GA 01.413/1.02

DRYVAC 50 & 100 S

Contents ***Page***

Note:

References to illustrations consist of (figure number/item number). For example, (1/2) refers to Figure 1, Item 2.

Safety Information

Hazard analyses per European standard EN 1012 were conducted for the DR YVAC 50 and 100 S pumps. Every person involved with connecting, operating or maintaining these pumps shall have read and understood this DRYVAC operating instruction manual in order to avoid hazards and operating malfunctions.

DRYVAC pumps are designed to pump down vacuum chambers to pressure values in the rough and fine vacuum ranges, and are intended for industrial use.

Precautionary notes in these instructions:

Warning – This indicates procedures and operations which must be strictly observed to prevent hazards to persons.

Caution – This indicates procedures and operations which must be strictly observed to prevent damage or destruction of the pump.

Media compatibility

DRYVAC pumps are authorized for use only in those applications and processes which are listed in the description section of this instruction manual. Contact Leybold before using a DR YVAC for applications and processes which are not listed.

Warning

Standard DRYVAC pumps are not suited for pumping media which could ignite or explode. If these pumps are nonetheless used in such applications, the owner / operator must take the precautionary measures required for explosion protection in compliance with legal requirements.

Electrical Safety

Warning

Disconnect the pump from the main power supply before beginning any assembly or disassembly work. Take measures to ensure that the pump cannot be started. The electrical connections shall be made only by a qualified and licensed electrician, in accordance with VDE standard 0105 and as per the VDE 0100 guidelines and local codes.

Mechanical Safety

Warning

Do not expose any parts of the body to the vacuum. In particular do not operate the pump with flanges open, or loosen any flange, oil filling or drain screws when a vacuum is present, even if the pump is switched off.

Remove the cover panels only when the pump is switched of f.

Do not remove the pump or perform any maintenance work before it has been vented and has come to a complete stop.

Protection Against Hazardous Gases

The exhaust line connections must be tight. Hazardous gases could escape at leaks or the gases being pumped could react with humid air .

The pump' s overall leak rate is $<1 \cdot 10^{-5}$ mbar·l·s^{-1}. Install a housing evacuation unit when pumping hazardous gases.

Whenever the pump is opened to:

- refit the purge-control plate
- check the direction of rotation
- remove the intake or exhaust line
- remove the pump from the system

the following safety instructions must be observed:

Warning

If the DRYVAC has pumped hazardous gases, you must determine the nature of the hazard and take the appropriate safety precautions. Comply with all safety regulations. Take adequate safety precautions before opening the intake or exhaust.

If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood.

DRYVACs that are used in semiconductor processes, for example, can be contaminated with process gases. These gases may be toxic and hazardous to health. In addition, deposits with similarly dangerous properties can form inside the pump. Many of these gases and deposits can seriously corrode the pump, especially when they are mixed with humid air .

To avoid health hazards and corrosion damage when the pump is detached from the system, lay a container of desiccant on the inlet splinter guard and then seal the pump immediately at all flange connections. Store the pump with a desiccant, in a polyethylene bag.

Handling PFPE

Since PFPE is used when pumping corrosive media, it can be contaminated with these media during use. Thus it is necessary to take appropriate precautionary measures depending on the medium that has been pumped (see “Protection against hazardous gases”).

Warning

Hazardous decomposition products may be formed at temperatures exceeding 350°C (660°F). Thus smoking is prohibited in rooms where PFPE is being used or handled; do not expose cigarettes or other tobacco products to PFPE.

All safety regulations applicable to handling the medium being pumped shall also be observed when working with PFPE and the pump.

PFPE must be reclaimed or disposed of as a toxic waste.

Returning Equipment

Complete the form at the back of this manual before returning equipment to Leybold for service. This form notifies us of any toxic or other harmful products (as defined by the applicable regulations such as the Common Market Guideline L360, 1976/1979 or VBG 16) that may exist in or near the equipment. Attach the form to the pump or enclose it with the pump. This statement detailing the contamination is required to satisfy legal requirements and to protect our employees.

1 Description

1.1 Design and Function

The DRYVAC 50S and 100S are dry-compression vacuum pumps designed especially for semiconductor etching and CVD processes.

Each of these DR YVACs are four-stage hook-and-claw vacuum pumps.

Although both DR YVAC pumps are similar in design and operation, there are differences, and these differences are detailed in Section 1.3 Technical Data.

Pump operating principle

Figure 1 illustrates the DR YVAC's operating principle.

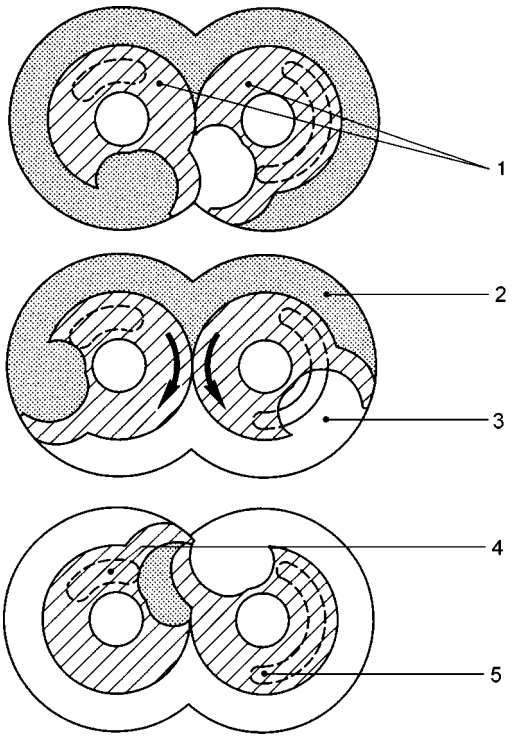
The two rotors (1/1) turn in opposite directions inside the pumping chamber . As they rotate, they open and close the intake (1/5) and outlet (1/4) slots with each cycle.

The pumping chamber is divided by the rotors. Gas is drawn in on the one side of the rotors and compressed on the other side.

The top sketch shows the beginning of the suction and compression cycle. As the rotors rotate, the sealed space above the rotors (1/2) is reduced in size and the gas is compressed. At the same time, the right rotor begins opening the inlet slot and gas is drawn into the pumping chamber below the rotors.

In the center sketch, the left rotor is starting to open the outlet slot, and compressed gas is being discharged from the pumping chamber .

In the bottom sketch, the cycle has been completed and the inlet and outlet slots are closed. Once the rotors have passed through the neutral position, the cycle starts again.



Key to Figure 1
1 Rotors
2 Compression chamber
3 Intake chamber
4 Outlet slot
5 Intake slot

Figure 1 Pump operating principle

Design

There are four pumping stages (2/5) located one above the other . The stages are pinned together .

The gas enters the pump through the intake port, is pumped through four pump stages, flows through an exhaust silencer (2/1), and through a non-return valve into the exhaust.

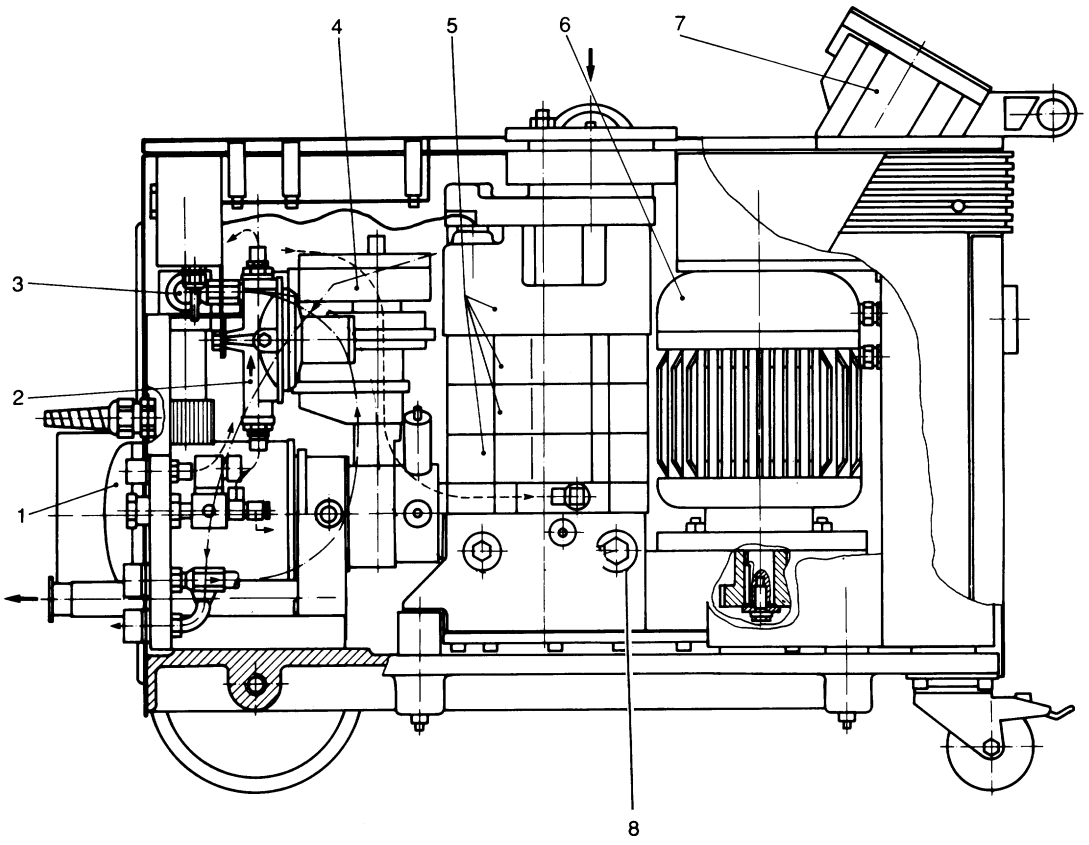
The rotors are driven by two vertical shafts connected to the motor (2/6) and synchronized by gears. The gears of the DRYVAC 100S are dif ferent for the 60 Hz and 50 Hz models so that both pump models rotate at 3000 rpm. The gears of the DR YVAC 50S are the same for all pump models.

The pumping chamber is free of sealants and lubricants; however , PFPE (perfluoropolyether) is used to lubricate the gearing and the lower bearings. The upper bearings are PFPE-grease lubricated.

Piston rings are used to seal each shaft where it passes through the stages. The gear box is isolated from the pumping chamber by piston rings and radial shaft seals. The upper bearings are isolated by shaft seals.

The bearings and seals are mounted in the water-cooled upper and lower end plates. The supply of cooling water is regulated by a thermostat (2/3). The pump stages are air cooled.

The pump is fully enclosed by panels, which can easily be removed for maintenance purposes. An air outlet for cabinet ventilation is on the top of the DR YVAC.



Key to Figure 2

1 Exhaust silencer	5 Pump stages
2 Pressure regulator	6 Motor
3 Thermostat valve	7 Control unit
4 Shutoff valve for the exhaust	8 Cooling water drain port (50S only)

Figure 2 Sectional drawing of a DRYVAC 50S (the 100S model is similar)

Exhaust shutoff valve

The exhaust valve (2/4) closes the exhaust when the pump is not running. It operates on compressed air and is controlled by a solenoid valve. The valve's position indicators signal whether the valve is open or closed.

Inert Gas Barrier and Purge Gas Device

The DRYVAC has a mechanism for barrier gas and for purge gas.

Inert gas for these devices is connected at the back of the pump. It flows into the pump through the main inert gas valve and two pressure regulators.

The barrier gas protects the lower radial shaft seals and bearings against aggressive media and particles. In addition, the barrier gas is pumped to the exhaust pressure switches and protects them against contamination.

The purge gas flows through the interstage purge block, the purge control plate, connecting pipes and nozzles, and into the three lower pump stages.

Electrical Equipment

The DRYVAC is monitored by several limit switches and a PT100 temperature sensor (refer to Table 1).

The temperature sensor measures the outlet temperature of the cooling water . The pump monitors the process' setting with this sensor and with the purge-gas flow indicator .

The signals of all monitoring equipment are brought together in the control unit (2/7) where they are processed.

The control unit includes pushbutton controls and a three-line display which shows the DR YVAC's operating status in clear text; you have the option of English or German.

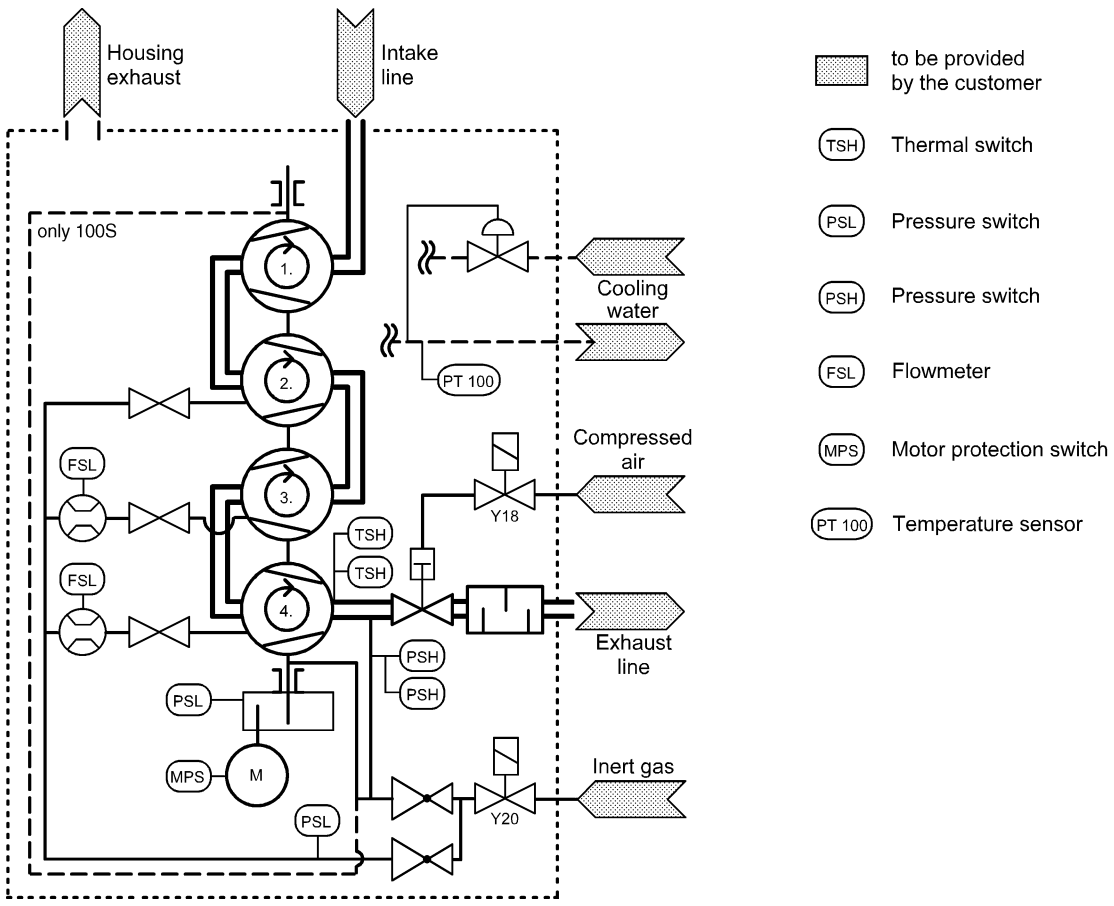


Figure 3 Simplified schematic of the DRYVAC pump

The control unit is mounted on the DR YVAC. It can also be attached up to 2.5 meters (8 feet) away . Its front panel fits into one half of a standard 19" rack (3 height modules).

During the initial start-up, you must set the DR YVAC to the desired process. Thereafter , it can be switched on and of f with the ST ART and STOP buttons. Run-up, operation, and run-down are then automatically controlled as appropriate for the relevant process.

When unacceptable conditions arise, the DR YVAC automatically switches of f. The error messages are stored to simplify troubleshooting.

The DRYVAC's parallel interface allows you to connect the pump to a central control system (see Figure 8).

The DRYVAC's transformer and rectifier generate the DC voltages required for control and operation. Each control voltage has a separate fuse.

The DRYVAC also features a lockable main switch.

1.2 Standard Equipment

The DRYVAC is delivered ready for operation with its gear box filled with PFPE (perfluoropolyether) lubricant.

A sealing disk with dirt trap and a union flange are attached to the intake port.

The intake and exhaust ports and the inert gas fitting are sealed for shipping.

The pump is shipped with the following:

- 2-meter (6.5-foot) main power cable without plug
- Extension cable for the control unit
- Allen key for removing or installing the exhaust silencer

Table 1 — Switches and Valves

Component	Component label	Name in Figure 3	Display [1]	Switching point [2]	Plug label
Temperature sensor PT100	B10	PT 100	"Process temp. <tmin >tmax"	Refer to Sec. 3.4.1	2X3
Thermal switch, pump Alarm	S17 (N.C.)	TSH	"A Temperature"	T ≥ 95/125°C[3]	2X8
Thermal switch, pump W arning	S16 (N.C.)	TSH	"W Temperature"	T ≥ 85/115°C[3]	2X7
Exhaust pressure switch, Alarm	S14 (N.C.)	PSH	"A Exhaust pressure"	p ≥ 1.5 bar	2X5
Exhaust pressure switch, W arning	S12 (N.C.)	PSH	"W Exhaust pressure"	p ≥ 1.3 bar	2X4
Pressure switch, lubrication	S10 (N.O.)	PSL	"W Lubrication/A Lubrication"	p ≤ 1.5 bar	2X11
Pressure switch, inert gas pressure	S13 (N.O.)	PSL	"W N2 pressure"	p ≤ 1.3 bar	2X10
Flow indicator , inert gas, 3rd stage	S20 (N.O.)	FSL	"W Flow 3rd stage"	≤300 Nl/hr	2X9
Flow indicator , inert gas, 4th stage	S18 (N.O.)	FSL	"W Flow 4th stage"	≤1500 Nl/hr	2X13
Position indicator , exhaust shutof f valve	S15 (N.O.)	—	"A Shutof f valve"		2X6
Standby set detection		—	"Standby installed" [4]		2X15
Flush valve detection		—	"Flush valve installed" [4]		2X14
LTO set detection		—	"L TO installed" [4]		2X9
Motor contactor	1K1	—	Closed in case of operation		
Auxiliary contact, motor contactor	1K1	—	"A Motor contactor"		—
Motor protection switch, drive motor	1Q1	MPS	"A Motor protection switch"	Nominal motor current	—
Motor protection switch, transformer	1Q2				
Compressed air valve		Y18	opens in case of RUN-UP 1		2X18
Main inert gas valve		Y20	opens in case of RUN-UP 1		2X20
Purge gas valve, 2nd stage (option)	Y17	—	closed in case of ST ANDBY		2X17
Purge gas valve, 3rd stage (option)	Y16	—	closed in case of ST ANDBY		2X16
Purge gas valve, 4th stage (option)	Y15	—	closed in case of ST ANDBY		2X15
Flush valve (option)	Y14	—	opens in case of FLUSH		2X14

[1] When the first letter in the display is "W" (W arning), the pump is approaching a critical value; when the first letter is "A" (Alarm), the pump shuts down because it exceeded a critical value.
[2] All pressures listed in bar are absolute values.
[3] Temperature values for the DR YVAC 50S/100S.
[4] Displayed only in REPOR T.

N.O. = Normally Open
N.C. = Normally Closed

1.3 Technical Data

DRYVAC Model 50S

Pumping Speed:
- 60 Hz operation ..... 55 $m^3 \cdot h^{-1}$ (32 cfm)
- 50 Hz operation ..... 45 $m^3 \cdot h^{-1}$ (26 cfm)

Ultimate pressure:
- 60 Hz operation .... ≤$2.5 \cdot 10^{-2}$ mbar (1.9×10^{-2} Torr)
- 50 Hz operation ..... ≤$4 \cdot 10^{-2}$ mbar (3×10^{-2} Torr)

Maximum intake pressure
- in continuous operation* ..... 500 mbar (375 Torr)

Motor power ..... 3 kW (4 hp)

Rotational speed:
- 60 Hz operation ..... 3600 rpm
- 50 Hz operation ..... 3000 rpm

Noise level with the exhaust line connected .... 64 dB(A)

Cooling water requirements, approx:
- At water temp. of 15 °C (59°F) .. 70 l · hr $^{-1}$ (18 gal/hr)
- Maximum cooling water temp. ..... 25°C (77°F)
- Cooling water pressure* ..... 2–10 bar (14–130 psig)
- Cooling water connection, female threads NPT $^1/_2$"

Inert gas pressure* ..... 4–10 bar (43–130 psig)
Inert gas connection, female thread ..... NPT $^3/_8$"
Inert gas consumption ..... Refer to Table 2

Barrier gas pressure* ..... 1.5 bar (7 psig)
Purge gas pressure* ..... 3.0 bar (29 psig)

Air pressure for activating
- exhaust shutoff valve ..... 6–7 bar (72–87 psig)

Compressed-air connection, female thread . NPT $^1/_4$"

Lubricant quantity gear box ..... 0.8 l (0.8 qt)
Maximum ambient temp. ..... 40°C (104°F)
Weight ..... 190 kg (419 lb)

Intake port ..... DN 63 ISO-K
Exhaust port ..... DN 25 KF

DRYVAC Model 100S

Pumping Speed:
- 60 Hz operation ..... 100 $m^3 \cdot h^{-1}$ (59 cfm)
- 50 Hz operation ..... 100 $m^3 \cdot h^{-1}$ (59 cfm)

Ultimate pressure:
- 60 Hz operation ..... ≤$1.5 \cdot 10^{-2}$ mbar (1.1×10^{-2} Torr)
- 50 Hz operation ..... ≤$1.5 \cdot 10^{-2}$ mbar (1.1×10^{-2} Torr)

Maximum intake pressure
- in continuous operation* ..... 150 mbar (112 Torr)

Motor power ..... 4.0 kW (5.4 hp)

Rotational speed:
- 60 Hz operation ..... 3000 rpm
- 50 Hz operation ..... 3000 rpm

Noise level with the exhaust line connected .... 68 dB(A)

Cooling water requirements, approx:
- At water temp. of 15 °C (59°F) ... 100 l · hr $^{-1}$ (26 gal/hr)
- Maximum cooling water temp. ..... 25°C (77°F)
- Cooling water pressure* ..... 2–10 bar (14–130 psig)
- Cooling water connection, female threads NPT $^1/_2$"

Inert gas pressure* ..... 4–10 bar (43–130 psig)
Inert gas connection, female thread ..... NPT $^3/_8$"
Inert gas consumption ..... Refer to Table 2

Barrier gas pressure* ..... 1.5 bar (7 psig)
Purge gas pressure* ..... 3.0 bar (29 psig)

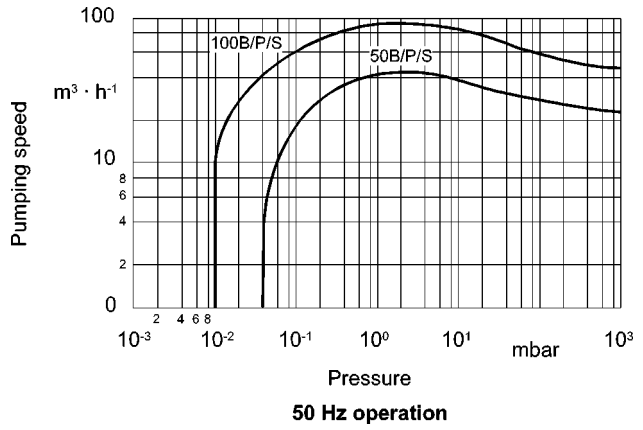
Air pressure for activating
- exhaust shutoff valve ..... 6–7 bar (72–87 psig)

Compressed air connection, female thread . NPT $^1/_4$"

Lubricant quantity gear box ..... 0.8 l (0.8 qt)
Maximum ambient temp. ..... 40°C (104°F)
Weight ..... 220 kg (485 lb)

Intake port ..... DN 63 ISO-K
Exhaust port ..... DN 25 KF

*All pressures given in bar or mbar are absolute values.



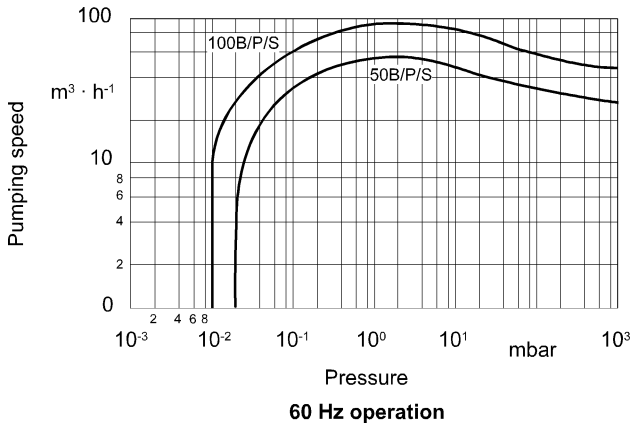
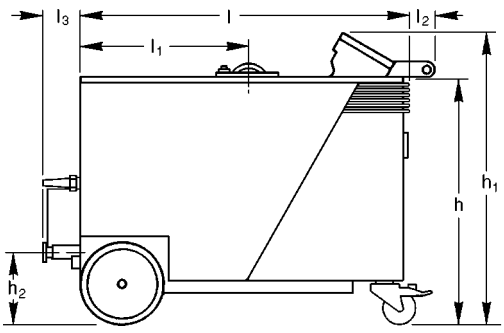
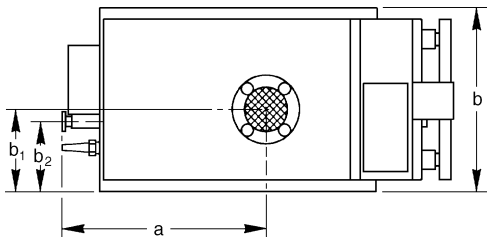


Figure 4 Pumping speed curves





Dimensions in mm

	a	b	b_1	b_2	h	h_1	h_2	l	l_1	l_2	l_3
50S	502	450	205	175	587	720	180	807	426	70	76
100S	476	450	170	187	598	720	203	866	410	70	66

Dimensions in inches

	a	b	b_1	b_2	h	h_1	h_2	l	l_1	l_2	l_3
50S	$19^3/_4$	$17^3/_4$	$8^1/_{16}$	$6^7/_8$	$23^1/_8$	$28^3/_8$	$7^1/_8$	$31^3/_4$	$16^3/_4$	$2^3/_4$	3
100S	$18^3/_4$	$17^{23}/_{32}$	$6^{23}/_{32}$	$7^3/_8$	$23^9/_{16}$	$28^{11}/_{32}$	8	$34^3/_{32}$	$16^5/_{32}$	$2^3/_4$	$2^{19}/_{32}$

h: upper edge of intake port

Figure 5 Dimensional drawing

1.4 Ordering Data

DRYVAC with motor:	**50S Catalog Number**	**100S Catalog Number**
200 V, 50 Hz, 3 phase	138 45	138 75
200 – 208 V, 60 Hz, 3 phase	138 45	138 77
400 (380) V, 50 Hz, 3 phase	138 46	138 76
Repair Kit	899553	899556
Exhaust silencer SD	137 50	137 50
Flush valve FS	137 60	137 65
Standby set SBV	137 70	137 70
LTO-Set	137 75	137 75
Battery backup	On request	On request
Drying canister for shipping and storage	200 78 563	200 78 563

2 Installation

2.1 Adapting the Pump to the Process

Warning

If the DRYVAC has pumped hazardous gases, you must determine the nature of the hazard and take the appropriate safety precautions. Comply with all safety regulations. Take adequate safety precautions before opening the intake or exhaust.

The DRYVAC is delivered set up for the processes of group B in Table 2 – unless specified otherwise by the sales order . This setup opens the purge-gas supply to the individual pump stages.

If your process is in the "C" group in Table 2, install the LTO set as described in Section 2.9.3.

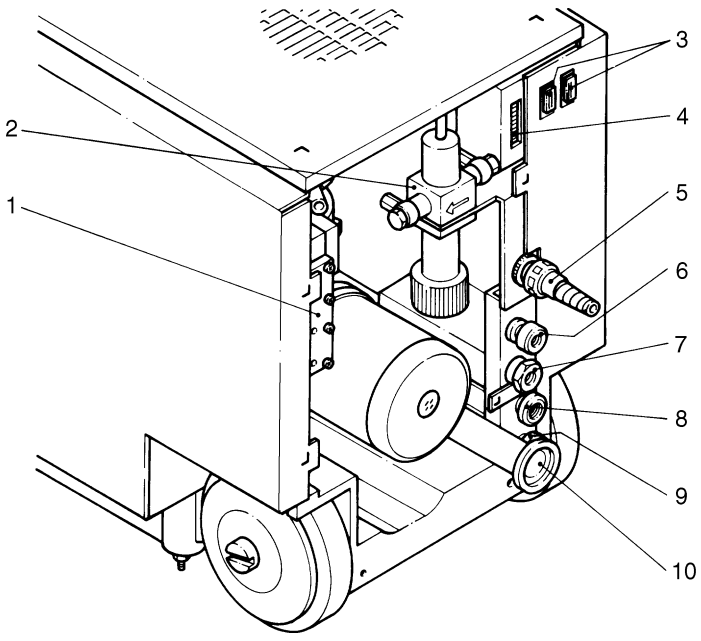
If your process is in the "A" group in Table 2, seal of f the supply of purge gas into the pump stages as follows (see Figure 6):

1. Open the four $^1/_4$-turn retaining clips and take of f the rear housing panel.
2. Remove the eight screws securing the plate (6/1) to the interstage purge block; remove the plate.
3. Turn over the plate and reinstall it with the outside in; when installed correctly for process A, the side of the plate marked "ETCH" faces out and the side marked "CVD" faces in.
4. Reinstall the rear housing panel.

2.2 Setting up the Pump

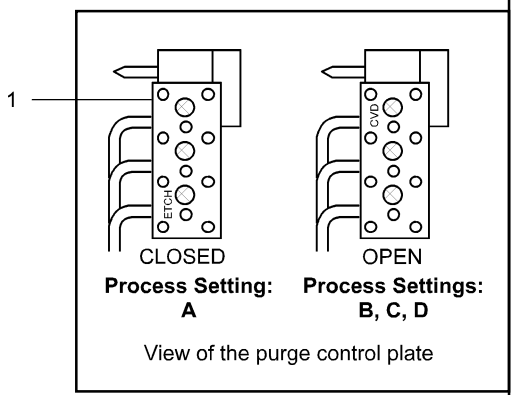
Set the pump on a flat even surface in a dry location. Lock the casters after the pump is in place.

The ambient temperature must not exceed 40 °C (104°F). Don't obstruct the ventilation grids. If installing the pump in an enclosed cabinet or system, ensure that suf ficient ventilation is available.



Key to Figure 6

1 Purge control plate
2 Thermostat valve
3 Interface/Sub-D connectors (X18 & X19)
4 DIP switches
5 Main power connection
6 Compressed air connection
7 Inert gas connection
8 Cooling water inlet
9 Cooling water outlet
10 Exhaust port



View of the purge control plate

Figure 6 Rear connectors and operating controls (with rear panel removed)

*Table 2 — Process Settings**

Process Group Setting	DIP Switch Setting	Processes	Thermo-stat Valve Setting	Purge Control Plate	Option Required	Inert Gas Consump-tion	Pump Operating Temp.
A	5 ON 6, 7, & 8 OFF	Al-Etching, Si-Etching, Poly-Si-Etching, SiO_2-Etching Tungsten-Etching	4	ETCH side out	No	1000-1500 Nl/hr	47-63°C 117-145°F
B	6 ON 5, 7, & 8 OFF	MOCVD, PECVD-SiO_2 PECVD-Si_3N_4, PECVD-TEOS, PECVD-Poly-Silicon, PECVD-PSG, PECVD-BPSG PECVD-W, PECVD-WSi_2, LPCVD-SiO_2, LPCVD-Si_3N_4, LPCVD-Poly/Silicon, LPCVD-TEOS, LPCVD-W, Ion implanter	4	CVD side out	No	4000-5000 Nl/Hr	47-63°C 117-145°F
C†	7 ON 5, 6, & 8 OFF	LTO, LPCVD-PSG, LPCVD-BPSG	2	CVD side out	LTO-Set	6000-7000 Nl/hr	27-43°C 81-109°F
D†	8 ON 5, 6, & 7 OFF	LPCVD-WSi_2	2	CVD side out	No	4000-5000 Nl/hr	27-43°C 81-109°F

* Consult your Leybold sales representative to confirm the correct process setting for your application.
† Additional DRYVAC modifications may be necessary for these applications. Consult your Leybold sales representative for additional information.

2.3 Electrical Connections

Warning

Electrical connections should be made only by a qualified and licensed electrician. Disconnect the pump from all voltages before beginning any assembly or disassembly work. Take measures to ensure that the pump cannot be started.

The following are the standard DR YVAC voltages and frequencies:

Catalog Number **Voltage, Frequency**

138 45 .... 200 V, 50 Hz / 200–208 V, 60 Hz, 3 phase
138 46 ..... 400 (380) V, 50 Hz, 3 phase
138 75 ..... 200 V, 50 Hz, 3 phase
138 77 ..... 200–208 V, 60 Hz, 3 phase
138 76 ..... 400 (380) V, 50 Hz, 3 phase

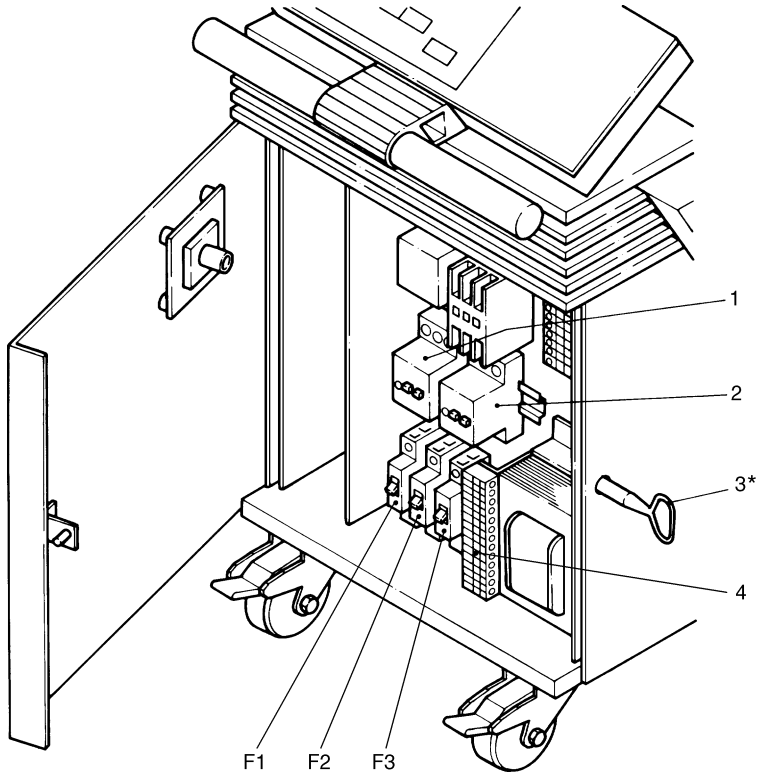
Other voltages are available on request.

Catalog numbers 138 45 and 138 77 are preset at 208 V , while 138 46 and 138 76 are preset at 380 V . If your local AC power source varies from these settings, refer to Section 2.3.1 to change the transformer settings so that the control voltage is as exact as possible.

Connect the pump's AC line cord to its rated AC voltage and frequency through a suitable circuit breaker (see the DRYVAC nameplate). **Don't turn ON the breaker** until all electrical and vacuum connections have been made.

DRYVAC	Main power	Max. current
50 S	3 PE AC 200 V, 50 HZ	13 A
	3 PE AC 200-208 V, 60 Hz	13 A
	3 PE AC 400 (380) V, 50 Hz	7.5 A
100 S	3 PE AC 200 V, 50 HZ	17 A
	3 PE AC 200-208 V, 60 Hz	17 A
	3 PE AC 400 (380) V, 50 Hz	9.5 A

Protective earth conductors (grounds) shall always be installed in accordance with applicable codes and shall be continuous and uninterrupted.



Key to Figure 7

1 Motor protection switch for drive motor
2 Motor protection switch for transformer
3 Power supply cabinet key*
4 Terminal block
F1 Circuit breaker
F2 Circuit breaker
F3 Circuit breaker

* Your model of the DRYVAC may not have a cabinet key. The key has recently been eliminated and replaced with a screwdriver slot.

Figure 7 Opening the front door

Caution **If you are adding a purge to the foreline, install a solenoid valve that automatically shuts off this purge when power to the DRYVAC is disconnected. Otherwise, the DRYVAC could be damaged from excessive pressure after power is disconnected.**

Refer to Section 2.3.2 if you want to connect the DRYVAC to an external remote control.

2.3.1 Setting the Pump to the Operating Voltage

The DRYVAC's transformer generates the voltages required for control and regulation.

DRYVAC model 100S catalog number 138 75 can be set only to 200V – its transformer can't be adjusted.

DRYVAC catalog numbers 138 76 and 138 46 are preset at 380 V; if your local AC power source is 390 V or 400 V, change the transformer setting as described below.

DRYVAC catalog numbers 138 77 and 138 45 are preset at 208 V; if your local AC power source is 200V, change the transformer settings as described below.

Warning

Disconnect the DRYVAC from your AC power source before making any electrical connections. Electrical connections should be changed only by a qualified electrician.

1. Turn of f the main switch and open the front door with the power supply cabinet key (7/3). Note that the key has been replaced with a screwdriver slot on recent pump models.
2. Change the connection of a black lead at the terminal block (7/4) to match the voltage of your local AC power source.
3. Ensure that the motor protection switches (7/1 and 7/2) and the automatic circuit breakers F1, F2, and F3 are turned ON. Then, close the front door.

The pump can be modified for use with other supply voltages or frequencies. Contact Leybold for details.

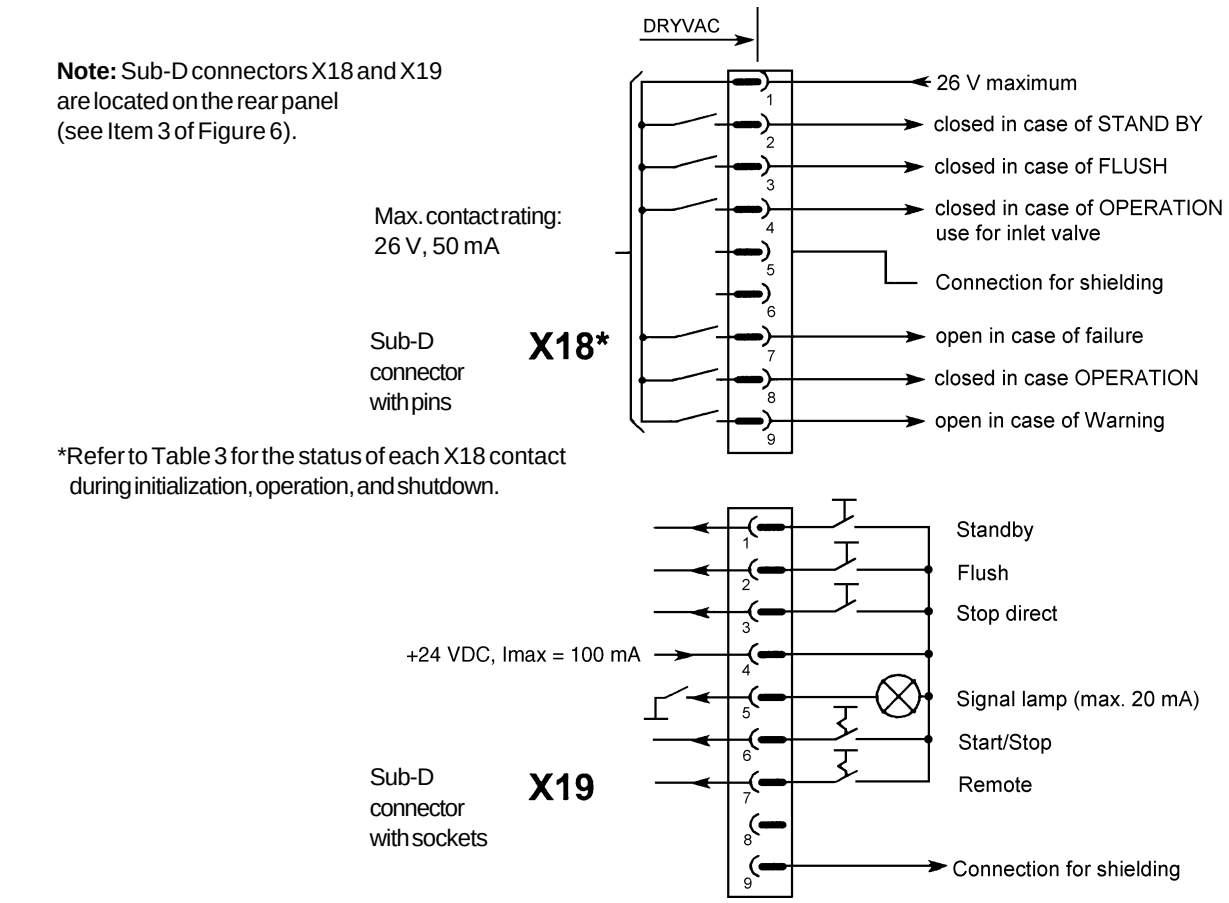


Figure 8 Contacts of the parallel interface

2.3.2 Connecting an External Remote Control

The parallel interface allows the DR YVAC to be connected to an external remote control. The connection is made via two 9-pin sub-D connectors (6/3).

Connector X18 allows you to check the DR YVAC operational status.

Connector X19 allows for remote control of the DR YVAC by way of floating (dry) contacts.

The voltage source for the control circuits must be provided from the secondary windings of an isolation transformer or from some other isolated source. In addition, ensure that the control voltage applied to Terminal 4 of X19 does not exceed 24 V (AC or DC), and that the contact load of each switch connected to X18 does not exceed 26 V AC/DC @ 50 mA.

The DRYVAC's input and output signals must be positively isolated from potentially hazardous voltages in down-line processing. This isolation shall be effective even if there is a defect in the electrical system.

Caution

Do not connect equipment to terminals other than the ones listed in the following instructions.

Failure to connect the switches as described may result in major damage to the pump, and lead to a loss of warranty.

Figure 8 shows the pin-out of the individual contacts of the sub-D connectors. See Table 3 for the status of each X18 contact during initialization, operation, and shutdown

The customer-supplied lines for plugs X18 and X19 must be shielded control lines. Connect the shielding according to Figure 8.

Standby Contact

(applies only if you have the stand-by set option)

Momentarily closing the contact changes the status of the purge valves. It closes the purge-gas valves to the pump stages if they were open; if they were closed, it opens them.

Table 3 — Interface (X18) Contact Status

		Run			
X18 Contacts	**Initialization/Ready to Start**	**Wait**	**Operation**	**Rundown**	**Off**
1 & 7 (Fail)	Close	Close	Close	Close	Open
1 & 8 (Operation)	Open	Open	Close	Open	Open
1 & 9 (Warning)	Close	Open	Close	Close	Open

Flush Contact
(applies only if you have the flush-valve option)

Momentarily closing the contact changes the status of the flush valve. It closes the flush valve if it was open; it opens the flush valve if it was closed.

Direct Stop Contact

When the direct stop contact closes, the DR YVAC is shut down immediately; **there is no run-down phase**. Use this contact only in emergencies.

Signal lamp

A signal lamp, which lights when the DR YVAC is operating, can be connected via contact 5 of connector X19.

Start/Stop Contact

The DRYVAC can be started via the Start/Stop contact if the control unit hasn't received an alarm message.

If you shutdown the DR YVAC at the control unit, it won't restart automatically even if the contact is closed. To restart the pump, open the contact and close it again.

If the DR YVAC doesn't start (the signal lamp doesn't light), review the error report at the control unit (refer to Section 3.7).

Remote Contact

When the remote contact is open, commands can be given simultaneously from the parallel interface and the control unit. **When the remote contact is closed, all of the buttons on the control unit are disabled except REPORT. The DRYVAC can only be operated through the remote control interface.**

Disconnecting the Control Unit

The control unit can be removed from the DR YVAC and installed up to 2.5 meters (8 feet) away as follows:

1. Remove four screws on the front of the control unit to remove it from the pump enclosure.
2. Disconnect the cable plug from the back of the control unit.
3. Use the adapter cable supplied with the DR YVAC to connect the control unit to the cable.
4. Install the control unit at its new location. Its front panel dimensions allow it to be mounted in half of a standard 19" rack (3 height modules). Don't attempt to extend the cable any farther than its maximum permissible extension of 2.5 meters (8 feet).

2.4 Connecting the Cooling Water

The cooling water should have the following properties:

pH	7.0 to 8.5
Chloride (Cl^-)	≤ 75 mg/l = 2.1 mmol/l
Sulfate (SO_4^{--})	≤ 70 mg/l = 0.7 mmol/l
Calcium ions	> 1.0 mmol/l = 100 ppm
	≤ 2.7 mmol/l = 268 ppm
Hydrogencarbonate hardness	125 to 179 ppm

Significant deviations from the recommended values may result in premature corrosion or deposits.

Connect the cooling water lines. Ensure that your water supply line is connected to the DRYVAC water inlet (6/8) and your drain line is connected to the DRYVAC water outlet (6/9).

If you will be using a water-flowmeter, install it in the water-supply line rather than in the drain line.

Caution **Operation without cooling water will damage the DRYVAC.**

Note: Special modifications may be required when using deionized (DI) water. Consult your Leybold sales or service representative for information.

Note: If you will be using a closed-loop cooling system, flush out the DRYVAC's cooling water to remove any residual rust before connecting the pump to your cooling system; also add a rust inhibitor to the cooling water.

The DRYVAC is shipped without cooling water. Fill the cooling channels as follows:

1. Open the four 1/4-turn retaining clips on the rear of the pump and remove the rear panel.
2. Open the thermostat valve all the way down.
3. Open the cooling water supply and wait until the water flows out of the cooling water outlet.
4. Set the thermostat to the recommended setting for your process (refer to Table 2). Contact your Leybold sales or service representative if you have questions about the correct thermostat-valve setting.

Caution **Operating the DRYVAC with an incorrect thermostat valve setting may cause premature failure of the pump and void the warranty.**

2.5 Connecting the Inert Gas and Compressed Air Supply

Remove the shipping seal from the DRY NITROGEN fitting (6/7) and connect your inert gas supply. The supply pressure should be 4 to 10 bar absolute (43 to 130 psig). Dry nitrogen is normally used as the inert gas.

Remove the shipping seal from the COMPRESSED AIR fitting (6/6) and connect your compressed air supply. The air pressure should be 6 to 7 bar absolute (72 to 87 psig). **Ensure that the compressed air pressure remains above 5 bar (58 psig) during operation. Even a brief drop below 5 bar (58 psig) will cause the DRYVAC to automatically shut down.**

2.6 Setting the Pump to Match the Process

This section describes how to set each of the eight DIP switches (6/4) on the rear of the DR YVAC. The setting for switches 5 through 8 depends on your process as listed in Table 2. Turn of f the main switch (10/2) before setting the DIP switches.

DIP Switch 1: Response following a power failure.

Switch 1 should always be switched ON.

Switch 1 OFF – The pump remains off after a power failure.

Switch 1 ON – The pump returns to its previous operational status when the power returns. "AUT O START" appears on the DR YVAC's LCD display .

Exception: If a power failure occurs during run-down, the pump remains off.

DIP Switch 2: Battery backup

Switch 2 is switched ON when the battery backup option is installed. Refer to Section 2.9.4.

DIP Switch 3: Sets the timer for low oil pressure.

This switch is normally OFF; it must be reset to OFF after a repair as explained in Section 3.4.4.

DIP Switch 4: Language on the display

Switch OFF – Text on the display is in German.

Switch ON – Text on the display is in English.

DIP Switches 5 to 8: Setting to match the process.

Refer to Table 2 to determine if your process is in group A, B, C, or D. Only one process setting can be ON; the rest must be off.

Process A – Switch 5 ON; Switches 6, 7, & 8 OFF .

Process B – Switch 6 ON; Switches 5, 7, & 8 OFF .

Process C – Switch 7 ON; Switches 5, 6, & 8 OFF .

Process D – Switch 8 ON; Switches 5, 6, & 7 OFF .

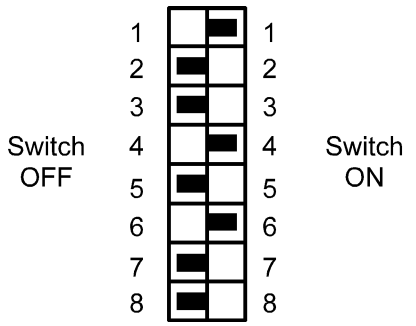


Figure 9 DIP switches - typical settings for Process B and no battery backup

After setting the DIP switches, turn ON the main switch:

Initialization

is displayed for about 2 minutes while the DR YVAC checks the settings. The pump won't respond to any commands until it finishes this internal check.

Once its internal check is finished, the DR YVAC displays the process setting; for example:

PROC SETTING PROCESS A Confirm!

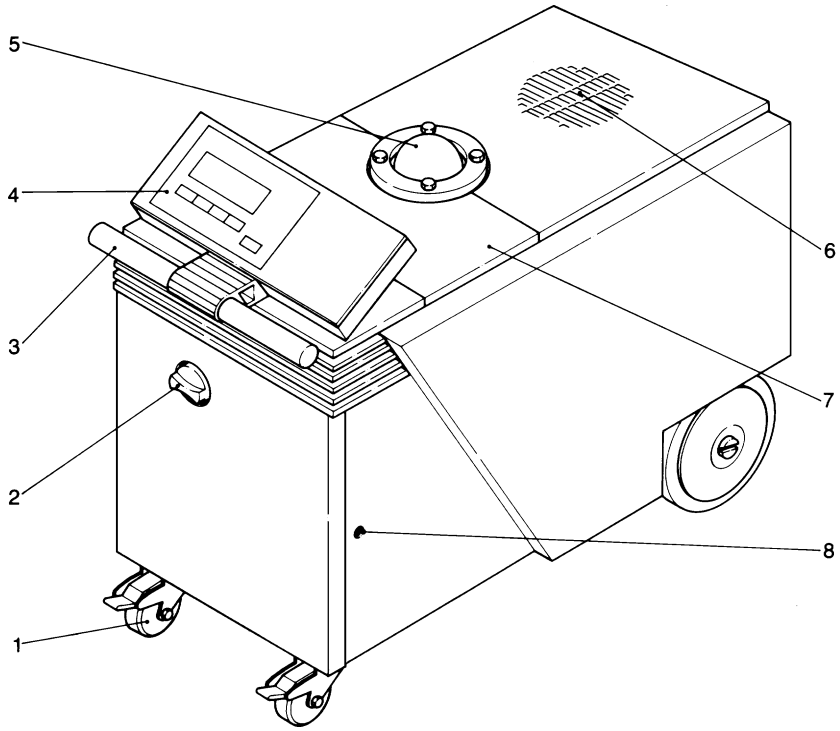
is displayed.

- **If the process displayed is wrong,** turn off the main switch and reset DIP switches 5 through 8 according to Table 2.
- **If the process displayed is correct,** confirm by *simultaneously* pressing the REPORT and STOP buttons.

Once you have confirmed the process, the DR YVAC displays the following:

PROCESS A Ready to start

Check the direction of rotation as described in Section 2.7 before starting the pump.



Key to Figure 10

1 Locking casters
2 Main power switch
3 Handle
4 Control unit
5 Intake port
6 Outlet for housing ventilation
7 Middle segment of top cover
8 Power supply cabinet door lock

Figure 10 Connectors and operating controls at front

2.7 Checking the Direction of Rotation

Warning

If the pump previously pumped hazardous gases, take appropriate precautions.

Caution

Don't remove the shipping seals until you are ready to install the pump. The pump's interior must be protected against humidity as long as possible.

Check the direction of rotation as follows:

1. Remove the shipping seals from the intake port (see Figure 11) and ensure that the pump's intake and exhaust ports are open. Save the shipping seals for future use.
2. Loosen the two 1/4-turn retaining clips and remove the middle segment of the top cover (10/7).
3. **Briefly** switch ON the pump and check whether the motor fan turns in the direction indicated by the arrow decal on top of the motor; then immediately shutdown the pump at the main switch. **If the pump rotated in the wrong direction,** ensure that the incoming power to the pump is OFF and then interchange two of the input leads at the motor junction box.

   The pump will automatically shutdown if you allow it to run in the wrong direction for more than 3 seconds (refer to Section 3.4.4).
4. Reinstall the cover .

Warning

During operation, the pump's temperature can exceed 100°C (212°F). All housing panels and covers must be reinstalled to protect the operators against contact with the hot pump.

2.8 Connecting the Intake and Exhaust Lines

Caution **Air/moisture leaks in the system's inlet or exhaust line can cause deposits and premature failure.**

2.8.1 Connecting the Intake Line

The intake line should have the same or larger diameter than the DR YVAC intake flange. The line must be clean and oil-free.

We recommend installing a valve between the pump and the vacuum chamber . Wire the valve so that it opens only when the DR YVAC is in the OPERA TION mode. A contact (Sub-D connector X18, contact 4) is available at the interface for controlling this inlet valve (see Figure 8).

A RUVAC WS/WSU 251/501 roots pump can be connected directly to the DR YVAC intake port.

Connect the intake line to the intake port; use bellows to eliminate tension in the line.

If dirt might enter the pump from the vacuum chamber or from the piping, ensure that the screened dirt trap is installed in the DR YVAC's intake flange.

When etching aluminum, we recommend that the intake line be at least 100 mm (4 inches) in diameter or be heated to at least 80 °C (176°F).

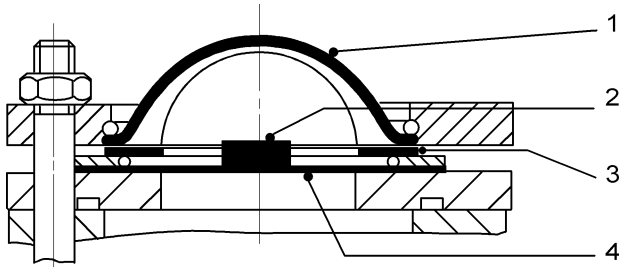
LPCVD nitride and TEOS applications may require special configurations to ensure satisfactory DR YVAC operation. Consult your Leybold sales or service representative.

2.8.2 Connecting the Exhaust Line

Connect the exhaust line; use bellows to eliminate tension in the line.

The exhaust line should have the same or larger diameter than the DR YVAC exhaust flange. The exhaust line must be able to withstand 1.5 bar absolute (7 psig) since the DRYVAC doesn't automatically shutdown until the exhaust pressure increases to 1.5 bar (7 psig).

Keep the exhaust line free of deposits. If the flow in the exhaust line becomes restricted, deposits often collect in the DRYVAC.



Key to Figure 11
1 Shipping cap
2 Drying canister
3 Gasket
4 Sealing disc

Figure 11 Shipping Seals

Avoid connecting the DR YVAC together with oil-sealed pumps to one central exhaust system. Using a common exhaust line could result in condensate backstreaming into the DR YVAC or in dust adhering in the exhaust line.

Special modifications may be necessary to eliminate noise and vibration when connecting several exhaust lines to a single plenum. Consult your Leybold sales or service representative.

The outlet for the ventilation air is on the top of the DRYVAC; if necessary , you can place an exhaust hood over the pump for certain clean-room applications.

2.9 Options (Standby, Flush, LTO, and Battery)

2.9.1 Standby Option

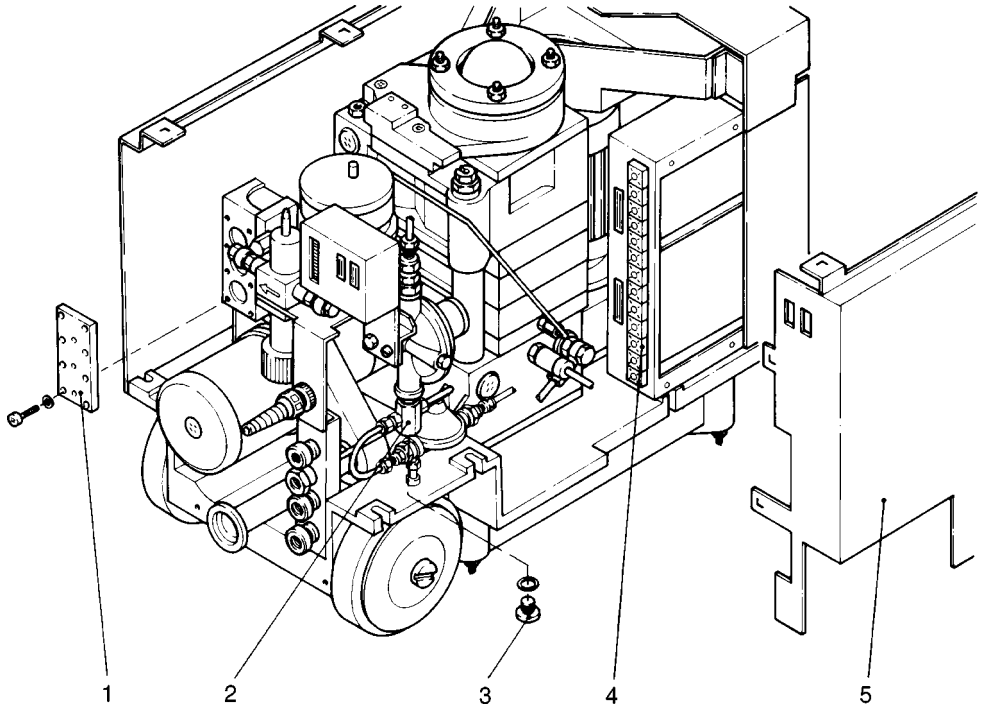
When the standby set is installed, the flow of purge gas into the pump stages can be stopped by pressing the STANDBY button on the control unit.

When the ST AND BY button is pressed,

STANDBY

is displayed.

The flow of purge gas to the 2nd, 3rd, and 4th pump stages is shut of f. The standby contact at the parallel interface closes and the OPERA TION contact opens.



Key to Figure 12
1 Purge control plate
2 Filter housing
3 Plug screw
4 Signal receptacles
5 Right side panel

Figure 12 Installing the standby set on a DRYVAC 50S (the 100S model is similar)

Pressing the ST AND BY button again restarts the purge gas supply . If your DR YVAC is set to "PROCESS A", however , the purge gas supply to the pump stages remains of f.

The standby set consists of a purge-gas-valve plate with three electromagnetic valves. The DRYVAC control unit can switch these three valves simultaneously .

You can determine if the standby option is installed by pressing the REPOR T button as described in Section 3.7; "Installed Options" is the last item in the report sequence.

Warning

If the DRYVAC has pumped hazardous gases, determine the nature of the hazard and take the appropriate safety precautions. Comply with all safety regulations. Take adequate safety precautions before opening the purge control plate.

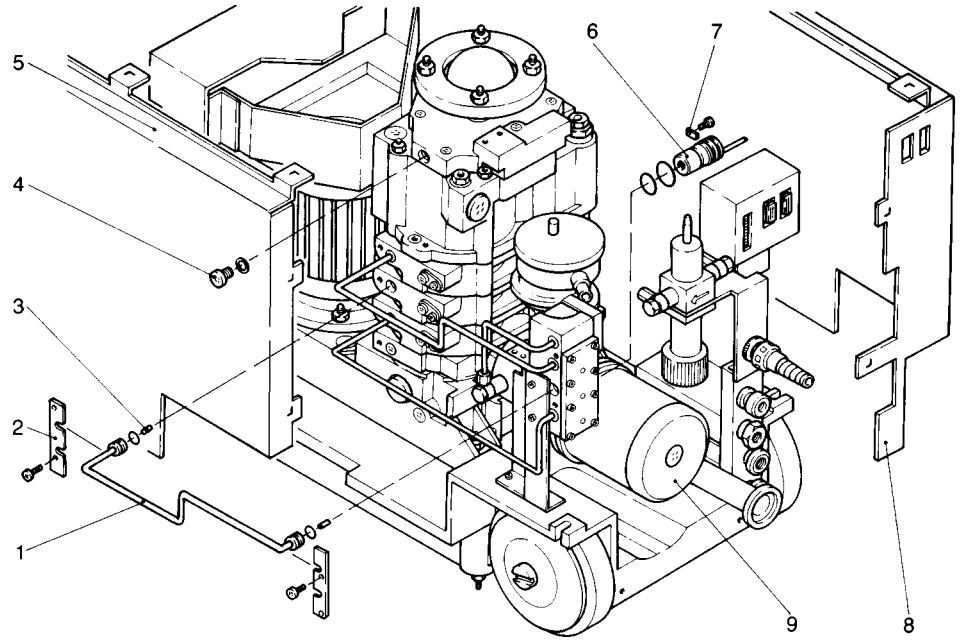
Disconnect the pump from your AC power source before starting work.

Install the standby set as follows:

1. Open the four $^1/_4$-turn retaining clips and take off the rear panel.
2. Open the $^1/_4$-turn retaining clips and remove the cover .
3. Loosen the two wingnuts below the right side panel (12/5) to remove it.
4. Unscrew eight capscrews and remove the purge control plate (12/1). In its place, install the electromagnetic valves. Ensure that the rubber seals fit properly .
5. Connect each valve plug to its signal receptacle (12/4) as listed below:

Purge gas valve	Receptacle
2nd stage, Y17	2X 17
3rd stage, Y16	2X 16
4th stage, Y15	2X 15

6. Secure the electrical cables so they can't contact the pump casing or the exhaust.
7. Reinstall the side panel, the cover , and the rear panel. **Don't forget to reinstall the ground cables.**



Key to Figure 13
1 Purge gas tube, 3rd stage
2 Retainer plate
3 Nozzle
4 Plug screw
5 Right side panel
6 Flow indicator
7 Retaining plate
8 Left side panel
9 Exhaust silencer

Figure 13 Installing the flush valve and LTO set on a DRYVAC 50S (100S is similar)

2.9.2 Flush Valve Option

When the flush option is installed, the pump can be flushed with purge gas by pressing the FLUSH button.

When the FLUSH button is pressed,

FLUSH

is displayed. The flush valve is opened and purge gas flows below the intake port into the pump. If the standby set is installed, the purge gas valves also open.

The flush valve closes automatically after 5 minutes. You can close it sooner by pressing the FLUSH button a second time.

You can determine if the Flush option is installed by pressing the REPORT button as described in Section 3.7; "Installed Options" is the last item in the report sequence.

Warning

If the DRYVAC has pumped hazardous gases, determine the nature of the hazard and take the appropriate safety precautions. Comply with all safety regulations. Take adequate safety precautions before opening the purge-gas tubing.

Disconnect the pump from the your AC power source before starting work.

Proceed as follows to install the flush valve:

1. Remove the DR YVAC panels as follows:
   a. Open the four $^1/_4$-turn retaining clips and take off the rear panel.
   b. Open the $^1/_4$-turn retaining clips and remove the cover .
   c. Loosen the two wingnuts below each side panel (13/8 and 13/5) and remove the left and right side panels.
2. Remove plug screw (13/4). In its place, screw the tube complete with solenoid valve into the threaded hole on the intake port.
3. Remove plug screw (12/3) from filter housing (12/2). In its place, connect the tube from the flush kit. Connect the other end of this tube to the solenoid valve/tube assembly installed in step 2.
4. Connect the valve plug to its signal receptacle (12/4) (receptacle 2X 14).
5. Secure the electrical cables so they can't contact the pump casing or the exhaust.
6. Reinstall the side panels, the cover , and the rear panel. **Don't forget to reinstall the ground cables.**

2.9.3 LTO Option

The LTO set must be installed for processes included in the "PROCESS C" group (refer to Table 2). It results in a large flow of purge gas into the 3rd pump stage. The flow indicator for the 3rd stage is also modified. Contact your Leybold sales or service representative for recommendations for these applications.

You can determine if the LTO option is installed by pressing the REPORT button as described in Section 3.7; "Installed Options" is the last item in the report sequence.

Warning

If the DRYVAC has pumped hazardous gases, determine the nature of the hazard and take the appropriate safety precautions. Comply with all safety regulations. Take adequate safety precautions before opening the purge-gas tubing.

Disconnect the pump from your AC power source before starting work. Proceed as follows to install the LTO set:

1. Remove the DRYVAC panels as follows:
   a. Open the 1/4-turn retaining clips and remove the cover.
   b. Loosen the two wingnuts below each side panel (13/8 and 13/5) and remove the left and right side panels.
   c. Remove the two retainer plates (13/2).
2. Install the new nozzle as follows:
   a. Pull out the center purge-gas tube (13/1).
   b. Unscrew the nozzle (13/3) and replace it with the LTO-set nozzle.
   c. Reinstall the tube (13/1).
3. Install the new 3rd-stage flow indicator as follows:
   a. Disconnect the plug of the 3rd-stage flow indicator from its receptacle 2X 9 (12/4).
   b. Remove the retaining plate (13/7).
   c. Pull out the flow indicator (13/6) for the 3rd stage and replace it with the LTO flow indicator.
   d. Insert the plug of the LTO flow indicator into signal receptacle 2X 9.
   e. Secure the electrical cables so they can't contact the pump casing or the exhaust.
4. Reinstall the retaining plates (13/2 and 13/7).
5. Reinstall the side panels and the cover. **Don't forget to reinstall the ground cables.**

2.9.4 Battery Backup Option

The battery backup option affects the pump's operation as follows:

- It skips the 2-minute initialization period during start-up and after a power failure.
- It keeps the pump running during a short power failure. If the power failure lasts for longer than one second, the pump shuts down.
- It allows you to restart the pump during the 10-minute rundown by pressing START.

The battery backup option must be installed at our factory or at one of our service centers.

Before starting the pump, ensure that the second dip switch (switch 2) is set to the ON (right) position.

The Sub-D connectors on the battery box are identical to the ones on the pump except for contact 7 of X18. Contact 7 of X18 or X18-1 **on the battery box** sends a failure signal when the pump is off. Contact 7 of X18 **on the pump** does not send a failure signal when the pump is off.

The battery is fully charged when you receive the pump, and it recharges as the pump runs. Thus, it is not normally necessary to recharge the battery. The battery should last for about 5 years.

To check the battery, turn off the main power switch. If the battery is OK, the background light on the display will dim but the text will remain visible for about 5 seconds. If the battery is discharged, the display and text will fade immediately when you switch off power.

If you do need to recharge the battery, turn the pump's power switch ON and allow it to recharge for 24 hours before starting the pump.

If you have the AMAT interface PC board installed, the status of all X18 interface contacts are the same as shown in Table 3 except that contact 1 & 7 (Fail) are open during initialization.

Note: The FLUSH or STAND BY button operates only if the optional flush or stand-by kit is installed.

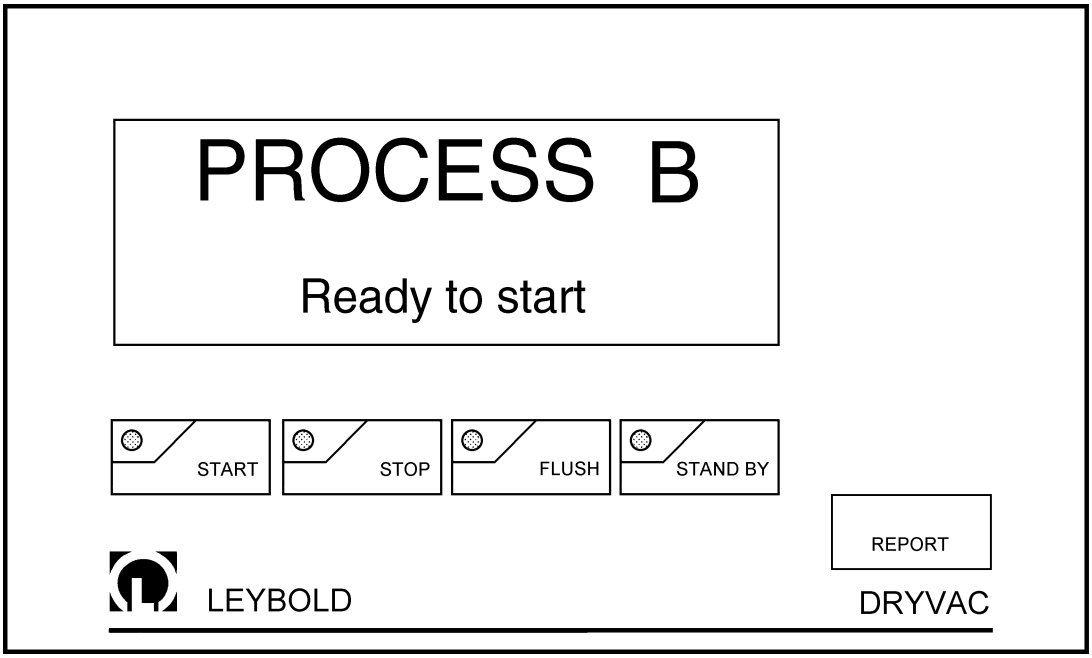


Figure 14 Control unit display

3 Operation

Before starting the pump, use the start-up checklist on page 32 to ensure that the pump is set up properly .

3.1 Start-up

Caution **Do not open the pump to process gas until the display indicates "OPERATION." If you open the pump to process while the display indicates "WAIT," vapors may condense in the pump.**

1. Switch ON the pump.

   Initialization

   is displayed for about 2 minutes while the DR YVAC checks the settings.

   You can not operate the DR YVAC until it finishes this internal check.

2. Open the inert gas supply; ensure that the inert gas pressure is at least 4 bar abs. (43 psig).

3. Open the compressed air supply; ensure that the air pressure is 6 to 7 bar abs. (72 to 87 psig).

4. Open the cooling water supply .

   The DRYVAC displays the following:

   PROCESS A, B, C, or D
   Ready to start

   The STOP LED lights up.

5. Press the ST ART button.

   The STOP LED goes out and the ST ART LED flashes.

   RUN-UP

   is displayed.

   After the pump has run up, it must reach the temperature required for the process that you selected. While the DR YVAC is warming up,

   WAIT
   Process temp. <tmin

   is displayed. This W AIT status lasts about 20 to 40 minutes.

When the pump has reached its process temperature,

OPERATION

is displayed. The DRYVAC is ready to evacuate process gases.

Section 3.7 describes how to use the REPORT button. The FLUSH and STAND BY buttons operate only if the optional flush or stand-by kit is installed on your DRYVAC (refer to Section 2.9).

If the motor protection switch trips when evacuating a large vacuum chamber, pre-evacuate the chamber with a small diameter line (soft pump line).

3.2 Pumping Non-Aggressive Gases

The DRYVAC is designed to pump aggressive gases during semiconductor production.

It can also be used to pump clean gases by setting the pump to "PROCESS A" and starting it. When the pump is in the OPERATION status, shut off the inert gas supply.

You can ignore the "W N2 pressure" warning when pumping clean gases.

Caution **When the inert gas supply is shut off, the shaft seals aren't protected against dust or against aggressive gases or vapors.**

3.3 Shutdown

We recommend that you operate the DRYVAC continuously. Allow it to continue operating overnight with its inlet closed to avoid corrosion during idle periods.

To shutdown, press the STOP button.

RUN-DOWN

is displayed. The pump continues to run for 10 minutes with the inert gas valve open. The STOP LED flashes.

Then the motor is switched off and the main inert gas valve and the shutoff valve are closed. The STOP LED lights.

In an emergency, you can use the main switch to shutdown the pump without purging. If you shutdown the pump without purging, correct any malfunctions, restart the pump, and then shut it down with inert-gas purging to remove toxic or hazardous gases from the pump.

Caution **If you have a foreline purge, shut off this purge flow when power is disconnected from the DRYVAC. Purging the foreline after power is disconnected could result in damage to the pump from excessive pressure. The pump's exhaust valve cannot open to release the pressure when power is not available to the pump.**

Warning

During operation, the pump's temperature can exceed 100°C (212°F). Always allow the pump to cool down before removing it from the system or before opening its housing.

Warning

If the DRYVAC previously pumped hazardous gas, take appropriate precautions before opening the intake or exhaust.

If the DRYVAC will be shutdown for an extended period, seal its intake and exhaust ports, and purge it with inert gas at a pressure of 1,000 mbar (760 Torr); refer to Section 3.5.

Refer Section 3.6 if the DRYVAC will be disconnected from the system.

3.4 Response to Malfunctions

Refer to Section 5 (troubleshooting) for the recommended corrective actions for each error displayed on the control unit.

3.4.1 Process Temperature Fault

Note: The DRYVAC warning and alarm temperatures referred to in Table 1 are independent of the process; these temperature limits are set to prevent excessive temperature from damaging the pump.

The operating temperatures listed below are automatically set depending on which process group you selected in Section 2.6.

Process Group Setting	A, B	C, D
Thermostat valve setting	4	2
Minimum operating temp.	47°C (117°F)	27°C (81°F)
Maximum operating temp.	63°C (145°F)	43°C (109°F)

If the pump is below the minimum operating temperature for the selected process,

Process temp < tmin

is displayed and the pump shifts to the W AIT status. It switches back to the OPERA TION status only after the temperature rises 3 °C (5°F) above the minimum operating temperature.

If the pump is above the maximum operating temperature for the selected process,

Process temp > tmax

is displayed and the pump shifts to the W AIT status. It switches back to the OPERA TION status only after the temperature drops 3 °C (5°F) below the maximum operating temperature.

Thus, there is a delay in returning to the OPERA TION status after a cold start or after a short overheating. The wait status lasts about 20 to 40 minutes during a normal cold start (refer to Section 3.1).

3.4.2 Warnings

When the first letter in the display is a "W" (W arning), the pump is approaching a critical operating limit; when the first letter is an "A" (Alarm), the pump shuts down because it exceeded a critical limit. Refer to Section 3.4.3 for information on Alarms.

If the flow indicator reading does not correspond to the process group setting,

W flow 3rd/4th stage

is displayed and the pump switches to the W AIT status. This is the only W arning that changes the pump' s status. Other warnings, such as "W temperature", just alert you that the pump is approaching a critical operating limit, but they don't change the pump's operational mode. When a warning is displayed, determine the source of the problem and correct any malfunctions.

Note: If the DR YVAC is set to "Process A" and it does not display the "W N2-Pressure" warning when you shut off nitrogen to its "dry nitrogen" port, contact Leybold concerning the N2-purge retrofit (P/N 200-77-009).

3.4.3 Alarms

When the following "A" (alarm) messages are displayed, the DR YVAC **shuts down immediately** and automatically closes the main inert gas valve and the exhaust shutof f valve:

- A Motor protection switch
- A Motor contactor
- A Temperature
- A Exhaust pressure
- A Shutof f valve

After eliminating any malfunctions, restart the DR YVAC and then shut it down with an inert gas purging cycle. Shutdown with inert gas purging removes toxic or hazardous gases from the pump.

3.4.4 Oil Pressure Warning and Alarm

The warning

W Lubrication

is displayed if the oil pressure in the DR YVAC gear box remains under 1.5 bar (7 psig) for longer than 3 seconds while the pump is running .

A timer starts when this warning is displayed and begins decreasing from 240 minutes (4 hours). The current counter reading can be displayed by pressing the REPORT button. The pump automatically shuts down and displays

A Lubrication

when the counter reaches zero. This delayed shutdown allows you to complete your process. Following shutdown, the pump must be repaired. After repair , reset the timer to 240 minutes as follows:

1. Turn DIP switch 3 ON while the pump is shutdown (see Figures 6 and 9).
2. Turn the pump ON at the main switch.

   The message

   PROC. SETTING
   Set oil t = 4h
   Confirm!

   is displayed.
3. Press the REPOR T and STOP buttons simultaneously .

   The message

   Reset switch

   is displayed.

4. Turn of f DIP switch 3.

Another timer in the control unit records every period that the pump ran without oil pressure for more than 3 seconds. This counter can't be reset.

If the oil pressure is below 1.5 bar (7 psig) for more than 3 seconds **during run-up,** the pump switches of f.

3.5 Shutdown for an Extended Period

Press the STOP button. The pump continues to run for 10 minutes with the inert gas valve open. Then, the motor switches of f and the main inert-gas valve and the exhaust valve close.

Warnings

During operation, the DRYVAC's temperature can exceed 100°C (212°F). Always allow the pump to cool down before removing it from the system or before opening its housing.

If the DRYVAC previously pumped hazardous gas, take appropriate precautions before opening the intake or exhaust.

Isolate the pump's intake port from the system either by a valve or a blank flange, or vent the system and the pump with inert gas to a pressure of 1000 mbar (750 T orr).

Warning

If you continue to purge the pump with inert gas after shutdown, avoid exceeding a pressure of 1.5 bar (7 psig).

When the pump is at a standstill and the main switch is turned ON, the exhaust valve automatically opens when the pressure in the pump's exhaust exceeds 1.5 bar (7 psig). It closes again when the pressure drops. This process is repeated as long as incoming inert gas causes the pressure limit to be exceeded. This protects the pump from a detrimental overpressure at standstill. However, **you should not operate the pump in this way for an extended period.**

Warning

Hazardous process gas may be released from the DRYVAC or the process chamber when the exhaust valve opens. Therefore, always disconnect the pump from the mains before working near the exhaust to prevent the valve from opening. You must also shutoff the inert-gas flow to the pump when the exhaust valve can't open to prevent the pressure in the pump from rising to dangerous levels.

The control unit won't accept any operator commands while the exhaust valve is open in response to an overpressure during a standstill.

3.6 Storing and Shipping

Shutdown the pump as described in Section 3.3.

Warnings

During operation, the DRYVAC's temperature can exceed 100°C (212°F). Always allow the pump to cool down before removing it from the system or before opening its housing.

If the DRYVAC previously pumped hazardous gases, take appropriate precautions before opening the intake or exhaust.

Place drying canisters into the pump's inlet to protect the pump' s interior from moisture. Then, seal the DR YVAC's intake and exhaust ports. You can reuse the shipping seals that were originally on the pump (see Figure 1 1); but you must use new drying canisters (P/N 200-78-563).

Caution

Always drain the cooling water before storing or shipping the pump. Failure to drain the water can result in the water freezing and bursting the pump housing.

Turn off the cooling water supply and then drain the cooling water as described in the following paragraphs before storing or shipping.

Draining Water From the DRYVAC 100S Model

1. Open the four $^1/_4$-turn retaining clips on the rear panel, and take of f the panel.
2. Open the thermostat valve to a setting less than 1.
3. Disconnect the cooling water hoses and drain the water. Then blow out the cooling water lines with compressed air .
4. Reinstall the rear panel.

Draining Water From the DRYVAC 50S Model

1. Open the four $^1/_4$-turn retaining clips and take of f the rear panel.
2. Loosen the $^1/_4$-turn retaining clips on top of the pump and remove the top cover .
3. Loosen the two wingnuts below the left side panel and remove the panel.
4. Completely open the thermostat valve.
5. Disconnect the cooling water hoses; remove the M12x1.5 plug screw (2/8); and let the water drain out. Then blow out the cooling water lines with compressed air.
6. Reinstall the plug screw , left side panel, top cover , and rear panel.

The DRYVAC must be shipped either in a gas tight container or sealed in plastic.

If the pump will be returned to Leybold, it must be accompanied by a listing of all hazardous substances which might be present in or around it. Complete the form at the back of this manual before sending any equipment to Leybold.

3.7 Report (REPORT button)

Press the REPOR T button to display information about the pump' s operational status. Refer to Section 5, the troubleshooting chart, for the recommended corrective actions for each error report.

When the REPORT button is pressed,

DRYVAC V (Software-version)
REPORT

is displayed. Each report is displayed for 3 seconds before automatically moving on to the next report.

Information is displayed in the following sequence:

Stored alarms (A's), such as:

- A Temperature
- A Exhaust pressure
- A Shutoff valve
- A Motor protection switch
- A Motor contactor
- A Lubrication

These stored alarms indicate why the pump was shutdown.

Current alarms (A's) — These are the same as the stored alarms except that the pump isn't ready to restart. **Correct the malfunction before restarting the pump.**

Warnings (W's), such as:

- Process temp < tmin
- Process temp > tmax
- W Temperature
- W Exhaust pressure
- W Lubrication
- W N2 pressure
- W Flow

Warnings mean that the pump is nearing a critical limit but is still fully operational. **Determine the reason for the warning and correct any malfunction as soon as possible.**

For the "W N2 pressure" or "W flow" Warnings, you must shut off the process gas if the malfunction can't be eliminated immediately . Operating without purge will eventually cause serious damage to the DRYVAC. Refer to Section 3.2 if you are pumping clean gases.

Operating hours — Displays the total hours the unit has operated.

Process Temperature — Displays its cooling water temperature in °C.

Lubr. Lack — If the oil pressure in the gear housing has always been normal, the DR YVAC displays:

Lubr lack DV(4h) 240

and then:

Lubr lack DV 000.0 h

If the oil pressure is inadequate, the first display shows less than 4 hours (240 minutes). This indicates the time remaining until the DR YVAC shuts down because of insufficient oil pressure (refer to Section 3.4.4).

The second display shows the total cumulative time the DRYVAC has run with inadequate oil pressure. If the DRYVAC has never operated with inadequate oil pressure, the second display will indicate 000.0 hours.

Process Setting — Displays the process you selected such as A, B, C, or D (refer to Table 2 and Section 2.6).

Installed Option — Displays any installed options as such as:

- Standby set
- Flush valve
- LTO set

If no options are installed, it skips this item.

The report can be interrupted by pressing the REPORT button again. It can be restarted at any time.

Stored alarms can be ignored when the DR YVAC is being put into operation for the first time. If an error report is displayed when the DR YVAC is switched on, you must press the REPOR T button before starting the DR YVAC.

Once all malfunctions have been eliminated, you can re-start the pump by pressing the ST ART button. This erases all stored error reports.

4 Maintenance

4.1 Routine Maintenance

The DRYVAC may require rebuilding periodically depending on your application and your production cycle. In some installations, the rebuild interval may vary from 12 to 24 months. If you seldom need to clean the inlet and exhaust lines, then the rebuild interval could be longer. **Contact your Leybold service center for recommendations on rebuild intervals for your particular installation.** Also ask about the service options available in your region.

Typically, the only other routine maintenance is replacing the exhaust silencer if it becomes clogged (see Sec. 4.2).

All work must be done by suitably trained personnel. Maintenance or repair done by inexperienced personnel may affect the life and performance of the pump and may void the warranty.

Warnings

Disconnect the DRYVAC from your AC power source before maintaining or repairing the pump. Take appropriate precautions to ensure that the pump cannot be started.

During operation, the DRYVAC's temperature can exceed 100ºC (212ºF). Always allow the pump to cool before removing it from the system or before opening its housing.

If the DRYVAC has pumped hazardous gases, determine the nature of the hazard and take the appropriate safety precautions. Comply with all safety regulations.

Before doing any maintenance or repair, shutdown the DRYVAC as described in Section 3.3 and disconnect it from the system. Refer to Section 3.6 to prepare the pump for shipping.

Caution **Always drain the cooling water before storing or shipping the DRYVAC. Failure to drain the water can result in the water freezing and bursting the DRYVAC housing.**

If the DRYVAC will be returned to Leybold, it must be accompanied by a listing of all hazardous substances that might be present in or around it. Complete the form at the back of this manual before sending any equipment to Leybold.

4.2 Replacing the Exhaust Silencer

The spin-on exhaust silencer (13/9) may need to be replaced periodically in certain processes.

As deposits build up in the exhaust silencer, the DRYVAC exhaust pressure increases until,

W Exhaust pressure

is displayed. The DRYVAC can continue to operate; however, the exhaust silencer must be changed as soon as possible. Otherwise, the exhaust pressure will continue to increase until the DRYVAC switches off and

A Exhaust pressure

is displayed.

Refer to Item 7 of the troubleshooting chart for other possible causes of excessive exhaust pressure.

Warnings

Disconnect the DRYVAC from your AC power source before removing the exhaust silencer. Take appropriate precautions to ensure that the pump cannot be started.

During operation, the DRYVAC's temperature can exceed 100°C (212°F). Always allow the pump to cool before removing it from the system or before opening its housing.

If the DRYVAC has pumped hazardous gases, determine the nature of the hazard and take the appropriate safety precautions. Comply with all safety regulations.

Change the exhaust silencer (P/N 137 50) as follows:

1. Open the four $^1/_4$-turn retaining clips and take off the rear panel.
2. Use the Allen key supplied with the pump, and a 17-mm wrench to unscrew the exhaust silencer (13/9).
3. Unscrew the shipping cover from the new exhaust silencer.
4. Apply PFPE grease on the gasket of the new exhaust silencer.
5. Install the exhaust silencer and tighten it to 20 Nm (27 ft-lb).

The shipping cover can be used to seal the old exhaust silencer.

Caution **Comply with local environmental regulations when disposing of the old exhaust silencer.**

5 Troubleshooting

Malfunction/ Display at the Control Unit	*Probable Cause*	*Recommended Corrective Action*	*References**
1.1 Pump does not start/ **No display**	Motor circuit switch 1Q2 is turned off.	Open the door at the front; turn switch on.	2.3.1
	Errors in the main power connection.	Check and rectify the wiring. Verify that the main supply voltage is correct.	2.3
1.2 Pump does not start/ "**STOP**" LED lights up.	One of the malfunctions listed below at 6, 7, 8 or 12 has been detected.	Refer to the descriptions of malfunctions under 6, 7, 8 & 12. Press the REPORT button to review the error report.	3.7
	The position indicator at the exhaust shutoff valve is malfunctioning.	Repair the exhaust shutoff valve.	Service
	The pump has seized causing the motor protection switch to trip during start-up	Repair the pump. If it does not start, check whether it turns freely by removing the middle segment of the top cover, and use a 5-mm Allen key (200 mm long) to turn the motor shaft from the outside.	Service
1.3 Pump runs up briefly, then "**W Lubrication**" is displayed.	Motor is malfunctioning.	Repair the pump.	Service
	Pump is rotating in the wrong direction.	Shut off power to the pump. Interchange two of the phase leads.	2.7
	Insufficient lubricant in the gearbox.	Measure the oil level via the fill plug. The target value is 6 to 9 mm ($^1/_4$ to $^3/_8$ inch) for the 100S and 12 to 15 mm ($^1/_2$ to $^5/_8$ inch) for the 50S.	Service
2. Pump does not reach ultimate pressure	Unsuitable measurement procedure or gauge.	Measure pressure at pump's intake port using suitable gauge.	---
	Purge gas supply is open	If you have the STANDBY option and if the process permits, use the STAND BY button to close the purge-gas valve.	2.9.1
	The pump has an external leak.	Find the leak; repair the pump.	Service
	Optional flush valve is leaking or will not close.	Replace the valve.	2.9.2
	Evaporating liquids in the pump.	Measure the partial pressure of the non-condensable gases. To do so, insert a low-temperature trap between the gauge and the intake port. If the ultimate pressure is achieved while this trap is operating, liquids are evaporating in the pump. One possible remedy: Open the purge gas valve and let the pump run $^1/_2$ hour without process load.	---
	Vacuum chamber is leaking or dirty	Seal or clean the vacuum chamber.	---
	Intake line is leaking or dirty.	Seal or clean the intake line.	---
3. Evacuation period is too long. (Pumping speed is too low.)	Intake line is too long or too narrow.	Install intake lines that have an adequate diameter; keep lines as short as possible.	2.8.1
	Dirt trap in the intake port is clogged.	Clean dirt trap.	---
	Pump is contaminted by deposits.	Clean the pump.	Service
	Pump rotation speed is too slow.	Check whether the frequency of your AC power source complies with the specifications for this pump.	Name-plate 2.3
4. The pressure in the system rises too quickly after the pump shuts down.	System or intake line is leaking.	Check the system and the intake line.	---
	The pump has an external leak.	Repair the pump.	Service

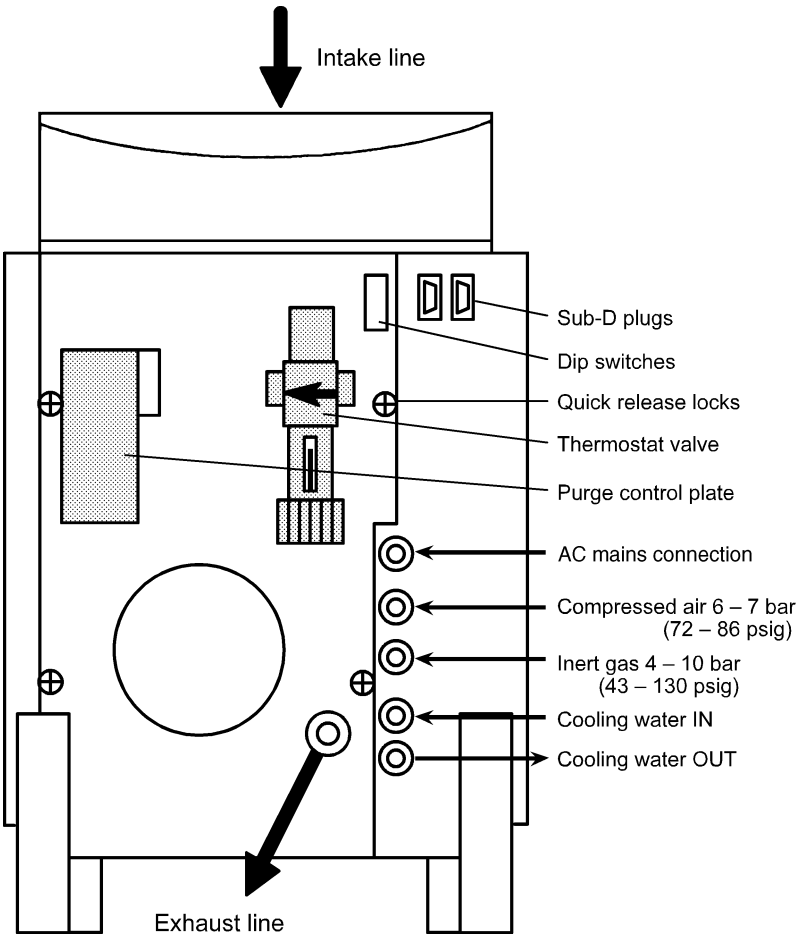
* This column refers to the section in the Operating instructions that contains the applicable repair information.

Malfunction/ Display at the Control Unit	***Probable Cause***	***Recommended Corrective Action***	***References****
5. The pump is extremely loud.	Bearings are malfunctioning.	Repair the pump.	Service
	Liquid "knocking" in the pump (too much liquid in the pump).	Install the exhaust line so that it slopes downward from the pump, or install a condensate trap. Increase the purge gas supply.	2.8.2
6. "**A Shutoff valve**" is displayed.	Insufficient air pressure at the exhaust shutoff valve.	Ensure that the compressed air supply is at least 6 bar (72 psig).	2.5
	Supply of compressed air was interrupted briefly.	Ensure that the compressed air supply is at least 6 bar (72 psig).	2.5
	Switch, plug, or cable malfunction.	Replace the malfunctioning part. Switch circuit breakers ON.	Service
7. Exhaust pressure "**W Exhaust pressure**" is displayed first. If it continues to rise "**A Exhaust pressure**" is displayed and the pump switches off.	Exhaust line is clogged.	Clean the exhaust line.	---
	Exhaust line is too narrow or too long.	Install an exhaust line which is large enough, and is as short as possible.	2.8.2
	Exhaust shutoff valve is malfunctioning.	Replace the valve.	Service
	Exhaust silencer is clogged.	Replace the exhaust silencer.	4.1
	Switch, plug, or cord malfunction.	Replace the malfunctioning part. Switch the circuit breakers ON.	Service
8. Temperature "**W Temperature**" is displayed first. If it continues to rise, "**A Temperature**" is displayed and the pump switches off.	Process gas is too hot.	Change the process.	---
	Ambient temperature is too high.	Change pump site or supply cooler air.	---
	Cooling air flow is restricted.	Clean the ventilation grids and the cooling air ducts; increase the distance between the grids and the walls.	---
	Friction in the pump is too high.	Repair the pump.	Service
	The switch, plug, or cable is malfunctioning.	Replace the malfunctioning part. Switch the circuit breakers ON.	Service
9. "**Process Temperature <tmin** or **>tmax**" is displayed.	Pump is in the warm-up phase.	Wait until the pump has reached its process temperature.	3.1
	Cooling water supply is not opened.	Turn ON the cooling water supply.	---
	Cooling water pressure is too low. Cooling water flow is too low. Cooling water temperature is too high.	Ensure that there is an adequate supply of cooling water: pressure 2–10 bar (14–130 psig), consumption about 100 l/hr (100 qt/hr) at water temperature of 15 °C (59°F). The max. cooling water inlet temperature is 25 °C (77°F).	2.4
	Lime deposits in the cooling water lines to the pump. During normal operation, the cooling water temperature will be below 70°C (158°F). At these temperatures, deposits form very slowly. Early clogging is an indication of some operational difficulty.	Repair the pump.	Service
	Dirt deposits in the pump's cooling water channels.	Dismantle the pump and clean the cooling water channels.	Service
	Cooling water lines are connected incorrectly.	Connect the cooling water lines correctly.	2.4
	The thermostat valve is set incorrectly.	Set the thermostat valve correctly.	2.4
	The pump was not filled with cooling water during installation.	Fill the pump with cooling water.	2.4
	Switch, plug, or cable is malfunctioning.	Replace the malfunctioning part; switch the circuit breakers ON.	Service

* This column refers to the section in the Operating instructions that contains the applicable repair information.

Malfunction/ Display at the Control Unit	***Probable Cause***	***Recommended Corrective Action***	***Refer-ences****
10. Oil pressure First "**WLubrication**" is displayed. After 4 hours, "**ALubrication**" is displayed and the pump is switched off. See Sect. 3.4.4.	The pump is rotating in the wrong direction; see malfunction 1.3.	Shut off power to the pump. Interchange two of the phase leads.	2.7
	Insufficient oil in the gear box.	Measure the oil level via the fill plug. The target value is 6 to 9 mm (1/4 to 3/8 inch) for the 100S and 12 to 15 mm (1/2 to 5/8 inch) for the 50S.	Service
	The oil pump is malfunctioning.	Repair the pump.	Service
	Switch, plug, or cable malfunction.	Replace the malfunctioning part. Switch circuit breakers ON.	Service
11. Either " **WN2-pressure**" or "**WFlow**" is displayed.	The inert-gas valve is not open.	Open the inert gas supply.	---
	Insufficient inert gas pressure.	Set the correct inert gas pressure (4–10 bar, 43–130 psig).	2.5
	The purge-gas valves are restricted.	Replace the valves.	Service
	The main inert-gas valve is restricted.	Replace the valve. The valve is closed when deenergized. If it does not open, check the power supply, connections, and fuses.	Figure 7 Service
	The purge-gas nozzles are dirty.	Clean the nozzles.	Service
	The purge-gas valve plate or purge-gas line was mounted incorrectly during pump conversion.	Correctly install the purge-gas valve plate or purge-gas line.	2.9.1/ 2.9.3
	Switch, plug, or cable is malfunctioning.	Replace the malfunctioning part. Switch circuit breakers ON.	Service
12. "**A Motor protection switch**" is displayed (the motor protection switch has tripped).	The intake pressure is too high.	Modify the system.	---
	The pump has seized.	Repair the pump. If the pump doesn't start, check whether it turns freely. Remove the middle segment of the top cover and use a 5-mm Allen key (200 mm long) to turn the motor shaft from the outside.	Service
	Main supply voltage is too low.	Connect the pump to the correct voltage.	2.3
	Ambient temperature is too high.	Change the site or ensure a cooler air supply.	---
	Switch, plug, or cable malfunction.	Replace the malfunctioning part. Switch the circuit breakers ON.	Service
	---	Switch the motor protection switch ON.	Figure 7
13. "**Key not allowed**" is displayed	The user pressed the FLUSH or STAND BY buttons which function only if the FLUSH or STANDBY options have been installed.	Press permissible buttons.	2.9.1 and 2.9.2
14. "**Call error report**" is displayed	When this is displayed, review the error report.	Press the REPORT button.	3.7
15. "**Remote operation**" is displayed	The pump is set to remote operation at the interface.	Open the REMOTE contact at the parallel interface.	2.3.2
16. "**Process not allowed**" is displayed	Process setting isn't allowed since an important option is absent.	Install option or select another process.	2.6/2.9.3
17. "**Wrong proc. setting**" is displayed	More than one process has been set at the DIP switches.	Set only a single process.	2.6
18. "**Confirm**" is displayed	---	Press the STOP and REPORT keys simultaneously.	2.6

* This column refers to the section in the Operating instructions that contains the applicable repair information.



Process Settings

Process group	DIP switches	Thermo-stat valve	Purge control plate	Option Required
A	5 ON	4	closed	—
B	6 ON	4	open	—
C	7 ON	2	open	LTO
D	8 ON	2	open	—

Start-up Checklist

Have you read the installation & start-up instructions in this manual? ..... ❒

Is the pump converted for the process? ... ❒

Is mains voltage correct for your pump model (see Section 2.3)? ..... ❒

Is pump set to the correct mains voltage .. ❒

Are cooling water inlet and outlet connected correctly? ..... ❒

Is pump filled with cooling water? ..... ❒

Is thermostat valve set to correct process? ..... ❒

Is inert gas connected (4-10 bar , 43-130 psig)? ..... ❒

Is compressed air connected (6-7 bar , 72-86 psig)? ..... ❒

Are DIP switches set to correct process? ... ❒

Is the main switch turned ON? ..... ❒

Is the process confirmed (REPORT + STOP)? ..... ❒

Are the shipping seals removed? ..... ❒

Is the direction of rotation correct? ..... ❒

Are the enclosure panels reinstalled? ..... ❒

Is the intake line equipped for the process (see Section 2.8.1)? ..... ❒

Is the intake line clean and oil free? ..... ❒

Is the intake line connected with bellows? ... ❒

Is the exhaust line connected to a proper exhaust system? ..... ❒

Are the inlet and exhaust lines free of leaks? ..... ❒

Is the inert gas supply open? ..... ❒

Is the compressed air supply open? ..... ❒

Is the cooling water supply open? ..... ❒

Is the exhaust line open and free of deposits? ..... ❒

Are the preset process group and "Ready to Start" displayed? ..... ❒

Press the start button and wait for the pump to reach its process temperature.

Start-up: Date: _____ Name: _____ Dept.: _____

Remarks: