures that there is no mixture capable of being ignited within the internal space of the pump.

10. Technical documents for the EC type test

1. Risk assessment
2. Test certificate
3. Internal inspection and production inspection of the products
4. Declaration of conformity (CE)
5. Designation on the rating plate
6. Additional statement in the valid operating instructions on the usability of the MPC types as devices of category 3 in zone 2 (Internal atmospheres only).

EG - Konformitätserklärung

EC Declaration of Conformity / CE Déclaration de Conformité

DE:		Gardner Denver Thomas GmbH Am Vogelherd 20 98693 Ilmenau Germany	T +49 3677 604 0 F +49 3677 604 131 welch.emea@gardnerdenver.com www.gardnerdenver.com/de-de/welch
Hiermit erklären wir			

unter eigener Verantwortung, dass nachstehendes Produkt aufgrund seiner Konzipierung und Bauart sowie in den von uns in Verkehr gebrachten Unterlagen den nachfolgend aufgeführten EG-Richtlinien und Normen entspricht.
Bei einer nicht mit uns abgestimmten Änderung des Produkts verliert diese Erklärung ihre Gültigkeit.

EN:	We (Gardner Denver Thomas GmbH) herewith declare under our sole responsibility that the product described below is in accordance with the following Directives standards and other technical specifications regarding design and version when delivered from our factory. This declaration becomes invalid whenever the product has been modified without our consent.
FR:	Nous (Gardner Denver Thomas GmbH) certifions par la présente, que le produit décrit ci-après est conforme, tant dans sa conception que dans sa réalisation, aux normes de sécurité et d'hygiène exigées par les standards de la CE. En cas de modification du produit sans notre accord, cette déclaration devient caduque.

Bezeichnung des Produkts (Pumpen / Pumpstände) Description of product (pumps / pump systems) Description du produit (pompes / pompe systèmes)	Labor-Vakuum-Systeme/Laboratory-Vacuum-Systems/Systèmes de laboratoire à vide LVS 600T, LVS 601T, LVS 602T, LVS 610T, LVS 611T, LVS 610T ef, LVS 610T ef extern, LVS 610T en, LVS 1200 E, LVS 1201 E netvac 1, LVS 1210 E ef
Artikel-Nr. / Fabrication No. / No. de fabrication	115051, 115051-01, 115051-05, 115057, 115057-01, 115057-02, 115057-03, 115057-05, 115057-10, 115052-11, 115052-12, 115053, 115053-01, 115053-05, 115054, 115054-01, 115054-03, 115054-06, 115055, 115055-01, 115055-05, 115254, 115254-01, 115254-03, 115254-04, 115258, 115258-01 115081-01, 115082-02, 115282

Das Produkt entspricht folgenden Richtlinien und Normen: / The product is in conformity with the following Directives and standards: / Le produit est conforme aux directives et standards suivants:

X	2006/42/EG	Maschinenrichtlinie / EC machinery directive / directive CE sur les machines (17.05.2006)
X	2014/34/EU	ATEX-Richtlinie für Verwendungen in explosionsgefährdeten Bereichen, Anhang III / ATEX Directive for applications in hazardous areas, Annex III
X	2014/30/EU	Elektromagnetische Verträglichkeit / EC Electromagnetic Compatibility Directive / Directive CE relative à la compatibilité électromagnétique
X	2011/65/EU	Gefährliche Stoffe in Elektro- und Elektronikgeräten (RoHS II) / Dangerous materials in electrical and electronics devices (RoHS II) / Substances dangereuses dans les appareils électriques et électroniques (RoHS II)
X	2012/19/EU	Elektro- und Elektronik - Altgeräte (WEEE) / Electrical and electronics - old devices (WEEE) / Électro et électronique - appareils de contralto (WEEE)
X	China - RoHS II	Umweltschutzgesetz - China 2016-01 / Environment protection law / Loi sur la protection de environnement

Angewandte harmonisierte Normen: / Applied harmonized standards: / Standards appliquées et harmonisées:

X	DIN EN 1127-1: 2011-10	Explosionsfähige Atmosphären - Explosionsschutz - Teil 1: Grundlagen und Methodik / Explosive atmospheres - Explosion prevention and protection - part 1: Basic concepts and methodology / Atmosphères explosives - Protection contre les explosions - partie 1: prescriptions et méthodologie
X	DIN EN 13463-1: 2009-07	Nicht-elektrische Geräte für den Einsatz in explosionsgefährdeten Bereichen - Teil 1: Grundlagen und Anforderungen / Non-electrical equipment for use in potentially explosive atmospheres - part 1: Basic method and requirements / Appareils non électriques destinés à être utilisés en atmosphères explosibles - partie 1: prescriptions et méthodologie
X	DIN EN 13463-5: 2011-10	Nicht-elektrische Geräte für den Einsatz in explosionsgefährdeten Bereichen - Teil 5: Schutz durch konstruktive Sicherheit „c“ / Non-electrical equipment for use in potentially explosive atmospheres - part 5: Protection by constructional safety „c“ / Appareils non électriques destinés à être utilisés en atmosphères explosibles - partie 5: protection par sécurité de construction „c“
X	DIN EN ISO 12100: 2011-03	Sicherheit von Maschinen - Allgemeine Gestaltungsleitsätze Risikobeurteilung und Risikominderung / Safety of machinery - General principles for design / Risk assessment and risk reduction / Sécurité des machines - / Principes généraux pour l'évaluation des risques et la réduction des risques
X	DIN EN ISO 13857: 2008-06	Sicherheit von Maschinen - Sicherheitsabstände gegen das Erreichen von Gefährdungsbereichen mit den oberen und unteren Gliedmaßen / Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs / Sécurité des machines - Distances de sécurité empêchant les membres supérieurs et inférieurs d'atteindre les zones dangereuses
X	DIN EN 1012-2: 2011-12	Kompressoren und Vakuumpumpen - Sicherheitsanforderungen - Teil 2: Vakuumpumpen / Compressors and vacuum pumps - Safety requirements - part 2: Vacuum pumps / Compresseurs et pompes à vide - Exigences de sécurité - partie 2: pompes à vide
X	DIN EN ISO 2151: 2009-01	Akustik - Geräuschmessnorm für Kompressoren und Vakuumpumpen - Verfahren der Genauigkeitsklasse 2 / Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2) / Acoustique - norme de mesure des émissions pour les compresseurs et les pompes à vide - Procédé de classe de précision 2
X	DIN EN 60204-1: 2014-10	Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen / Safety of machinery - Electrical equipment of machines - part 1: General requirements / Sécurité des machines - Equipement électrique des machines - partie 1: Prescriptions générales
X	EN 61000-6-2: 2011-06	Elektromagnetische Verträglichkeit (EMV) - Teil 6-2: Fachgrundnormen - Störfestigkeit für Industriebereiche / Electromagnetic compatibility (EMC) - part 6-2: Generic standards - Immunity for industrial environments / Compatibilité électromagnétique (EMV) - partie 6-2: Normes génériques - Immunité pour les environnements industriels
X	EN 61000-6-4: 2011-09	Elektromagnetische Verträglichkeit (EMV) - Teil 6-4: Fachgrundnormen - Störaussendung für Industriebereiche / Electromagnetic compatibility (EMC) - part 6-4: Generic standards - Emission standard for industrial environments environments / Compatibilité électromagnétique - partie 6-4: Normes génériques - Emissions de parasites pour les activités industrielles
X	DIN EN 50110-1: 2014-02	Betrieb von elektrischen Anlagen / Operation of electrical installations / Fonctionnement des installations électriques
X	DIN EN 61010-1/A1:2015-04	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte - Teil 1: Allgemeine Anforderungen / Safety requirements for electrical equipment for measurement, control and laboratory use - part 1: General requirements / Consignes de sécurité pour les appareils électriques de mesure, de commande, de régulation ou de laboratoire - partie 1: Prescriptions générales

Bevollmächtigter Vertreter mit Sitz in der Europäischen Gemeinschaft und Person, die befugt ist, die technischen Unterlagen zu erstellen. /
Authorized representative established in the European Community and person, who is authorized to compile the technical file. /
Représentant autorisé établi dans la Communauté européenne et personne autorisée à établir la documentation technique.

Gardner Denver Thomas GmbH Am Vogelherd 20 98693 Ilmenau / Germany	Datum / Data Baujahr / Year of manufacture / Année de fabrication	2019-08-19
Werksleiter / Plant manager / <i>Directeur d'usine</i>	Name / Name / Nom Robert Götz	