

**Operation Manual** (EN)  
Translation of the german original manual

# Laboratory-Vacuum-Systems

Ultimate pressure < 2 mbar

## Models:

- ▶ manual regulated  
LVS 201 T
- ▶ automatic regulated  
LVS 210 T
- ▶ ecoflex  
LVS 210 T ef
- ▶ economic  
LVS 210 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:

<b>2006 / 42 / EC</b>	Machinery Directive
<b>2014 / 30 / EU</b>	Electromagnetic Compatibility Directive
<b>2014 / 34 / EU</b>	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 8 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:

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

## 1.7 Product Standards, Safety Regulations

Laboratory-Vacuum-Systems meet the following product standards:

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


The following additional safety regulations apply in the FR Germany:

<b>BGV A3</b>	Electrical equipment and operating materials
<b>VBG 5</b>	Power-driven machines
<b>BGR 120</b>	Guidelines for laboratories
<b>BGI 798</b>	Hazard assessment in the laboratory
<b>BGG 919 (VBG 16)</b>	Accident prevention regulations for "compressors"
<b>BGR 189 (BGR 195;192;197)</b>	Use of protective working clothes

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

## 2 Basic Safety Instructions

### 2.1 General Information

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

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 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 BGV A2 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 VDE 0100-410 (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 VDE 0100-410.

# 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.

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

**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
- + 60 °C for 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 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 substances),
- 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 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.

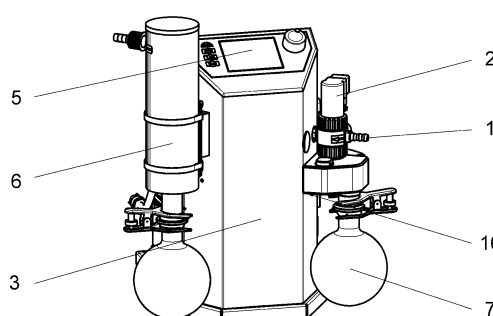
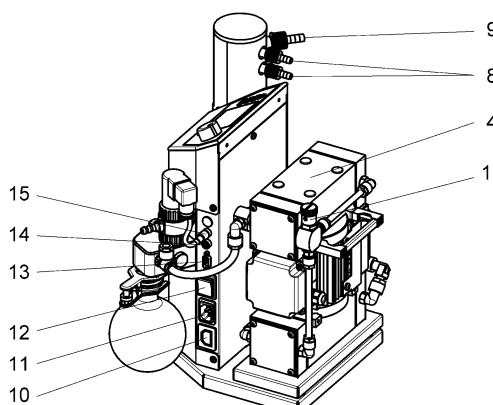
1	<b>Pressure side connection</b> hose nozzle for hose DN8	
2	<b>Control valve</b> (LVS - automatically regulated)	
3	<b>Column complete</b> on swivelling foot	
4	<b>Diaphragm pump MPC 201 T</b>	
5	<b>Vacuum controller 521</b>	
6	<b>Emission condenser KD 500/5 insulated</b> at the pressure side with safety valve and cooling water connections	
7	<b>Separator</b> (round-bottomed flask) suction side	
8	<b>Cooling water</b> (feed flow/back flow)	
9	<b>Connection outgoing air</b> hose nozzle for hose DN8	
10	<b>Connection Pump</b> (pump)	
11	<b>Connection non-heating device power cable</b> (main in)	
12	<b>Main switch</b> (power)	
13	<b>Connection PC</b> (RS 232)	
14	<b>Connection control cable</b> LVS - automatically regulated (sensor)	
15	<b>Connection water valve</b>	
16	<b>Connection inert gas</b>	
17	<b>Gas ballast valve</b>	

Fig. 1a LVS 210 T - Front view

Fig. 1b LVS 210 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 <sup>*)</sup>

<sup>\*)</sup> 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.

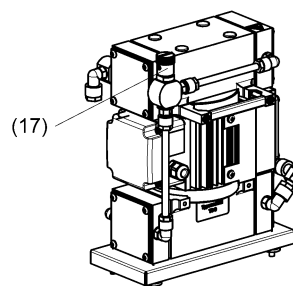


Fig. 2 Diaphragm pump MPC 201 T

## Description

### 3.1.3 Vacuum Controller 521

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 are to be found *in chapter 6* of this operating manual.

The Laboratory Vacuum Systems is supplied with complete internal electric wiring.

► **Technical data:** see chapter 4.3.1

## 3.2 Overview of the variants

Part	Laboratory-Vacuum-Systems LVS			
	Piece per LVS			
	201 T	210 T	210 T ef	210 T en
Suction side connections for hose DN8	1 manually regulated	1 automatically regulated	1 ecoflex regulated	1 economic regulated
Control valve	-	1	-	-
Column complete	1	1	1	1
Diaphragm pump	1	1	1	1
Vacuum controller	-	1 (cv)	1 (ef)	1 (en)
Emission condenser	1	1	1	1
Separator	1	1	1	1
Pressure side connection for hose DN8	1	1	1	1
Frequency changer	-	-	1	-
<b>Special variants</b> , additional with:				
- Dial gauge (analog / digital)	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 around 2 mbar without using the lubricant oil

► **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.

## 3.5 Examples of application

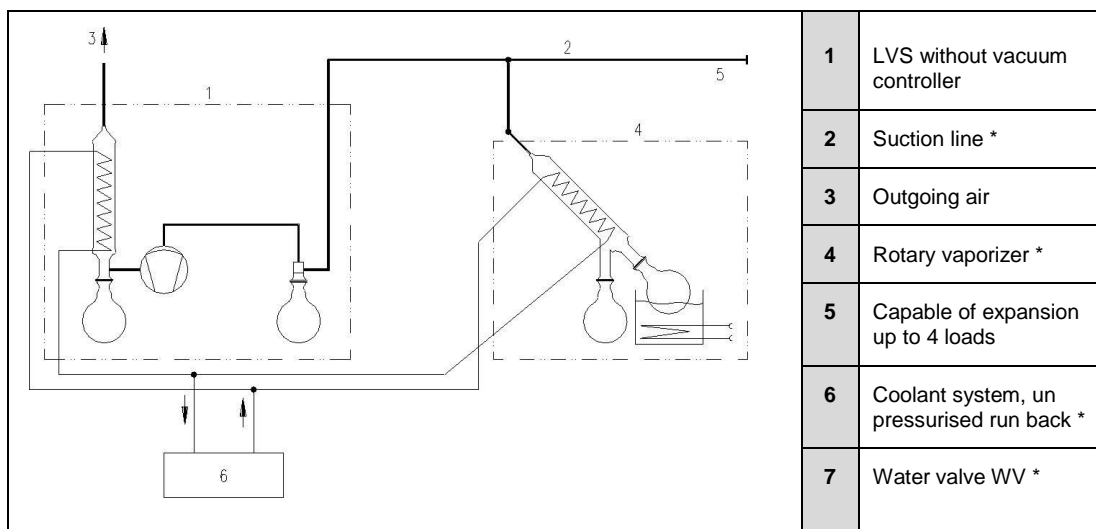


Fig. 3 Example of application - LVS manually regulated

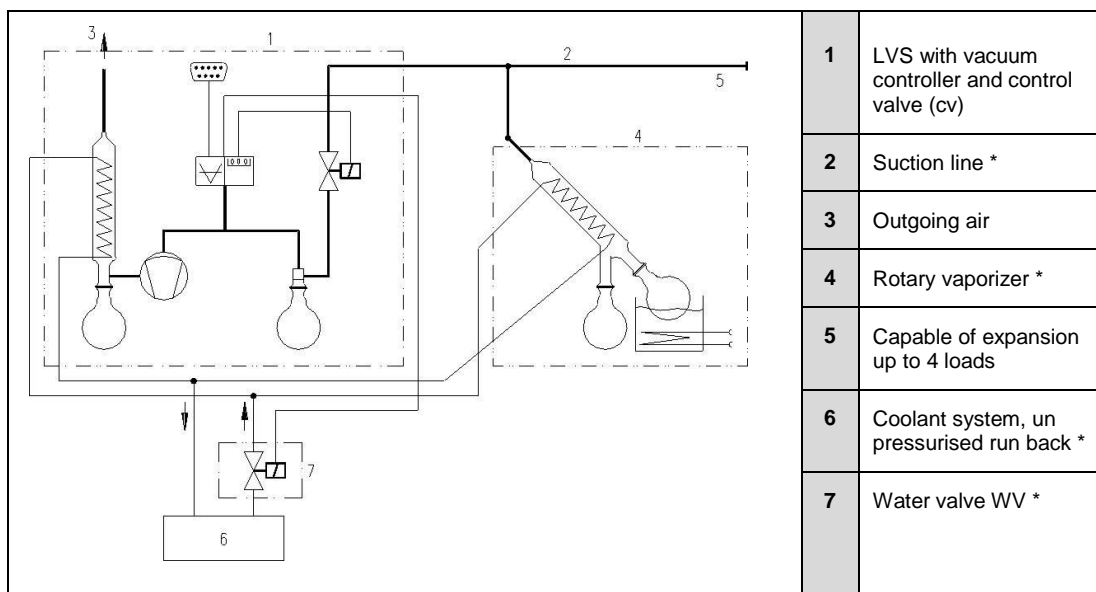


Fig. 4 Example of application – LVS „cv“ (Control valve) automatically regulated

\* Not included in the scope of delivery

## Description

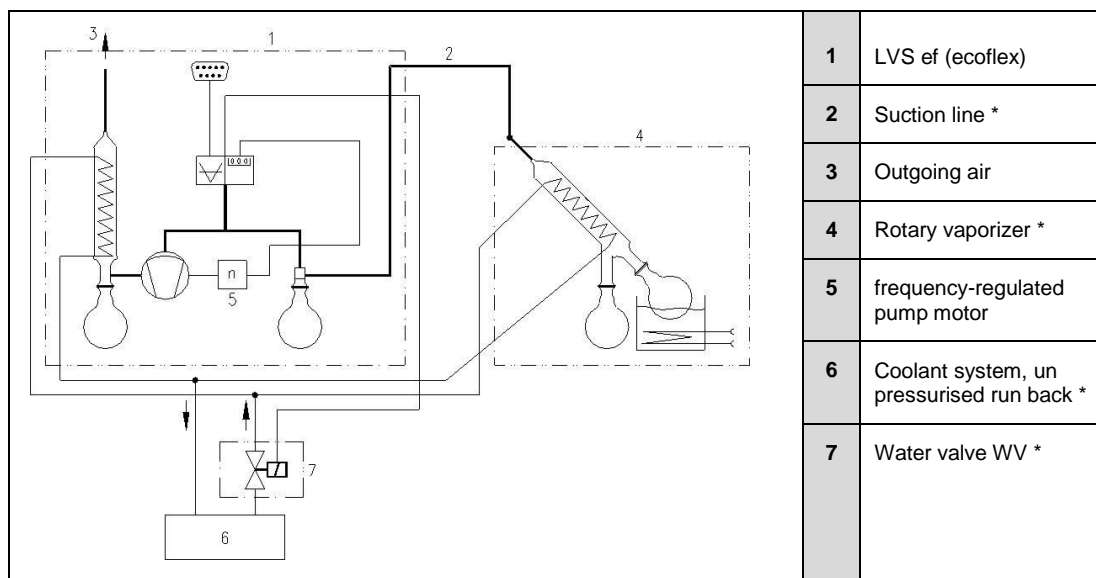


Fig. 5 Example of application – LVS „ef“ ecoflex

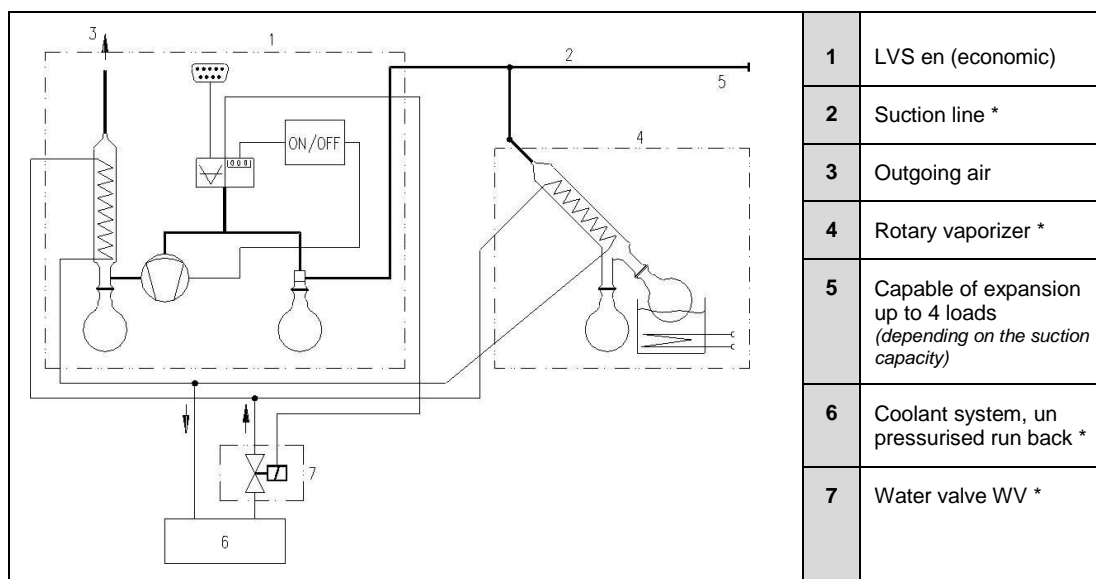

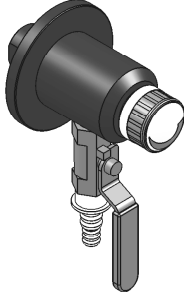
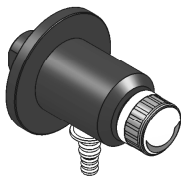




Fig. 6 Example of application – LVS „en“ economic

	<b>CAUTION !</b>
<p>The economic Laboratory Vacuum System "LVS ... en" is suitable for slow processes and central laboratory supplies using a large hysteresis (&lt; 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>	

### 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.

	<b>netvac +</b>		
	<b>Set BC1 - 63</b>	<b>Order no. 700563</b>	<i>for mounting on wood furniture</i>
	<b>Set BC2 - 63</b>	<b>Order no. 700563-01</b>	<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 / 82 mm  Mounting hole: Ø 25 to Ø 35 mm</p>		
	<b>netvac +</b>		
	<b>Set BC1 - 62</b>	<b>Order no. 700562</b>	<i>for mounting on wood furniture</i>
	<b>Set BC2 - 62</b>	<b>Order no. 700562-01</b>	<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>		
	<b>Vacuum Control-Box</b>		
	<b>VCB 521 cv</b>	<b>Order no. 600053</b>	
	<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>		
	<b>Operating software „WELCH-Control 521“</b>		
	<b>on CD</b>	<b>Order no. 620637</b>	
	to connect the vacuum controller to the PC		

## Description

	<b>Water valve</b>	
	<b>WV 2</b>	<b>Order no. 700300-02</b>
	<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>	
	<b>Hose nozzle with FKM - O-Ring</b>	
	<b>DN 10</b>	<b>Order no. 710955</b>
	<p>Material: PP Male thread: 1/4"</p>	
	<b>Inlet fitting</b>	
	<b>DN 16 KF</b>	<b>Order no. 710116</b>
	<p>Material: PP Male thread: 1/4"</p>	
	<b>Vacuum hose</b>	
	<b>10 / 8x1</b>	<b>Order no. 828332</b>
	<p>Material: PTFE Please state the length you want to order!</p>	
	<b>Vacuum hose</b>	
	<b>18 / 8x5</b>	<b>Order no. 828310-4</b>
	<p>Material: Rubber, red Please state the length you want to order!</p>	
	<b>Mains connection cable IEC with plug</b>	
	<b>Type 12 (CH)</b>	<b>Order no. 825877</b>
	<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.

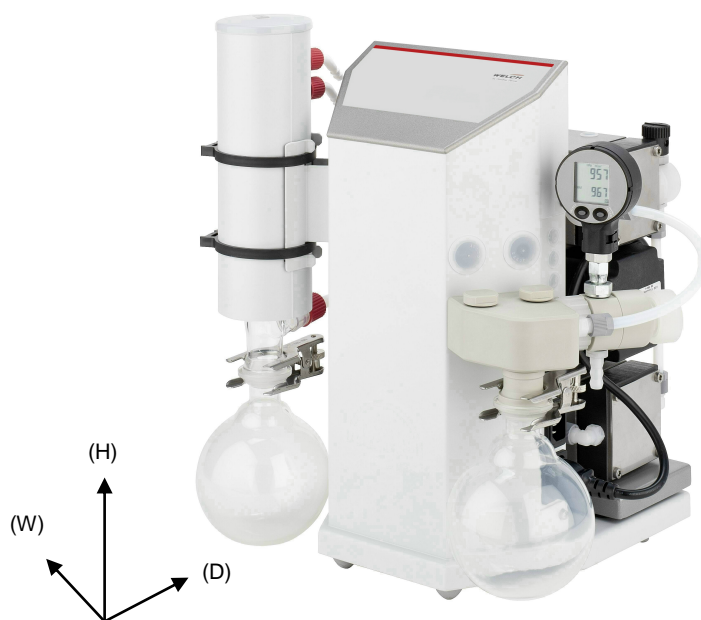


Fig. 7 View of device (LVS 201 T), dimensions see chapter 4.3

### 4.2 Intake Pressure / Pumping Speed – Diagram

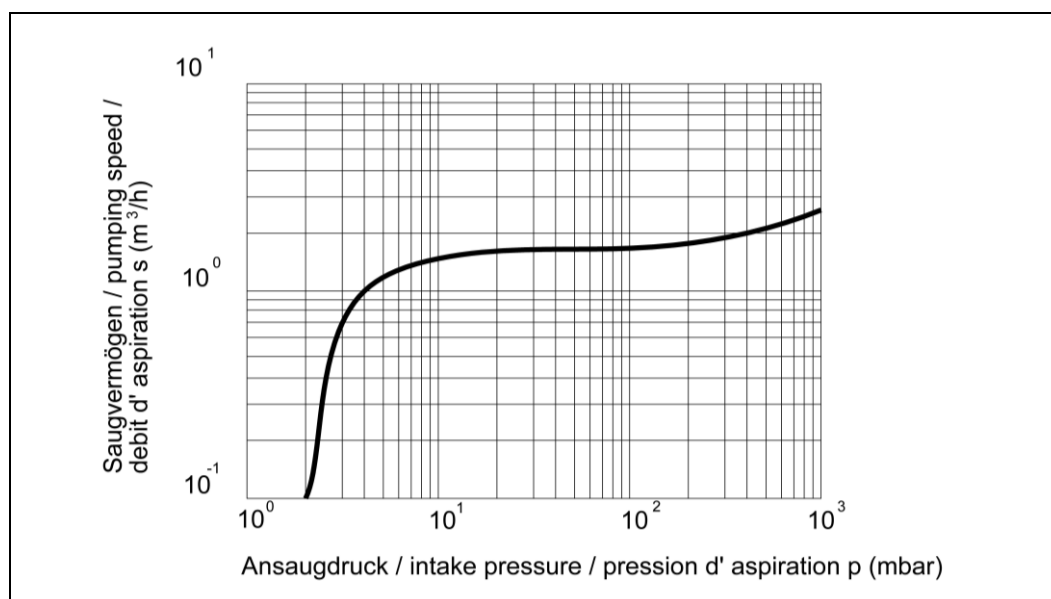



Fig. 8 Intake Pressure / Pumping Speed – Diagram

# Technical Data

## 4.3 Device data

### 4.3.1 Laboratory-Vacuum-Systems

Parameter	Unit	LVS			
		201 T	210 T	210 T ef	210 T en
<b>Pumping speed 50/60 Hz</b> DIN 28432 at speed of 1500 rpm	m <sup>3</sup> / h	1.8 / 2.0	1.8 / 2.0	2.2	1.8 / 2.0
<b>Ultimate pressure</b> at speed of 1500 rpm	mbar	< 2			
<b>Ultimate pressure with gas ballast</b> at speed of 1500 rpm		9			
<b>Max. inlet pressure</b>	bar	1			
<b>Max. outlet pressure</b>		1			
<b>Intake and pressure ports</b>	-	Hose nozzle DN 8 for hose inside diameter 8 mm			
<b>Ambient temperature</b>	°C	+ 10 to + 40			
<b>Max. Operating gas temperature</b>		+ 60			
<b>Bearing</b>	-	maintenance-free			
<b>Reference surface sound pressure level</b> DIN EN ISO 2151	dB (A)	< 44			
<b>Voltage / Frequency</b> (different data upon customer request)	V, Hz	230, 50/60 (115, 50/60) (generally with motor protection switch, switch and cable)			
<b>Power</b>	W	90			
<b>Operating mode</b>	-	S 1			
<b>Type of protection</b> DIN EN 60529		IP 54			
<b>Motor / Class of insulation</b> DIN EN 600034-1		F (160°C)			
<b>Type Examination Certificate no.</b>	-	WELCH_ATEX_03-01			
<b>Designation EX</b>		 II3G IIC T3 X (internal Atm. only)			
<b>Dimensions (W/D/H)</b>	mm	360 / 310 / 445			
<b>Weight</b>	kg	15.0 / 15.3	15.7	19.0	15.8
<b>Order numbers for LVS:</b>					
<i>in 230 V</i> <i>inclusive mains connection cable IEC</i> <i>with plug CEE, UK</i> - LVS ... - LVS ... with dial gauge digital	-	115037 115037-10	115034 -	115234 -	115238 -
		115037-01 115037-11	115034-01 -	115234-01 -	115238-01 -

## 4.3.2 Vacuum Controller 521

Parameter	LVS 210 T	LVS 210 T ef	LVS 210 T en	Unit
<b>Sensor</b>	integrated			
Sensor type	ceramic sensor			-
Measuring range	1 - 1100			mbar
Measuring uncertainty	< ± 0.3 % FS			
<b>Controller</b>				
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	-	Bit
Communication interface	RS 232			-
Power consumption - controller in normal operation	max. 15 (depends upon the control power)			W
Fuse (internal controller)	5			A
<b>Power pack</b>	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
<b>Entire unit</b>				
Protective system	IP 20			-
Working temperature	15 - 40			°C
<b>Connections</b>				
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 suction connector of the LVS to your apparatus with vacuum hose DN8.
- 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.
- Connect the Laboratory-Vacuum-System to the power supply.
- Check that the connections are properly seated.

#### 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 suction and pressure 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 suction-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 suction-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 nozzles. 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 must be unpressurized. The exhaust can be led off through a DN 10 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 suction 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.

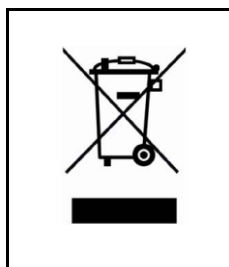
In case of soiling by solid matter, the pump heads must be opened and the entire interior space, including valves and diaphragm, cleaned mechanically (*see chapter 7.2.1*).

### 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 suction and pressure ports. Another equally good protection may be used.

### 5.4 Scrap Disposal



**CAUTION !**

**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.**

## 6 Operation

### 6.1 LVS without vacuum controller

Switch the Laboratory Vacuum System LVS 201 T on using the main switch. Vacuum is generated immediately and without regulation.

### 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.

### 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).

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

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

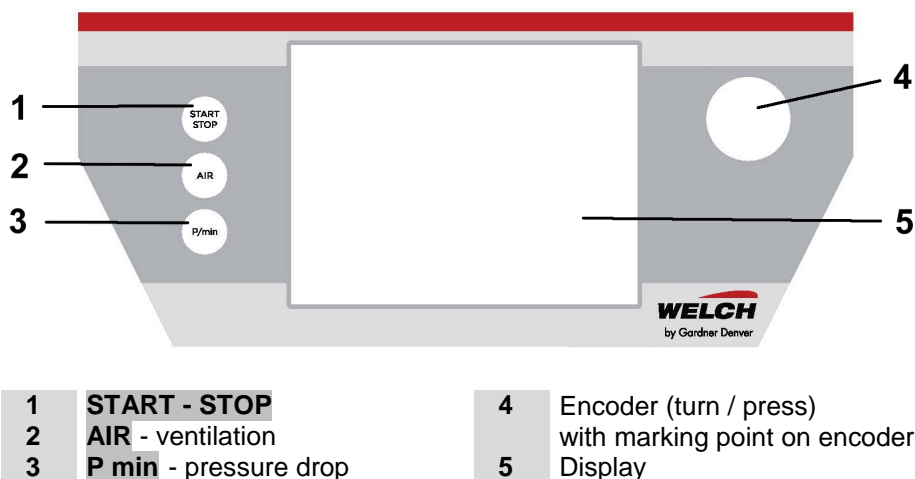


Fig. 9 Control panel

## 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
<b>AIR</b>	- 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.
<b>P min</b>	- Starts "ultimate pressure" mode directly.
<b>START STOP</b>	- 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 6.9</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	<b>VCZ 521</b> <small>V 1.15</small>
Automatic	
Low pressure	
<b>Configuration</b>	
Self cleaning	
P = 960 mbar	

## Configuration: display settings



MAIN-MENU	
Manual	<b>VCZ 521</b> <small>V 1.15</small>
Automatic	
Low pressure	
<b>Configuration</b>	
Self cleaning	
P = 960 mbar	

Configuration	
<b>language</b>	<b>VCZ 521</b> <small>V 1.15</small>
display settings	
pressure unit	
calibrate	
back	
P = 960 mbar	

Configuration	
language	<b>VCZ 521</b> <small>V 1.15</small>
<b>display settings</b>	
pressure unit	
calibrate	
back	
P = 960 mbar	

language	
<b>English</b>	<b>VCZ 521</b> <small>V 1.15</small>
Deutsch	
Français	
Español	
back	
P = 960 mbar	

display settings	
<b>contrast</b>	<b>VCZ 521</b> <small>V 1.15</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

# Operation

## Configuration: pressure unit



MAIN-MENU	
Manual	<b>VCZ 521</b> <small>V 1.15</small>
Automatic	
Low pressure	
<b>Configuration</b>	
Self cleaning	
P = 960 mbar	

## Configuration: calibrate



MAIN-MENU	
Manual	<b>VCZ 521</b> <small>V 1.15</small>
Automatic	
Low pressure	
<b>Configuration</b>	
Self cleaning	
P = 960 mbar	

Configuration	
language	<b>VCZ 521</b> <small>V 1.15</small>
display settings	
<b>pressure unit</b>	
calibrate	
back	
P = 960 mbar	

Configuration	
language	<b>VCZ 521</b> <small>V 1.15</small>
display settings	
pressure unit	
<b>calibrate</b>	
back	
P = 960 mbar	

pressure unit	
mbar	<b>VCZ 521</b> <small>V 1.15</small>
torr	
psi	
hPa	
back	
P = 960 mbar	

calibrate	
Cal. Start pressure	<b>VCZ 521</b> <small>V 1.15</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	<b>VCZ 521</b> <small>V 1.15</small>
Automatic	
Low pressure	
Configuration	
<b>Self cleaning</b>	
P = 960 mbar	

## Low pressure:



MAIN MENU	
Manual	<b>VCZ 521</b> <small>V 1.15</small>
Automatic	
<b>Low pressure</b>	
Configuration	
Self cleaning	
P = 960 mbar	

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

MAIN MENU	
<div style="border: 1px solid black; padding: 10px; text-align: center;"> <b>Self cleaning</b>  <b>Cleaning in action</b>  <b>Remaining seconds</b>  <b>120</b>  <b>Cancel with &lt;OK&gt;</b> </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).

# Operation

## Automatic:



MAIN-MENU	
Manual	VC 521 V 1.15
<b>Automatic</b>	
Low pressure	
Configuratio	
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
<b>No. of pressure ramps</b>	<b>0</b>	
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
<b>No. of pressure ramps</b>	<b>1</b>	
start cycle 1	2	mbar
cycle time 1	600	sec
cycle pressure 1	600	mbar
VENTILATE on STOP	0	
Auto Restart	0	
back	----	

## Manual:



MAIN-MENU	
<b>Manual</b>	VC 521 V 1.15
Automatic	
Low pressure	
Configuration	
Self cleaning	
P = 960 mbar	

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
<b>No. of pressure ramps</b>	<b>0</b>	
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
<b>No. of pressure ramps</b>	<b>1</b>	
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

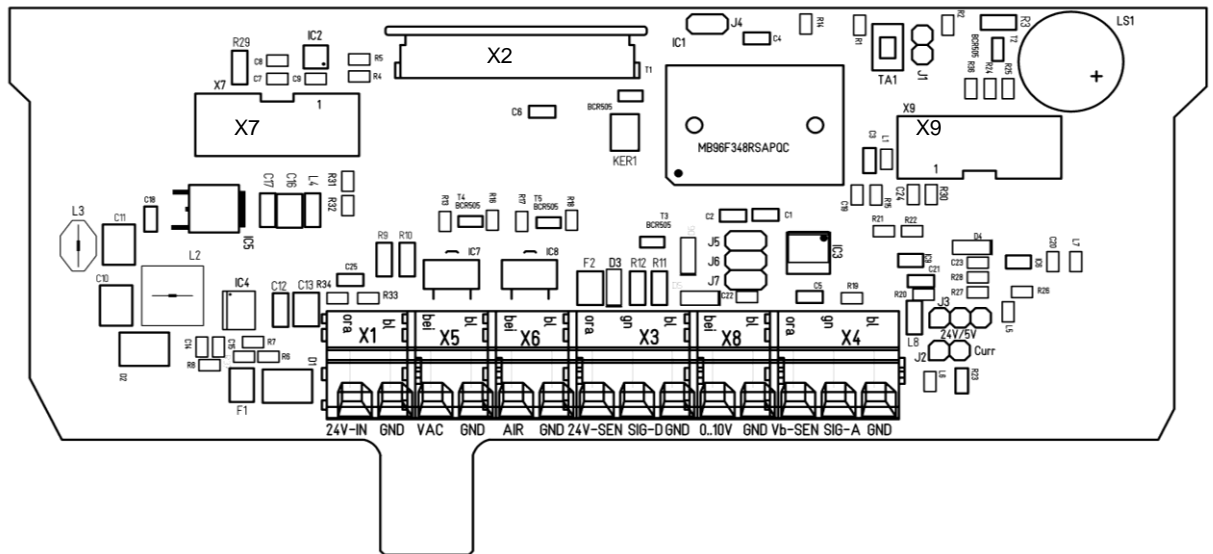


Fig. 10 Positions of components and interfaces

#### 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

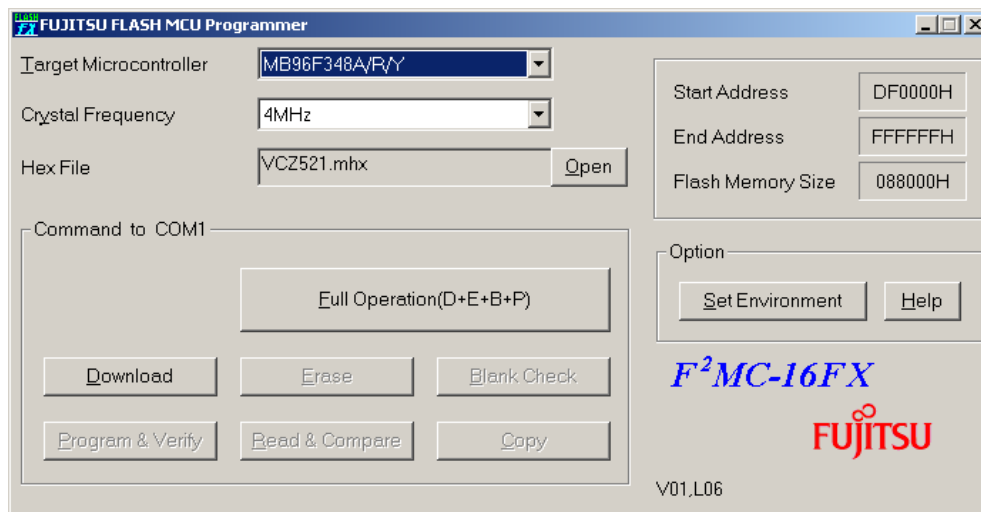
### 6.7.2 Software-Update

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).

	<b>NOTE !</b>
<b>The highest sequential number VCZ521_XXX.mhx is always the most current software version. (currently: VCZ521_115.mhx)</b>	



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

	<b>CAUTION !</b>
<b>The controller should be switched off during each interruption.</b>	

## 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 1.15	620637

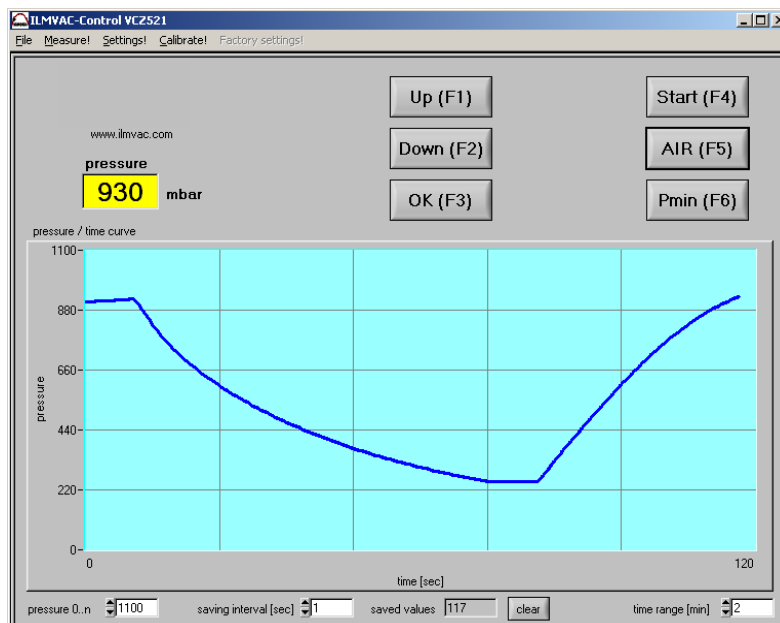
	<b>CAUTION !</b>
<p>1.) "WELCH-Control 521" is currently version V 1.15.                  2.) Flash software is also currently version VCZ521_115.mhx.                  3.) Version 1.) and 2.) need not be identical!</p>	

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	
<b>Save settings</b>	Saving the Settings dialog settings in a file
<b>Load settings</b>	Loading the Settings dialog settings from a file
<b>Print settings</b>	Printing out an image of the Settings dialog on the standard printer
<b>Save memory</b>	Saving the pressure data in a file
<b>Load memory</b>	Load the print data from a file
<b>Print curve</b>	Printing out the current pressure curve on the standard printer
<b>Password</b>	Changing the basic setting of the controller is password-protected. Release is given by inputting the date as a hex number. <b>Example : 25.03.2015 = 250315 = 3D1CB</b> <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>
<b>Info</b>	Information about the program version
<b>Exit &lt;ESC&gt;</b>	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

P start 2

P lower 600

T lower 600

ramp 2

P start 0

P lower 20

T lower 1926

ramp 3

P start 0

P lower 20

T lower 60

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.

# Operation

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**.

	<b>CAUTION !</b>
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

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

	<b>WARNING !</b>
<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 of the hoses 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 pressure plate **(2)**, the connection head **(3)** and the pump head **(6)**. The valves **(5)** and diaphragm **(8)** are now freely exposed.
5. Loosen the diaphragm **(8)** at the strain washer **(7)** by turning the size 3 pin type face wrench anticlockwise.
6. Clean the valves **(5)** and the diaphragm **(8)** with a soft cloth and acetone.
7. Check that the drive is in good working order.

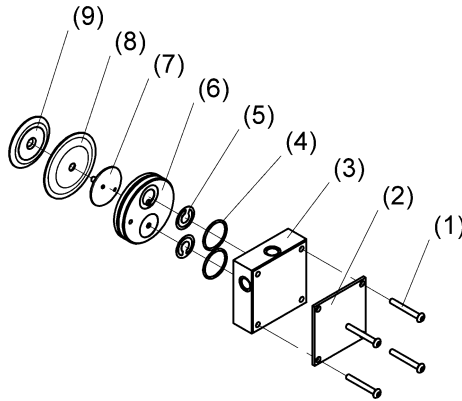


Fig. 11 Disassembly, assembly



### WARNING !

**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!**

## 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 **(9)**, the diaphragm **(8)** and the strain washer **(7)** with a torque of 5 - 6 Nm.
3. Bring the connecting rod **(5)** (see fig. 16) and the diaphragm **(8)** into the central position.
4. Replace the pump head **(6)**.
5. Insert the valves **(5)** and the O-rings **(4)**.  
 Ensure that they are lying completely flat. Do not insert the burred side facing the sealing surface. Align the cylindrical head flush with the pin.
6. Replace the pressure plate **(2)** and insert and tighten the 4 machine screws with a torque of 3 - 4 Nm.
7. Reattach the hose connections with clamping ring screw fittings.

## Maintenance and Servicing

### 7.2.1.3 Test

- Connect a vacuum measuring device to the suction 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.

	<b>WARNING !</b>
<b>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.</b>	

## 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.welchvacuum.com](http://www.welchvacuum.com)

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.

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

## 8 Troubleshooting

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

Trouble	Cause	Remedy	
		by:	with:
<b>Vacuum pump does not start</b>	no power supply	<b>Qualified electrician</b>	Check electrical installation
	Motor defective	<b>Service workshop</b>	Exchange
	Pump body defective		Repair and/or exchange
<b>Vacuum pump does not generate a vacuum or only an inadequate one</b>	Connected apparatus and/or connecting elements leaking	<b>User or Service workshop</b>	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	<b>Service workshop</b>	Repair and/or exchange
	Diaphragm defective	<b>User or Service workshop</b>	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.
<b>Running noise</b>	Vacuum pump dirty	<b>User or Service workshop</b>	General maintenance / cleaning
<b>Glass components</b>	defective and/or leaking	<b>User</b>	Exchange of the glass parts or seals
<b>Cable(s)</b>	defective and/or brittle	<b>Qualified electrician</b>	Exchange of the cable(s)
<b>No pressure indicated on the controller</b>	no power supply	<b>Qualified electrician</b>	Electrical system to be checked
<b>Controller cannot be set or programmed</b>	Electronics / display defective	<b>Service workshop</b>	Repair and/or exchange
<b>Missing control signal</b>	Incorrect input	<b>User</b>	Check the input and correct if necessary
	Controller defective	<b>User</b>	Switch the device off, and switch it on again after three seconds
		<b>User or Service workshop</b>	Replace the controller


## Spare Parts Overview

## 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!

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

#### 9.1 Service kit - Diaphragm Pump

Designation	Order no.
Service kit	402015

The service kit consists of:

Designation	Piece	Order no.
O-Ring ø 12 x 2	6	829217-3
O-Ring ø 28 x 2	8	829252-2
Valve	8	400656
Diaphragm	4	400822-2

## 9.2 Spare parts - Laboratory-Vacuum-Systems, manually regulated

### Spare parts view LVS 201 T

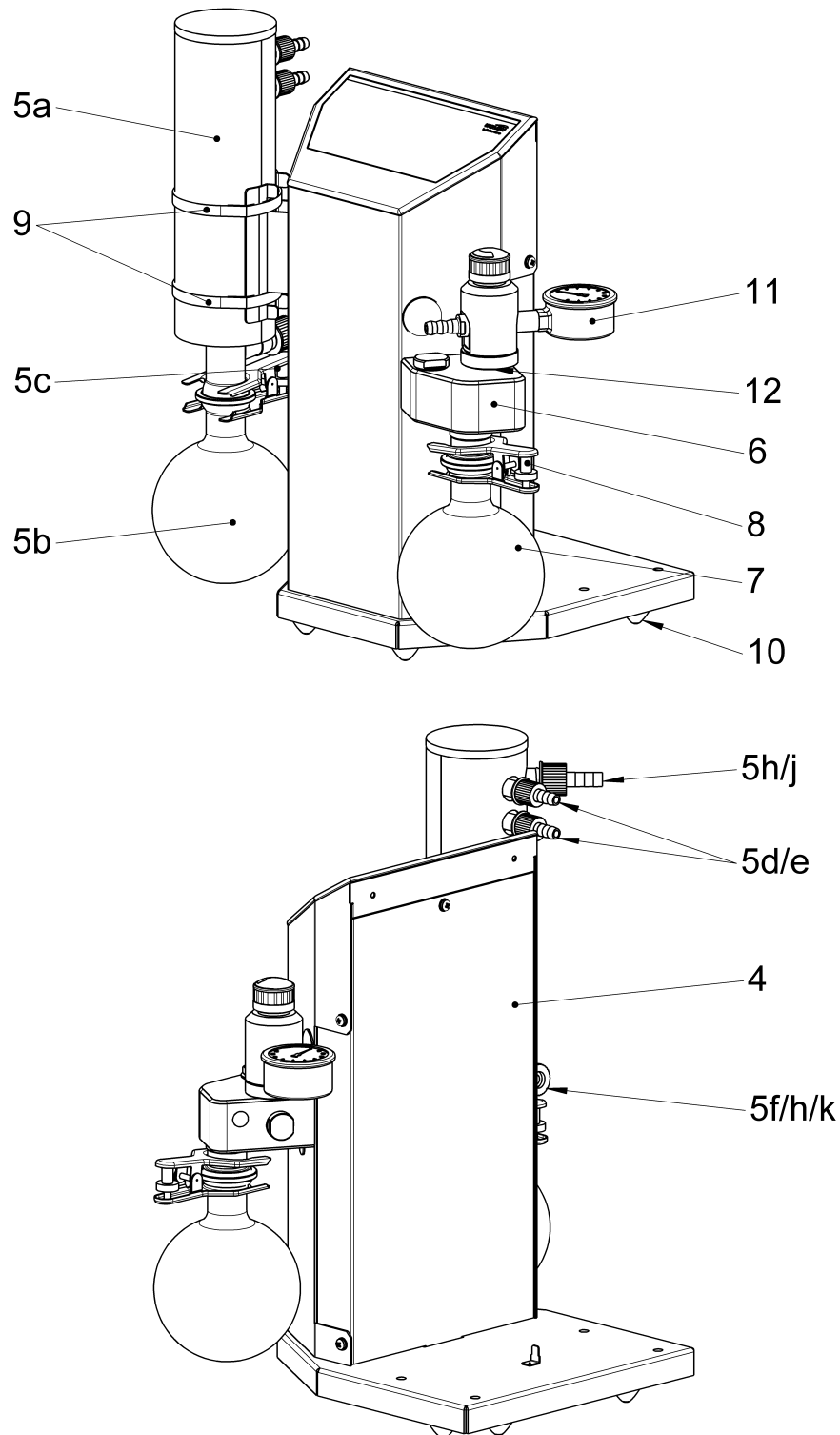


Fig. 12 Front- and rear unit - LVS manually regulated (without item no. 1 and 2)

# Spare Parts Overview

## Spare parts list - LVS 201 T, manually regulated

Item no.	Designation	Piece	LVS 201 T	LVS 201 T with digital dial gauge	LVS 201 T with analog dial gauge
			Order no. 115037 115037-01 115037-05	Order no. 115037-10 115037-11	Order no. 115037-12
			Order no.	Order no.	Order no.
1	<b>Diaphragm pump MPC 201 T (230V)</b> (consisting of: – see chapter 9.6)	1	412543-05	412543-05	-
	- Mains connection cable IEC with plug CEE (D)	1	825885	825885	-
	- Mains connection cable IEC with plug BS (UK)	1	825878	825878	-
	<b>Diaphragm pump MPC 201 T (115V)</b> (consisting of: – see chapter 9.6)	1	412543-06	412543-06	-
	- Mains connection cable IEC with plug NEMA 5-15 (US)	1	825903	825903	-
2	<b>Straight threaded joint with seal edge PVDF, 10 – 1/4"</b>	1	829931	829931	829931
	<b>O-ring EPDM Ø12 x 2</b>	1	829217-3	-	-
	<b>Threaded elbow joint PVDF, 10 – 1/4"</b>	1	-	829984	829984
3	<b>Column 7 complete</b> (consisting of position: 4 – 12)	1	115502-06	115502-24	115502-22
4	<b>Rear panel</b>	1	115512-02	115512-02	115512-02
5	<b>Emission condenser complete KD 500/5</b> (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	<b>Valve seat complete</b>	1	113522	113523	113522
7	<b>Round-bottomed flask 500 ml – KS 35</b>	1	828839	828839	828839
8	<b>Ball and socket clamp – KS 35</b>	1	828845	828845	828845
9	<b>Retaining strap 70 – 75 mm</b>	2	824130	824130	824130
10	<b>Rubber metal-pad</b>	6	829138-1	829138-1	829138-1
11	<b>Fine control valve VVC-M2</b>	1	700443-01	-	-
	<b>Fine control valve VVC-M14 with dial gauge - digital</b>	1	-	700463	-
	<b>Fine control valve VVC-M3 with dial gauge - analog</b>	1	-	-	700444-02
12	<b>O-ring EPDM Ø15 x 2</b>	1	829311-1	829311-1	829311-1

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

### Spare parts view LVS 210 T

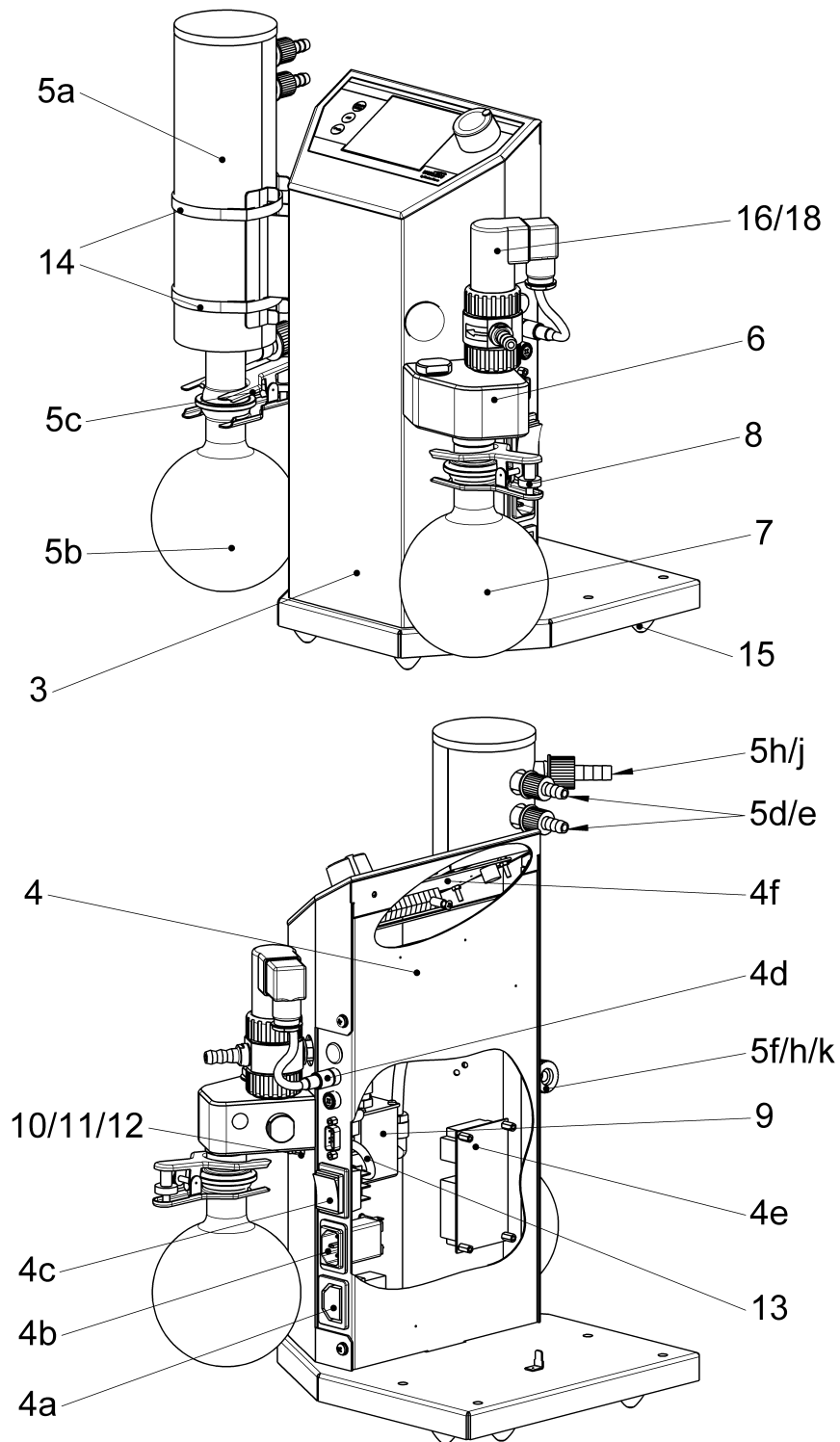


Fig. 13 Front- and rear unit - LVS automatically regulated (without item no. 1 and 2)

# Spare Parts Overview

## Spare parts list – LVS 210 T, automatically regulated

Item no.	Designation	Piece	LVS 210 T
			Order no. 115034 115034-01 115034-05
			Order no.
1	<b>Diaphragm pump MPC 201 T (230V)</b> <i>(consisting of: see chapter 9.6)</i>	1	<b>412543-05</b>
	- Mains connection cable IEC + plug CEE (D)	1	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878
	<b>Diaphragm pump MPC 201 T (115V)</b> <i>(consisting of: see chapter 9.6)</i>	1	<b>412543-06</b>
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903
2	<b>Straight threaded joint with seal edge PVDF, 10 – 1/4"</b>	1	<b>829931</b>
	<b>O-ring EPDM Ø12 x 2</b>	1	<b>829217-3</b>
3	<b>Column 4 complete</b> <i>(consisting of position: 4 – 18)</i>	1	<b>115502-03</b>
4	<b>Rear panel 7 complete</b> <i>(consisting of pos. 4a – 4f)</i>	1	<b>115503-06</b>
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	<b>Emission condenser complete KD 500/5</b> <i>(consisting of pos. 5a – 5k)</i>	1	<b>700183-08</b>
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 <i>(sold by the metre)</i>	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	<b>Valve seat complete</b>	1	<b>113522</b>
7	<b>Round-bottomed flask 500 ml – KS 35</b>	1	<b>828839</b>
8	<b>Ball and socket clamp – KS 35</b>	1	<b>828845</b>
9	<b>Sensor – built-in controller</b>	1	<b>620052-17</b>
10	<b>Screw in socket amended</b>	1	<b>160537</b>
11	<b>Screw in socket</b>	1	<b>828791</b>
12	<b>Distance piece M5/M5</b>	1	<b>160529</b>
13	<b>Silicone hose I Ø 3 x 1.5 mm</b>	0.2 m	<b>H100086</b>
14	<b>Retaining strap 70 – 75 mm</b>	2	<b>824130</b>
15	<b>Rubber metal-pad</b>	6	<b>829138-1</b>
16	<b>Automatic valve VVC-E4</b>	1	<b>700425-01</b>
18	<b>Straight threaded joint with seal edge PVDF, 8 - 1/4"</b>	1	<b>829919-1</b>

## 9.4 Spare parts – Laboratory-Vacuum-Systems, ecoflex

### Spare parts view LVS 210 T ef

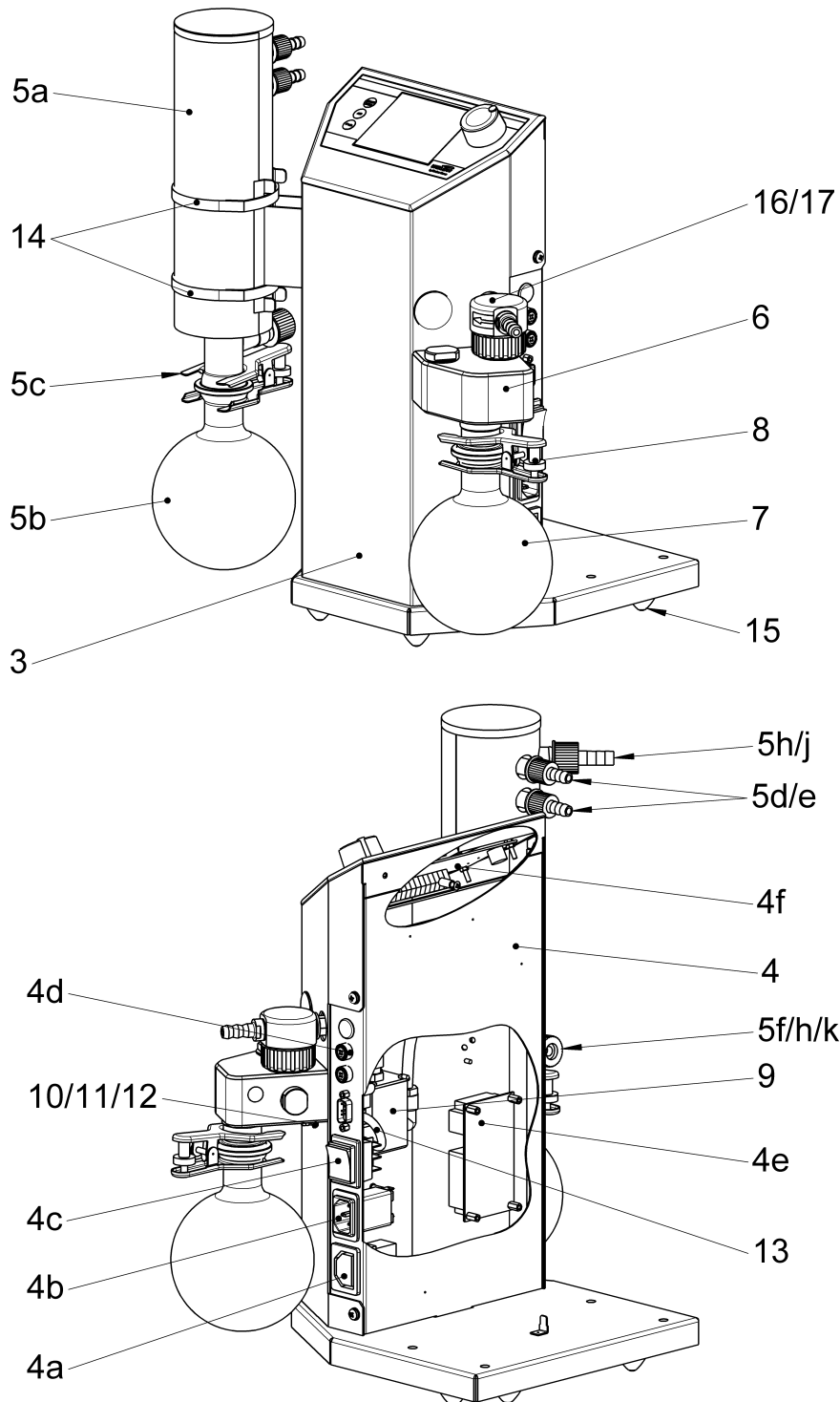


Fig. 14 Front- and rear unit - LVS 210 T ef (without item no. 1 and 2)

# Spare Parts Overview

## Spare parts list - LVS 210 T ef, ecoflex

Item no.	Designation	Piece	LVS 210 T ef
			Order no. 115234 115234-01
			Order no.
1	<b>Diaphragm pump MPC 201 T</b> (115/230V) (consisting of: see chapter 9.6)	1	<b>412543-07</b>
	- Mains connection cable IEC + plug CEE (D)	1	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903
2	<b>Straight threaded joint with seal edge PVDF, 10 – 1/4"</b>	1	<b>829931</b>
	<b>O-ring EPDM Ø12 x 2</b>	1	<b>829217-3</b>
3	<b>Column 10 complete</b> (consisting of position: 4 – 17)	1	<b>115502-09</b>
4	<b>Rear panel 9 complete</b> (consisting of pos. 4a – 4f)	1	<b>115503-08</b>
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	<b>Emission condenser complete KD 500/5</b> (consisting of pos. 5a – 5k)	1	<b>700183-08</b>
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	<b>Valve seat complete</b>	1	<b>113522</b>
7	<b>Round-bottomed flask 500 ml – KS 35</b>	1	<b>828839</b>
8	<b>Ball and socket clamp – KS 35</b>	1	<b>828845</b>
9	<b>Sensor – built-in controller</b>	1	<b>620052-17</b>
10	<b>Screw in socket amended</b>	1	<b>160537</b>
11	<b>Screw in socket</b>	1	<b>828791</b>
12	<b>Distance piece M5/M5</b>	1	<b>160529</b>
13	<b>Silicone hose I Ø 3 x 1.5 mm</b>	0.2 m	<b>H100086</b>
14	<b>Retaining strap 70 – 75 mm</b>	2	<b>824130</b>
15	<b>Rubber metal-pad</b>	6	<b>829138-1</b>
16	<b>Vacuum connection point VVC-M5</b>	1	<b>700418-02</b>
17	<b>Straight threaded joint with seal edge PVDF, 8 - 1/4"</b>	1	<b>829919-1</b>

## 9.5 Spare parts – Laboratory-Vacuum-Systems, economic

### Spare parts view LVS 210 T en

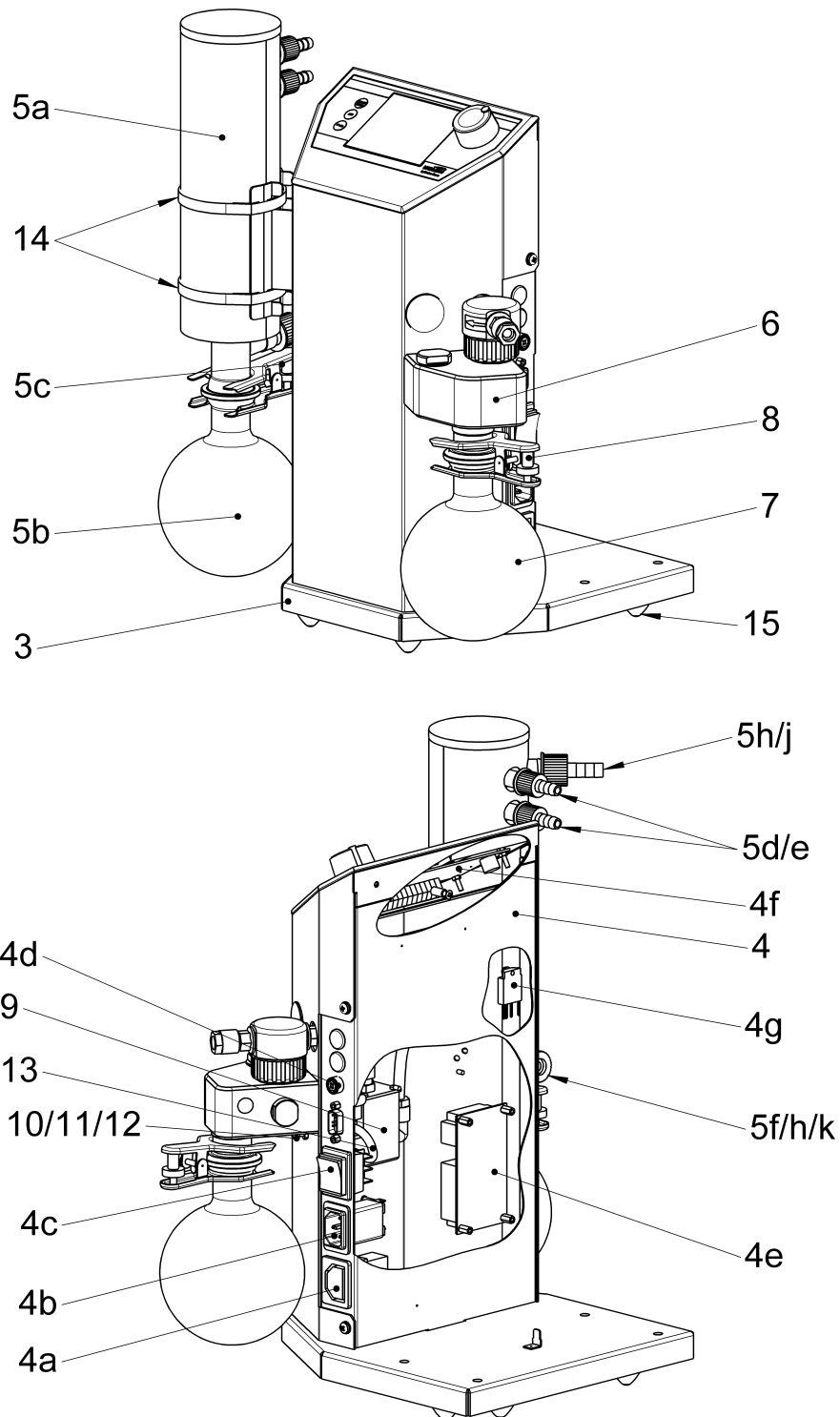


Fig. 15 Front- and rear unit - LVS 210 T en (without item no. 1 and 2)

# Spare Parts Overview

## Spare parts list - LVS 210 T en, economic

Item no.	Designation	Piece	LVS 210 T en
			Order no. 115238 115238-01
			Order no.
1	<b>Diaphragm pump MPC 201 T (230V)</b> <i>(consisting of: see chapter 9.6)</i>	1	<b>412543-05</b>
	- Mains connection cable IEC + plug CEE (D)	1	825885
	- Mains connection cable IEC + plug BS (UK)	1	825878
	<b>Diaphragm pump MPC 201 T (115V)</b> <i>(consisting of: see chapter 9.6)</i>	1	<b>412543-06</b>
	- Mains connection cable IEC + plug NEMA 5-15 (US)	1	825903
2	<b>Straight threaded joint with seal edge PVDF, 10 – 1/4"</b>	1	<b>829931</b>
	<b>O-ring EPDM Ø12 x 2</b>	1	<b>829217-3</b>
	<b>Threaded elbow joint with attitude taps PVDF, 10 – A10</b>	1	<b>829913-1</b>
	<b>Hose sleeve PVDF, A10 - 8</b>	1	<b>829924-1</b>
3	<b>Column 11 complete</b> <i>(consisting of position: 4 – 16)</i>	1	<b>115502-21</b>
4	<b>Rear panel 8 complete</b> <i>(consisting of pos. 4a – 4g)</i>	1	<b>115503-07</b>
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	<b>Emission condenser complete KD 500/5</b> <i>(consisting of pos. 5a – 5k)</i>	1	<b>700183-08</b>
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 <i>(sold be the metre)</i>	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	<b>Valve seat complete</b>	1	<b>113522</b>
7	<b>Round-bottomed flask 500 ml – KS 35</b>	1	<b>828839</b>
8	<b>Ball and socket clamp – KS 35</b>	1	<b>828845</b>
9	<b>Sensor – built-in controller</b>	1	<b>620052-17</b>
10	<b>Screw in socket amended</b>	1	<b>160537</b>
11	<b>Screw in socket</b>	1	<b>828791</b>
12	<b>Distance piece M5/M5</b>	1	<b>160529</b>
13	<b>Silicone hose I Ø 3 x 1.5 mm</b>	0.2 m	<b>H100086</b>
14	<b>Retaining strap 70 – 75 mm</b>	2	<b>824130</b>
15	<b>Rubber metal-pad</b>	6	<b>829138-1</b>
16	<b>Vacuum connection point VVC-M5 en</b>	1	<b>700418-07</b>

## 9.6 Spare parts - Diaphragm pumps

### Spare parts view MPC 201 T for LVS

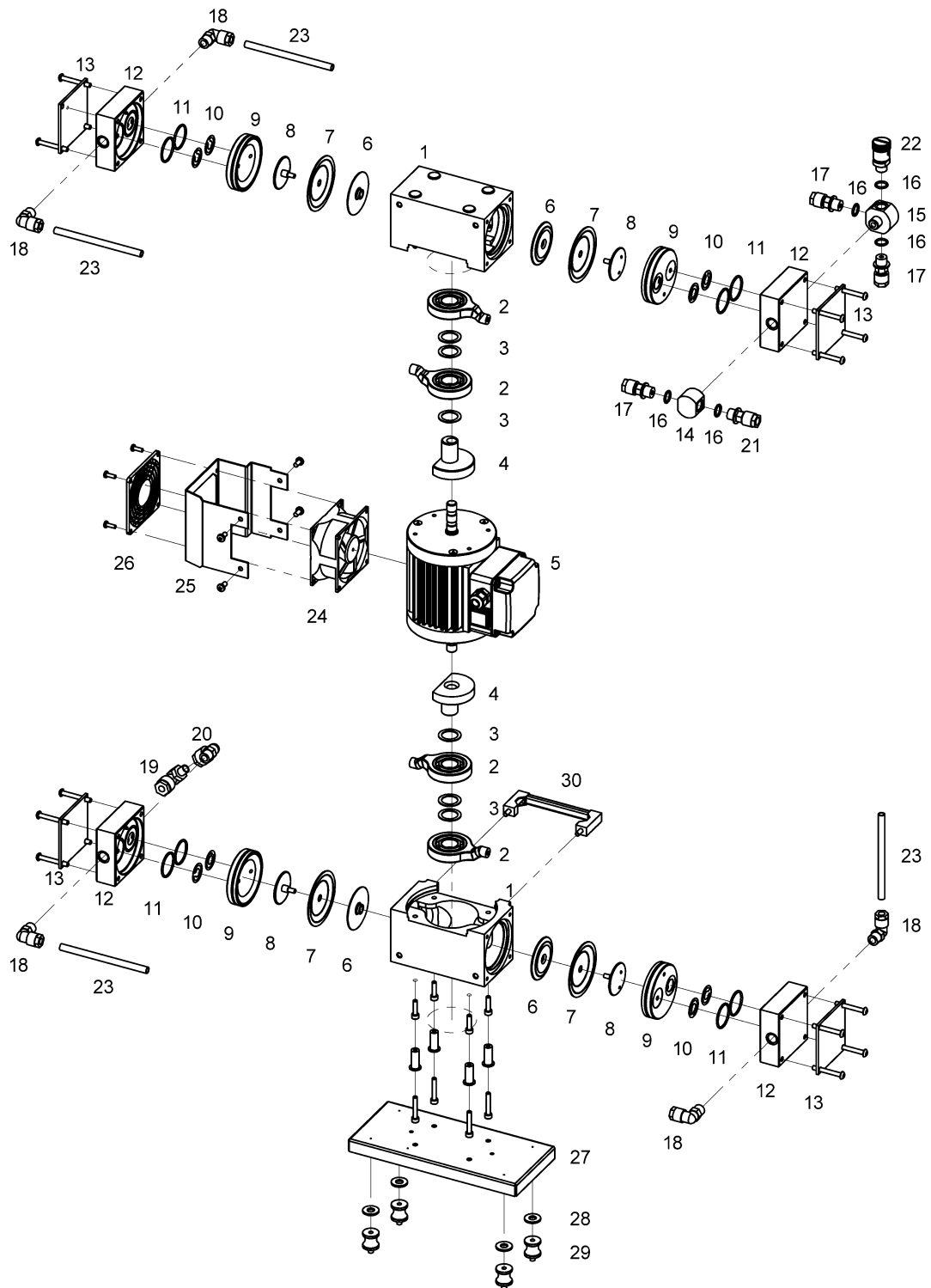


Fig. 16 Exploded view - diaphragm pump

# Spare Parts Overview

## Spare parts list - MPC 201 T for LVS

Item no.	Designation	Piece	230 V	115 V	115/230 V
			Order no. 412543-05	Order no. 412543-06	Order no. 412543-07
			Order no.	Order no.	Order no.
- *)	Basic pump complete (consisting of position: 1 – 5)	1	410302	410302-01	410302-04
1	Pump casing	2	400764	400764	400764
-	Drive complete (consisting of position: 2 – 4)	2	400763-01	400763-01	400763-01
2	Piston rod with ball bearing	2	400771-01	400771-01	400771-01
3	Close tolerance spacer 20 x 28 x 1	3	824957-2	824957-2	824957-2
4	Eccentric	1	400770	400770	400770
5	Alternating-current motor	1	826456-4	826456-5	-
	Alternating-current motor with frequency changer	1	-	-	826456-8
6	Pressure washer	4	400772-1	400772-1	400772-1
7	Diaphragm	4	400822-2	400822-2	400822-2
8	Tensioning washer	4	400773-3	400773-3	400773-3
9	Pump head	4	400768	400768	400768
10	Valve	8	400656	400656	400656
11	O-ring EPDM Ø 28 x 2	8	829252-2	829252-2	829252-2
12	Connection head 3	4	400834	400834	400834
13	Pressure plate	4	400769	400769	400769
14	Distributor PP, G1/4" – 2xG1/4" I	1	400790	400790	400790
15	Distributor PP, G1/4" – 3xG1/4" T	1	400864	400864	400864
16	O-ring EPDM Ø 12 x 2	5	829217-3	829217-3	829217-3
17	Straight threaded joint with seal edge PVDF, 8 – 1/4"	3	829919-1	829919-1	829919-1
18	Threaded elbow joint PVDF, 8 – 1/4"	5	829929	829929	829929
19	Threaded elbow joint PVDF, 10 – 1/4"	1	829984	829984	829984
20	Threaded elbow joint with attitude taps PVDF, 10 – A10	1	829913-1	829913-1	829913-1
21	Straight threaded joint with seal edge PVDF, 10 – 1/4"	1	829931	829931	829931
22	Gas ballast valve	1	400599-01	400599-01	400599-01
23	Vacuum hose PTFE, 8 / 6x1 mm	1 m	828331	828331	828331
24	AC axial fan	1	829851-2	829851-2	829851-2
25	Holder fan	1	410331	410331	410331
26	Protective grating for fan	1	829851-4	829851-4	829851-4
27	Pump bracket	1	115514	115514	115514
28	Washer	4	112538	112538	112538
29	Rubber metal-pad	4	829129	829129	829129
30	Handle	1	828631	828631	828631
31	Sub miniature round plug – coupling plug, 4 pole	1	-	-	825277

\*) The "basic pump" module (items 1 – 5) can only be supplied complete under order numbers 410302, 410302-01 or 410302-04.

# Instructions for certification - Laboratory-Vacuum-Systems LVS - 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 types:

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 ...** - devices with a diaphragm diameter the diaphragm pump of 75 mm, 95 mm and 97 mm.  
**600 E; 1200 E; 1201 E; 2401 E;**  
**101 Z; 110 Z; 300 Z; 301 Z; 302 Z; 310 Z; 311 Z; 320 Z; 901 Z;**  
**910 Z; 1801 Z;**  
**201 T; 210 T; 600 T; 601 T; 602 T; 610 T; 611 T; 620 T; 1210 T**

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 - 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  $0.5 \times 10^{-2}$  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

### DIN EN ISO / IEC 17050

<b>(de)</b>  Hiermit erklären wir	 by Gardner Denver	Gardner Denver Thomas GmbH Am Vogelherd 20 98693 Ilmenau Germany	T +49 3677 604 0 F +49 3677 604 131 <a href="mailto:welch.emea@gardnerdenver.com">welch.emea@gardnerdenver.com</a> <a href="http://www.welchvacuum.com">www.welchvacuum.com</a>
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.			
<b>(en)</b> 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.			
<b>(fr)</b> 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.			

<b>Bezeichnung des Produkts (Pumpen / Pumpstände)</b> Description of product (pumps / pump systems) Description du produit (pompes / pompe systèmes)	<b>Labor-Vakuum-Systeme</b> / Laboratory-vacuum-systems / Systèmes de laboratoire à vide LVS 201 T, LVS 210 T, LVS 210 T ef, LVS 210 T en
<b>Artikel-Nr. / Fabrication No. / No. de fabrication</b>	115037, 115037-01, 115037-05, 115037-10, 115037-11, 115037-12, 115034, 115034-01, 115034-05, 115234, 115234-01, 115238, 115238-01
<b>Baujahr / Year of manufacture / Année de fabrication</b>	<b>2017</b>

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

<b>Angewandte harmonisierte Normen: / Applied harmonized standards: / Standards appliqués et harmonisés:</b>		
X	DIN EN 1127-1: 2011-10	<b>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</b>
X	DIN EN 13463-1: 2009-07	<b>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</b>
X	DIN EN 13463-5: 2011-10	<b>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 »</b>
X	DIN EN ISO 12100: 2011-03	<b>Sicherheit von Maschinen - Allgemeine Gestaltungsgrundsätze 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</b>
X	DIN EN ISO 13857: 2008-06	<b>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</b>
X	DIN EN 1012-2: 2011-12	<b>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</b>
X	DIN EN ISO 2151: 2009-01	<b>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</b>
X	DIN EN 60204-1: 2014-10	<b>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</b>
X	EN 61000-6-2: 2011-06	<b>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</b>
X	EN 61000-6-4: 2011-09	<b>Elektromagnetische Verträglichkeit (EMV) - Teil 6-4: Fachgrundnormen - Störaussendung für Industriebereiche / Electromagnetic compatibility (EMC) - part 6-4: Generic standards - Emission standard for industrial environments / Compatibilité électromagnétique - partie 6-4: Normes génériques - Emissions de parasites pour les activités industrielles</b>
X	DIN EN 50110-1: 2014-02	<b>Betrieb von elektrischen Anlagen / Operation of electrical installations / Fonctionnement des installations électriques</b>
X	DIN EN 61010-1/A1:2015-04	<b>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</b>

<b>Datum / Data</b>	<b>2017-02-16</b>
<b>Qualitätsbeauftragter / Quality representative / Délégué de qualité</b>	<b>Name / Name / Nom</b> <b>Gerd Reinhardt</b>
<b>Produktmanager / Product manager / Directeur de produit</b>	<b>Name / Name / Nom</b> <b>Oliver Fickert</b>