Leybold

TURBOVAC 850 i(X), 950 i(X), 1350 i, 1450 i

Turbomolecular Pumps with Integrated Frequency Converter

Operating instructions 300855170_002_C12

Part No.

84007xVxxxx

84008xVxxxx

84009xVxxxx

84010xVxxxx

850092Vxxxx(U)

850102Vxxxx(U)

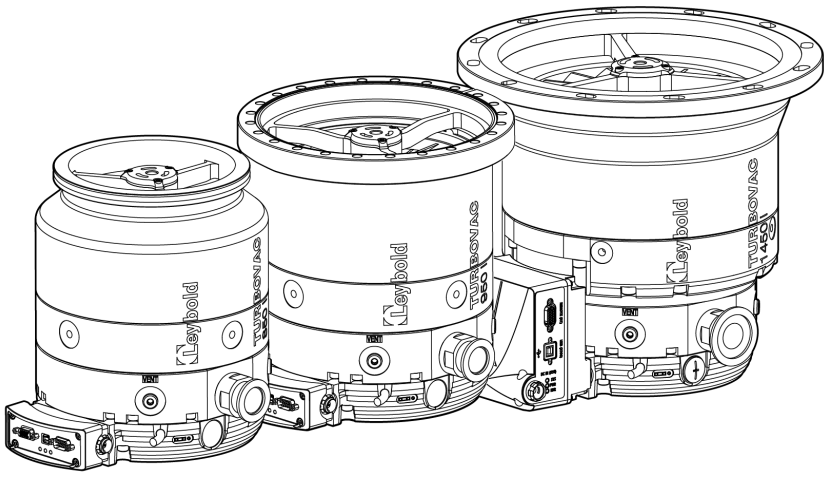
850112Vxxxx(U)

850122Vxxxx(U)

850132Vxxxx(U)

850142Vxxxx(U)

x = 0 to 9



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Associated publications

Publication title	Publication number	Link
Serial Interfaces for TURBOVAC i/i(X)	300450826	*https://4vac.io/320s6k*
TURBOVAC i/i(X) EtherCAT Interface	300687441	*https://4vac.io/64t1ds*
TURBOVAC i Interface Module	300905828	*https://4vac.io/3f4bod*
TURBOVAC 850i, 950i, 1350i, 1450i Bearing Exchange Kit	300872821	*https://4vac.io/ftbhdc*

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Disclaimer

The content of this manual may change from time to time without notice. We accept no liability for any errors that may appear in this manual nor do we make any expressed or implied warranties regarding the content. As far as practical we have ensured that the products have been designed and constructed to be safe and without risks when properly installed and used in accordance with their operating instructions.

We accept no liability for loss of profit, loss of market or any other indirect or consequential loss whatsoever.

Product warranty and limit of liability are dealt with in our standard terms and conditions of sale or negotiated contract under which this document is supplied.

You must use this product as described in this manual. Read the manual before you install, operate, or maintain the product.

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1 Safety and compliance

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use. Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions.

The instruction manual is an important safety document that we often deliver digitally. It is your responsibility to keep the instruction manual available and visible while working with the equipment. Please download the digital version of the instruction manual for use on your device or print it if a device will not be available.

1.1 Definition of Warnings and Cautions

Important safety information is highlighted as warning and caution instructions which are defined as follows. Different symbols are used according to the type of hazard.

WARNING:

If you do not obey a warning, there is a risk of injury or death.

CAUTION:

If you do not obey a caution, there is a risk of minor injury, damage to equipment, related equipment or process.

NOTICE:

Information about properties or instructions for an action which, if ignored, will cause damage to the equipment.

We reserve the right to change the design and the stated data. The illustrations are not binding.

1.2 Trained personnel

For the operation of this equipment “trained personnel” are:

- skilled workers with knowledge in the fields of mechanics, electrical engineering, pollution abatement and vacuum technology and
- personnel specially trained for the operation of vacuum pumps

1.3 Safety symbols

The safety symbols on the products show the areas where care and attention is necessary.

The safety symbols that we use on the product or in the product documentation have the following meanings:

	**Warning/Caution** Risk of injury and/or damage to equipment. An appropriate safety instruction must be followed or a potential hazard exists.
	**Warning - Dangerous voltage** Risk of injury. Identifies possible sources of hazardous electrical shock.
	**Warning - Hot surfaces** Risk of injury. Identifies a surface capable of inflicting burns through contact.
	**Warning - Risk of explosion** Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.
	Warning - Overhead or Suspended load Do not stand below the suspended load.
	Warning - Vacuum hazard Avoid exposing any part of the human body to the vacuum.

2 Important safety information

2.1 Mechanical hazards

WARNING: VACUUM HAZARD

Risk of injury. Avoid exposing any part of the human body to the vacuum.

WARNING: ROTATING PARTS

Risk of injury. Avoid exposing any part of the human body to the rotating parts.

WARNING: UNSUITABLE ATTACHMENTS

Risk of injury. Do not use unsuitable attachments for the pumps or attachments that can be torn off. When using clamped flange connections at the housing or with components above the housing, there is a risk of sudden twisting of the entire pump.

WARNING: EXPLOSION HAZARD

Risk of injury. The pressure in the pump must not exceed 1.4 bar(absolute).

1. The pump is intended for generating a vacuum only. If there is a risk of overpressure within the system and the pump, then the pump must be protected with an overpressure safety valve, for example.
2. Vent the pump only up to atmospheric pressure.
3. When using the pump with a purge gas valve, protect the purge gas supply such that in the event of a malfunction no overpressure can occur within the system.
4. The pump must be firmly mounted to the vacuum chamber. If the mounting is not sturdy enough, pump blockage could cause the pump to break loose, internal pump components could be thrown in all directions.
5. Do not operate the pump (in bench testing, for example) without proper flanging to the vacuum chamber. Refer to *Attach the pump to the vacuum chamber* on page 42.
6. Due to high speed and temperature, the service life of the rotor is limited. If the rotor is changed too late, it may be damaged. Thus in the flange mounts, high forces and torque conditions can occur. We recommend an exchange of the rotor unit after 80000 operating hours at the latest.
7. Turbomolecular pumps as described in the following operation manual contain a high portion of kinetic energy due to their high rotational speed in combination with the specific rotor mass. In case of a malfunction of the system, for example, rotor/stator contact or even a rotor crash, the rotational energy is released.

8. To avoid the risk of injury or damage to the equipment, follow the installation instructions as given in this manual.

2.2 Electrical hazards

WARNING: DANGEROUS VOLTAGE

Risk of injury. Lethal voltages are present at the mains connections. Before starting any maintenance or service work, de-energise (lockout/tagout) the product first. Obey the safety instructions given below when you work on the equipment.

1. The electrical connection must only be provided by a trained person. Please observe the national regulations in the country of use like EN 50110-1 for Europe, for example.
2. The pump must only be connected to power supplies which meet the requirements for functional extra-low voltages with positive isolation in accordance with IEC 60364-4-41 (or local regulations) (PELV). All interfaces must only be operated with PELV-fed components and devices.
3. Only unplug connectors when the mains voltage is switched off and the pump is no longer turning.
4. Unauthorised device conversion and modifications are prohibited for safety reasons.
5. The outputs at the frequency converter are not free of voltage.
6. Lay connecting lines so that they cannot be damaged. Protect the lines against humidity and contact with water. Avoid any heat stress on the line due to unfavourable laying conditions.
7. Suitably support the connecting lines so that the pumps are not exposed to any major mechanical stress.
8. Do not expose the pump and the connections to dripping water. Note the information on the IP type of protection.
9. When storing the pump in a humid atmosphere, these can suffer corrosion. Corrosion gives rise to conductive deposits which in turn can cause short-circuits and reduce the insulation levels of electrical components.
10. Transport the pump only in its original packaging so as to avoid any mechanical damage which in turn may reduce air gaps and creepage distances.
11. When applying external voltages above 42 V to the connection terminals, observe the applicable VDE safety regulations.
12. Make the electrical connections only after pump and accessories (for example, air cooler) have been installed mechanically.
13. The slot for the Anybus interface must be blanked off during operation of the pump: either through a blank panel or by inserting an optional Anybus module.

2.3 Thermal hazards

WARNING: HOT SURFACE

Risk of burn. During the operation of the pump certain areas can get hot (65 °C maximum). Protect hot parts against being touched. Handle the equipment only after venting and cooling down.

2.4 Hazards caused by materials and substances

WARNING: HAZARDOUS MATERIALS

Risk of injury. Contaminated parts can be detrimental to health and environment. Before beginning with any work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts. Obey the safety instructions given below when you work on the equipment.

1. The pump is not suitable for pumping reactive or corrosive media. The rotor may get damaged due to process gases. Thus in the flange mounts, high forces and torque conditions can occur. The mounting screws for the pump may be torn off. When using clamped flange connections at the housing or with components above the housing, sudden twisting of the entire pump can be experienced.
2. When pumping dusty media, use a dust filter. The pollution degree II applies to the inside surface of the pump.
3. If low concentration corrosive or reactive gases are being pumped, then operate the pump with purge gas.
4. Consult with us for which types of pumps are required for specific processes and applications.
5. The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity. Do a leak check after you install the pump and after every service on the vacuum system. Upon delivery, the pump has an integral leak rate of $< 1 \times 10^{-8}$ mbar·l/s. Do a leak check regularly, when pumping toxic gases.
6. If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection. Before opening the pump, purge it for a longer period with an inert gas. If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood. Firmly seal off the pump. When shipping the contaminated pump for servicing, also state the type of hazard.
7. The cooling water from the return is not of drinking water quality and should not be used for this purpose. After operating the pump, the cooling water lines may suffer from microbiological contamination. Take appropriate safety precautions.

2.5 Ignition hazards

WARNING: IGNITION HAZARD

Risk of injury. Sparks could occur in case of damage to the pump, this can ignite the explosive mixtures. Check the pump at regular intervals for damage.

During operation, the pressure inside the turbomolecular pump is so low that there is no risk of ignition (at pressures less than 100 mbar). A hazardous condition will be created if flammable mixtures enter the hot pump at pressures more than 100 mbar. During operation, the pump can reach temperatures as high as 140 °C internally, and at parts of the outside surfaces 65 °C. Also, note the safety information provided by the gas supplier.

2.6 Dangers in connection with safety-related measures and precautions

The frequency converter is not equipped with its own emergency shutdown switch. Such a facility needs to be provided from the side of the system.

2.7 Risk of damaging the pump

1. Do not touch the rotor, it cause injury and damage the rotor bearing.
2. Foreign objects which enter the pump through the intake would cause serious damage to the rotor. To avoid damage install an inlet screen. Damages caused during operation without the inlet screen are excluded from warranty.
3. The contact surfaces of the pump housing, vacuum system and centring ring must be dry and free of grease so as to ensure sufficient stability in case the rotor seizes.
4. Connect a purge gas or venting valve to the correct flange. Interchanging the venting and purge gas flange can cause shock venting of the pump.
5. The interface connectors have UNC 4-40 threads. Do not use connectors with M3 treads.
6. Only connect and disconnect the cable connections between the pump and power supply when the pump is not turning (green status LED off) and with the mains power switched off (yellow power LED off). Otherwise there is the risk of damaging the frequency converter.
7. Exposure of the pump to accelerating forces must be avoided or reduced to such an extent that the rotor will not be excited by vibrations. In the case of critical applications you must consult our applications department first.

3 Description

The TURBOVAC 850 i(X), 950 i(X), 1350 i and 1450 i are turbomolecular pumps designed to evacuate vacuum chambers down to pressure levels in the high vacuum and ultra-high vacuum range.

They are suitable for pumping air and clean gases. A forevacuum pump and a power supply are required for their operation.

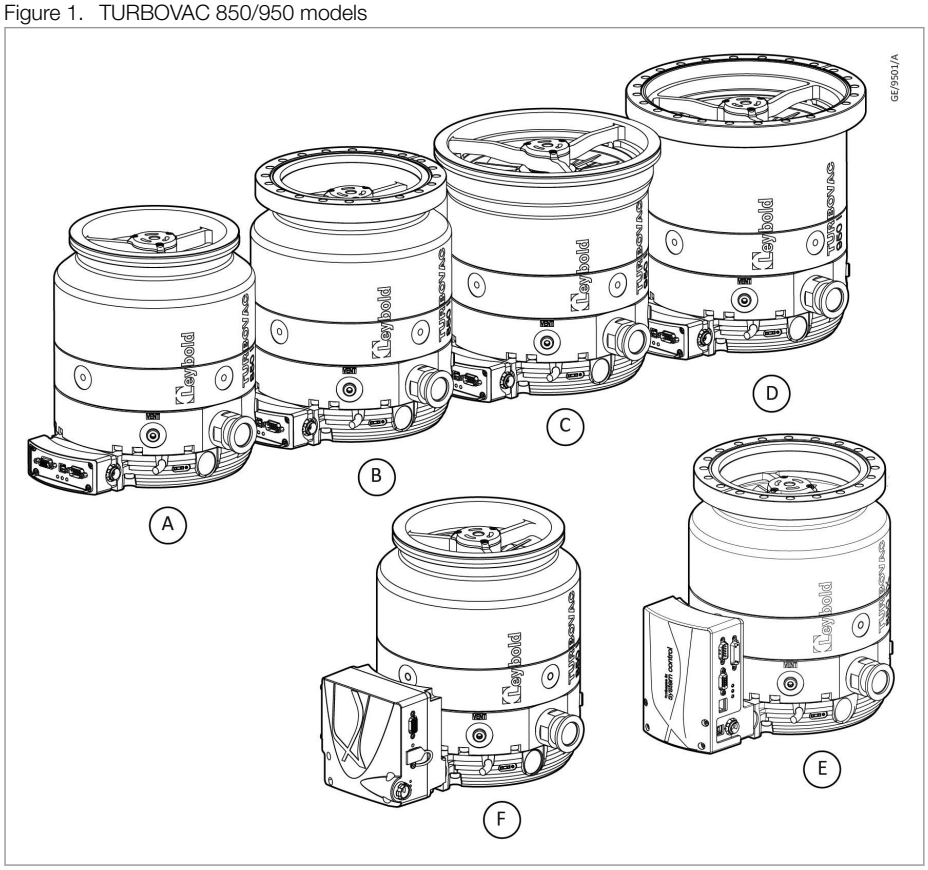
The TURBOVAC allows controlling of the pump through both standard and optional interfaces and setting up of some pump functions according to specific requirements.

Refer to Serial Interfaces for TURBOVAC i/i(X) (Publication number - 300450826) for a detailed description of the interfaces RS 232, RS 485, Profibus and USB of the TURBOVAC.

Refer to TURBOVAC i/i(X) EtherCAT Interface (Publication number - 300687441) for a detailed information on the EtherCAT Interface.

Refer to TURBOVAC i Interface Module (Publication number - 300905828) for a detailed description of the Anybus modules.

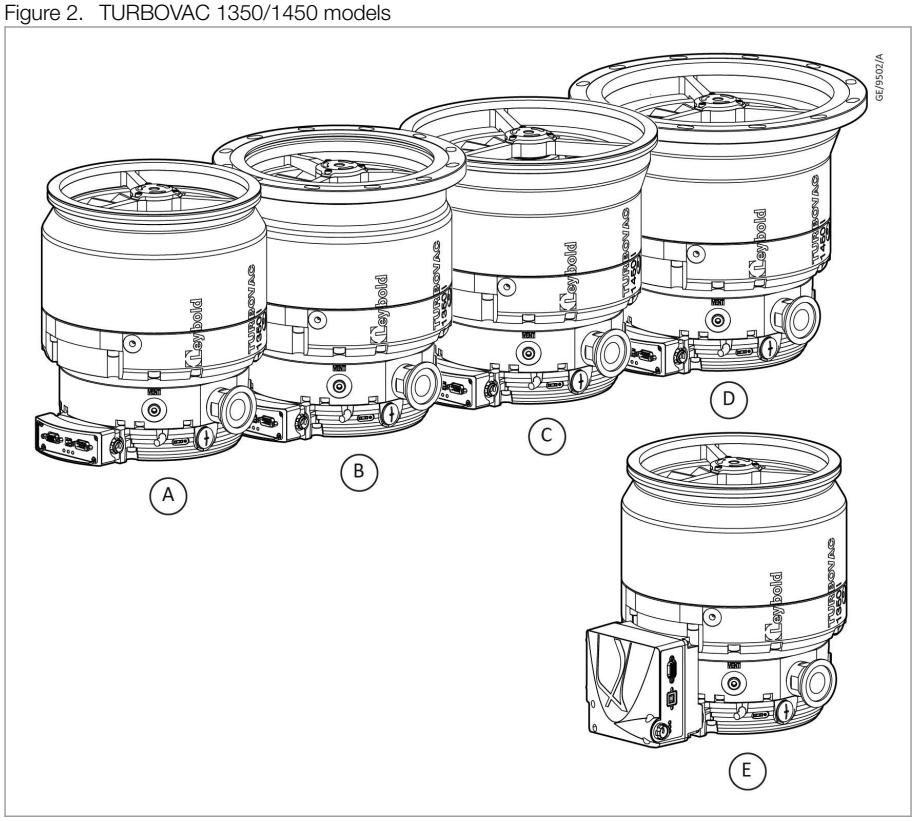
Figure 1. TURBOVAC 850/950 models



A. TURBOVAC 850 i DN 160 ISO-K
B. TURBOVAC 850 i DN 160 CF
C. TURBOVAC 950 i DN 200 ISO-K
D. TURBOVAC 950 i DN 200 CF
E. TURBOVAC 850 iX
F. TURBOVAC 850 i with optional interface

Description

Figure 2. TURBOVAC 1350/1450 models



A. TURBOVAC 1350 i DN 200 ISO-K
B. TURBOVAC 1350 i DN 200 ISO-F
C. TURBOVAC 1450 i DN 250 ISO-K
D. TURBOVAC 1450 i DN 250 ISO-F
E. TURBOVAC 1350 i with optional interface

3.1 Design

The TURBOVAC models are wide-range turbomolecular pumps equipped with an additional Holweck stage.

With the built-in frequency converter as the electronic drive the TURBOVAC forms one single unit. The electronic drive governs the pump's speed and serves as a monitor for all functions of the pump. The TURBOVAC iX is equipped with an integrated vacuum system controller for connection and operation of various accessory components.

At the high vacuum side the bearing is of a non-wearing permanent magnetic bearing type, at the forevacuum side a lifetime lubricated oil-free ceramic ball bearing is used.

Water cooling or an air cooling fan is available for the TURBOVAC 850 i and 950 i as an optional equipment. The TURBOVAC 1350 i and 1450 i are water cooled as standard.

The intake flange should be fitted with a wire mesh inlet screen to protect the pump against mechanical damage caused by foreign objects.

The pumps are equipped with a venting and a purge gas facility. The connections are blanked off by default with G1/8" closure screws.

Venting and purge gas valves, or a venting screw, or a pressure regulator can be connected directly to the pump.

3.2 Standard equipment

Turbomolecular pump with the integrated electronic drive unit and two eye-bolts for TURBOVAC.

High and fore-vacuum flanges are protective-capped.

Flange mounting elements and the inlet screen are not enclosed, but are available as accessories.

Only TURBOVAC iX

The PC software LEYASSIST can be used for the configuration of the pump and accessories and for data logging. The tool is available for download free of charge on our website:

www.leybold.com > Media > Downloads > Download Software > PC-Software for Turbomolecular pumps (*https://www.leybold.com/en/media/downloads/download-software/pc-software-for-turbomolecular-pumps/*).

3.3 Conforming utilisation

The turbomolecular pump is intended for generating a vacuum. It is suited for non-corrosive processes only.

The turbomolecular pump must be bolted to a rigid vacuum system and connected to a suitable backing pump.

Operate the turbomolecular pump in a closed rooms.

Accessories which have not been specified by us should only be used after approval by us.

3.3.1 Non-conforming utilisation

WARNING: NON-CONFORMING UTILISATION OF PUMP

Risk of injury and damage to equipment. Any non-conforming utilisation of pump, frequency converter and accessories can result in severe injury or death and cause damage to components.

Non-conforming utilisations for both pump and frequency converter are:

- Pumping of gases and vapour for which the materials of the pump are unsuitable.
- Operation in connection with processes in which GaAs (gallium arsenide) is being pumped.
- Pumping gas mixtures with an oxygen content of > 21%.
- Pumping corrosive gases and dust containing gases without reverting to purge gas operation.
- Pumping condensable vapour without controlling the temperature of the pump. Upon compression within the pump, these vapours can condense or form deposits.
- Pumping dust and solids without the use of suitable screens and filters.
- Operation at a high forevacuum pressure.
- Operation at high gas loads.
- Utilisation of both pump and frequency converter in explosion hazard areas.
- Non-compliance with the specified maintenance and servicing intervals.

Description

- Operation of the pump and drive electronics in environments which demand a higher protection type than that of the pump and where the installation site is more than 4000 m above sea level.
- The maximum permissible pressure in the pump and the system must not exceed 1.4 bar (absolute).
- Operation with an inadequately mounted pump.
- Operation without having flanged the pump to the system or without having connected it to a suitable backing pump.
- Operation with additional heat sources involving thermal radiation, thermal conduction through the high vacuum or the forevacuum flange, strong magnetic fields or very hot process gases, for example. In environments with water cooling operation, CF flanges may be baked-out up to 100 °C.
- Use in systems in which impact stress and vibrations or periodically occurring forces affect pump, frequency converter and cables.
- Operation on the moving system or system components (locks, for example).
- Operation at vibration absorbers and vacuum components (gate valves, valves) which are not capable of sustaining the specified deceleration torque at which the pump rotor seizes.
- Stepping on the pump, add-on parts, drive electronics, flanges and cables to climb onto the system. Fitting of add-on parts to the forevacuum flange which causes an inadmissible high load.
- Removing, covering or obstructing warning notices.
- Standstill or storing of the pump without suitable sealing-off and drying.
- Storing in a humid atmosphere which can cause corrosion.
- Conversions, manipulations and maintenance work by personnel not authorised by us.

4 Technical data

4.1 Operating environment

Table 1. Operating environment

Parameter	Value
Permissible ambient temperature	5 to 40 °C*
Installation altitude	up to 4000 m†

** Depending on the ambient temperature, the gas throughput and the type of gas, forced air cooling or water cooling may be necessary. No dripping or spraying of water (for pumps with IP40), no explosive gas atmospheres.*

† At altitudes more than 2000 m heat dissipation by the ambient air is impaired.

4.2 General technical data

Technical data

Table 2 Technical data TURBOVAC 850/950 i(X)

TURBOVAC	Unit	850 i	850 i	850 iX	850 iX	950 iX	950 iX	850 i	950 i
		UHV		Standard				IND	
High-vacuum connection	DN	160 ISO-K	160 CF	160 ISO-K	160 CF	200 ISO-K	200 CF	160 ISO-K	200 ISO-K
Forevacuum connection	DN	25 KF							
Pumping speed* N_2 Ar He H_2	$l \cdot s^{-1}$	 720 655 850 755	 680 610 790 710	 720 655 850 755	 680 610 790 710	 900 840 925 770	 850 780 860 720	 730 665 820 715	 925 865 905 735
Gas throughput* N_2 Ar He H_2	$mbar \cdot l \cdot s^{-1}$	 4 2.6 7 17		 14 3.5 >20 >20				 >40 6.8 >50 >50	
Compression ratio* N_2 Ar He H_2		 -	 $>1 \times 10^{13}$ $>1 \times 10^{13}$ 5×10^{9} 3×10^{8}	 -	 $>1 \times 10^{11}$ $>1 \times 10^{11}$ 1×10^{8} 4×10^{6}	 -	 $>1 \times 10^{11}$ $>1 \times 10^{11}$ 1×10^{8} 4×10^{6}	 $>1 \times 10^{8}$ $>1 \times 10^{8}$ 1×10^{5} 1×10^{4}	
Ultimate pressure with 2-stage oil-sealed rotary vane pump ISO-K / CF§	mbar	$<7 \times 10^{-9}$	$<1 \times 10^{-10}$	$<7 \times 10^{-9}$	$<3 \times 10^{-10}$	$<7 \times 10^{-9}$	$<3 \times 10^{-10}$	$<1 \times 10^{-7}$	$<1 \times 10^{-7}$
Maximum permissible forevacuum pressure for N_2	mbar	12		15				6	
Operating speed	min^{-1}	49200							
Minimum speed	min^{-1}	30000							
Run-up time, approximately	min	2.5							
Maximum power consumption	W	500 (default), 600 (maximum)							

TURBOVAC	Unit	850 i	850 i	850 iX	850 iX	950 iX	950 iX	850 i	950 i
		UHV		Standard				IND	
Power consumption at ultimate pressure	W	40							
Type of protection	IP Type 1 (UL 50E)	40 54 for i-version with Abus 1							
Ambient temperature during operation storage	°C	+5 to +40† -15 to +70							
Cooling standard		Convection†						Water†	
Cooling optional		Air or water†						na	
Cooling water connection		plug connection for 6x1 hose / alternatively G 1/8" screw-in thread							
Cooling water consumption	l/h	60							
Permissible cooling water pressure (bar(g): bar (gauge) is overpressure, i.e. atmospheric pressure = 0 bar(g))	bar(g)	6							
Permissible cooling water temperature	°C	15 to 35							
Weight	kg	14.6	19.6	14.6	19.6	15.4	21.7	15.4	21.7
Recommended forevacuum pumps		ECODRY 65 plus, TRIVAC D 65 B, SCROLLVAC 7 plus, DIVAC 3.8 HV3							
Noise level with convection and water cooling with radial air cooler	dB(A)	<40 <55						<40 na	
Maximum bake-out temperature of the CF version, water cooled	°C	100						na	
Maximum relative air humidity		approximately 85% (non-condensing)							
Purge gas flow	$mbar \cdot l \cdot s^{-1}$ sccm	0.4 24							
Purge gas connection		G1/8"							

Technical data

TURBOVAC	Unit	850 i	850 i	850 iX	850 iX	950 iX	950 iX	850 i	950 i
		UHV		Standard				IND	
Venting connection		G1/8"							
Magnetic field resistance[#] ▪ Continuous operation at nominal speed (all directions) ▪ Short term operation (< 10 min) at nominal speed (all directions) ▪ For error free communication with the pump at zero speed	mT	9 13 100							
Magnetic stray field at ▪ in axial direction (10 cm distance to high-vacuum flange) ▪ in radial direction (10 cm distance to housing)	mGauss	400 400							

** Contact us when using argon or other "heavy" gases as process gas.*

§ Contact the supplier to discuss your specific system details and the achievement of ultimate pressure.

† Depending on the ambient temperature, the gas throughput and the type of gas, forced air cooling or water cooling may be necessary.

 # These values are especially relevant, if the magnetic field run in a radial direction (in a plane orthogonal to the rotational axis). The resistance to an axial magnetic field is much higher and this depends on the homogeneity of the magnetic field.

Table 3 Technical data TURBOVAC 1350/1450 i

TURBOVAC	Unit	1350 i	1450 i
High-vacuum connection	DN	200 ISO-K 200 ISO-F 200 CF	250 ISO-K 250 ISO-F 250 CF
Forevacuum connection	DN	40 KF	
Pumping speed* N_2 Ar He H_2	$l \cdot s^{-1}$	 1250 1150 1350 1150	 1380 1280 1390 1210
Gas throughput* N_2 Ar He H_2	$mbar \cdot l \cdot s^{-1}$	 >24** 12 >30 >30	
Compression ratio* N_2 Ar He H_2		 $>1 \times 10^8$ $>1 \times 10^8$ 4×10^5 2×10^4	
Ultimate pressure with 2-stage oil-sealed rotary vane pump ISO-K, ISO-F / CF§	mbar	$<7 \times 10^{-9}$	
Maximum permissible forevacuum pressure for N_2	mbar	4	
Operating speed	min^{-1}	42000	
Minimum speed	min^{-1}	23100	
Run-up time, approximately	min	2.5	
Maximum power consumption	W	660 (default), 800 (maximum)	
Power consumption at ultimate pressure	W	50	
Type of protection	IP Type 1 (UL 50E)	40 54 for i-version with Abus 1	
Ambient temperature during operation storage	°C	+5 to +40† -15 to +70	
Cooling standard		Water†	
Cooling optional		-	-
Cooling water connection		plug connection for 6x1 hose / alternatively G 1/8". screw-in thread	
Cooling water consumption	l/h	60	
Permissible cooling water pressure (bar(g): bar (gauge) is overpressure, i.e. atmospheric pressure = 0 bar(g))	bar(g)	6	
Permissible cooling water temperature	°C	15 to 35	

Technical data

TURBOVAC	Unit	1350 i	1450 i
Weight	kg	23.5 (ISO-K) 24.3 (ISO-F) 34.2 (CF)	24.4 (ISO-K) 25.5 (ISO-F) 34.7 (CF)
Recommended forevacuum pumps		ECODRY 65 plus, TRIVAC D 65 B, SCROLLVAC 7 plus, DIVAC 3.8 HV3	
Noise level with convection and water cooling	dB(A)	<44	
Maximum bake-out temperature of the CF version, water cooled	°C	100	
Maximum relative air humidity		approximately 85% (non-condensing)	
Purge gas flow	mbar · l · s^{-1} sccm	0.4 24	
Purge gas connection		G1/8"	
Venting connection		G1/8"	
Magnetic field resistance# ▪ Continuous operation at nominal speed (all directions) ▪ Short term operation (< 10 min) at nominal speed (all directions) ▪ For error free communication with the pump at zero speed	mT	 7 10 100	
Magnetic stray field at ▪ in axial direction (10 cm distance to high-vacuum flange) ▪ in radial direction (10 cm distance to housing)	mGauss	 400 100	

** Contact us when using argon or other "heavy" gases as process gas.*

*** Contact us for high gas throughput of Nitrogen.*

§ Contact the supplier to discuss your specific system details and the achievement of ultimate pressure.

† Depending on the ambient temperature, the gas throughput and the type of gas, forced air cooling or water cooling may be necessary.

 # These values are especially relevant, if the magnetic field run in a radial direction (in a plane orthogonal to the rotational axis). The resistance to an axial magnetic field is much higher and this depends on the homogeneity of the magnetic field.

4.3 Pumping speed curve

Figure 3. Pumping speed curves for the TURBOVAC 850 i

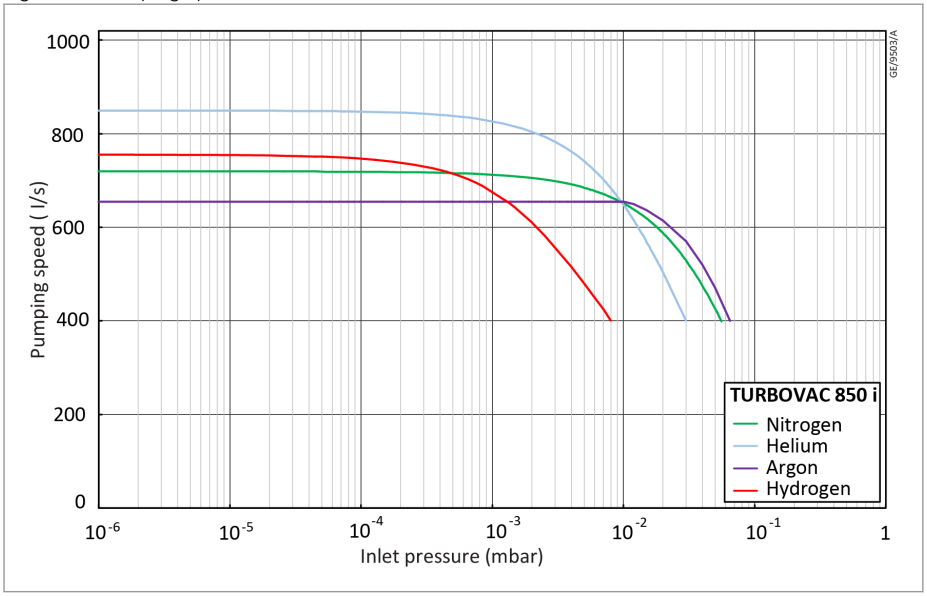
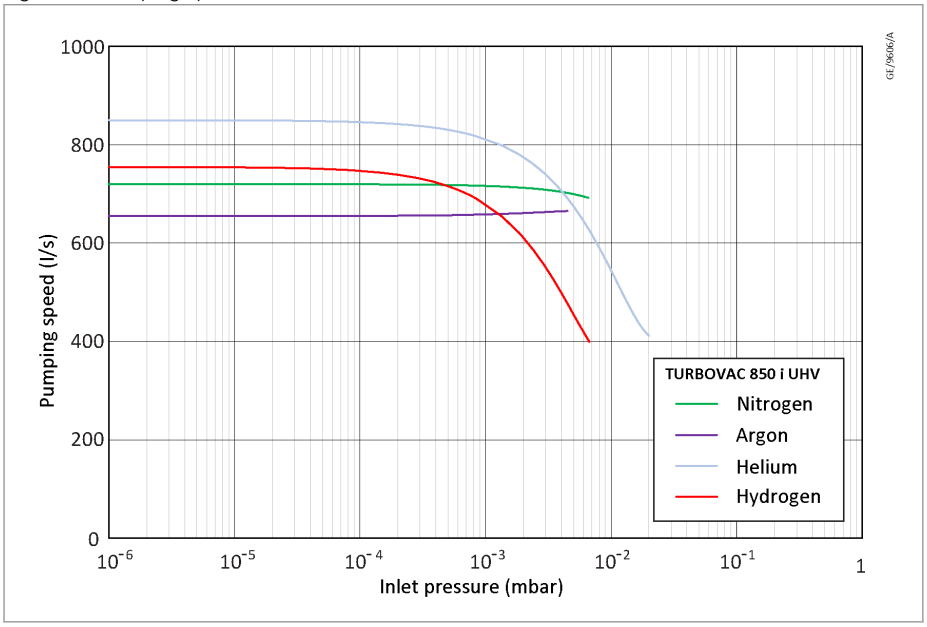


Figure 4. Pumping speed curves for the TURBOVAC 850 i UHV



Technical data

Figure 5. Pumping speed curves for the TURBOVAC 850 i IND

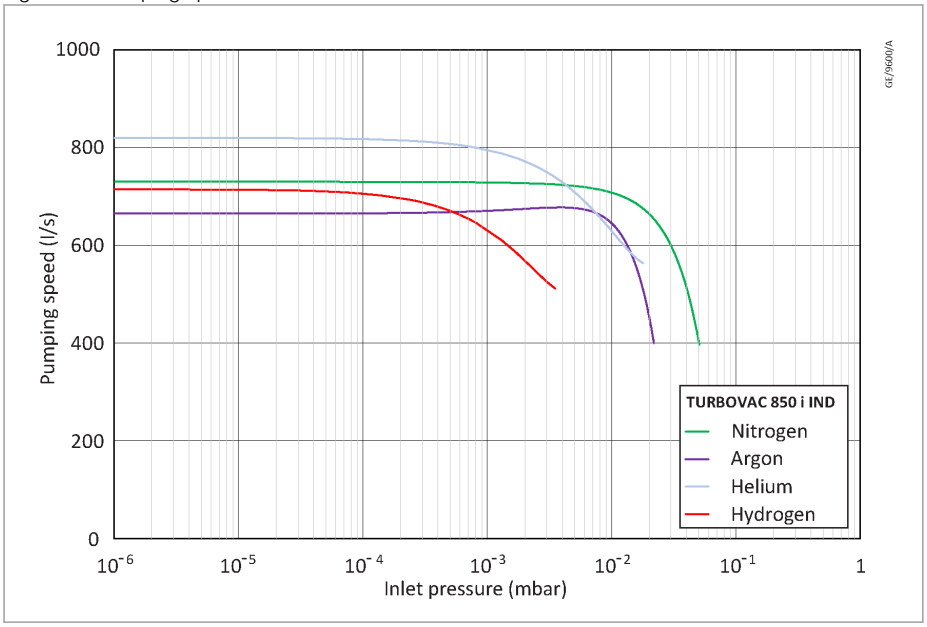


Figure 6. Pumping speed curves for the TURBOVAC 950 i

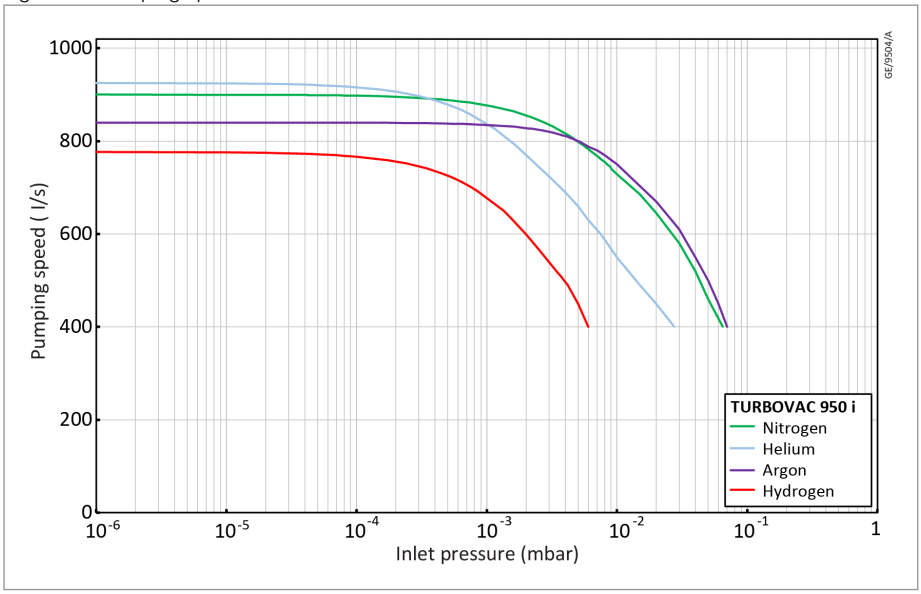


Figure 7. Pumping speed curves for the TURBOVAC 950 i IND

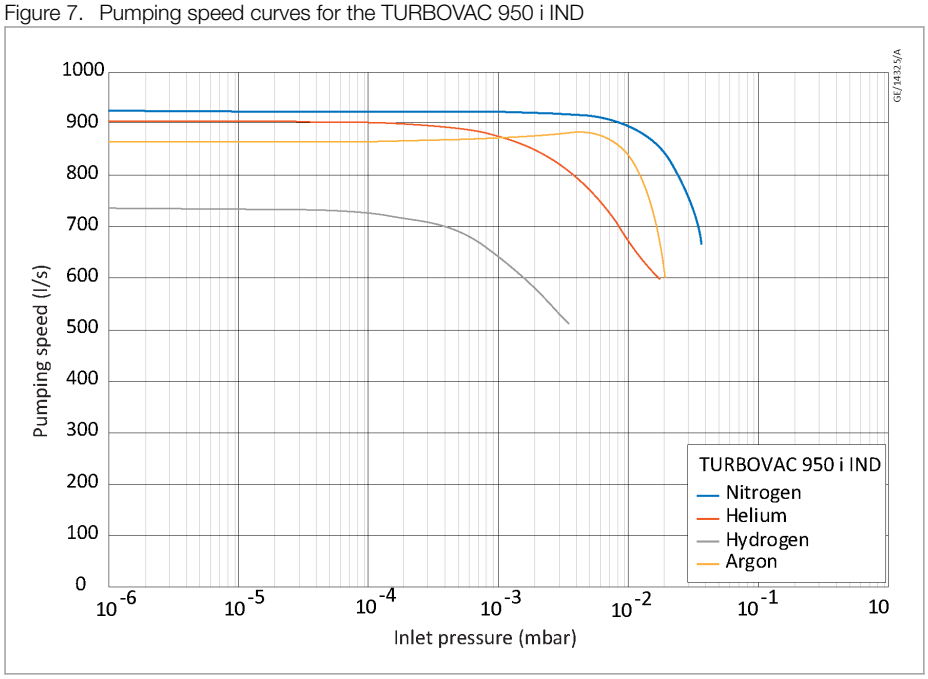


Figure 8. Pumping speed curves for the TURBOVAC 1350 i

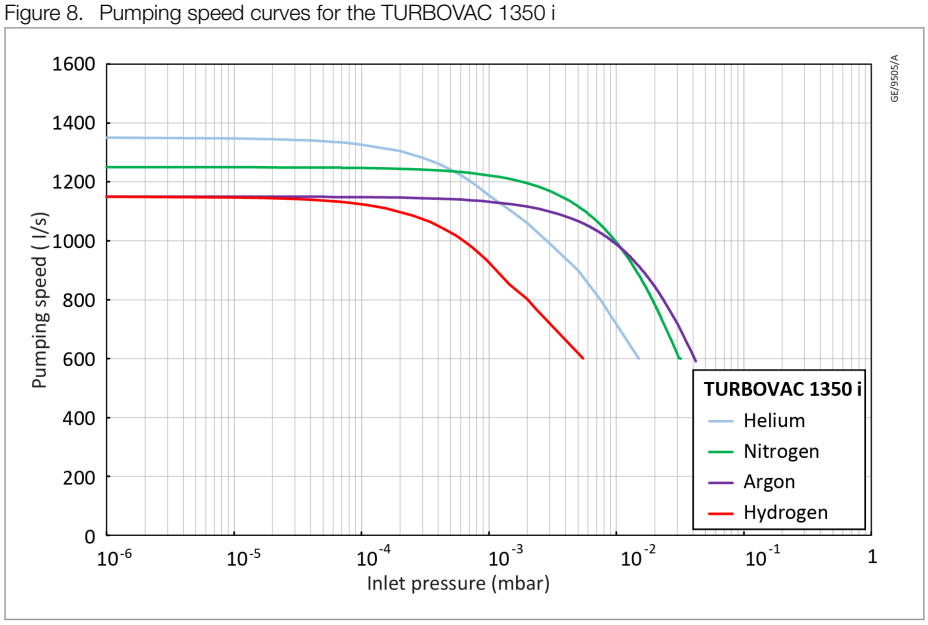
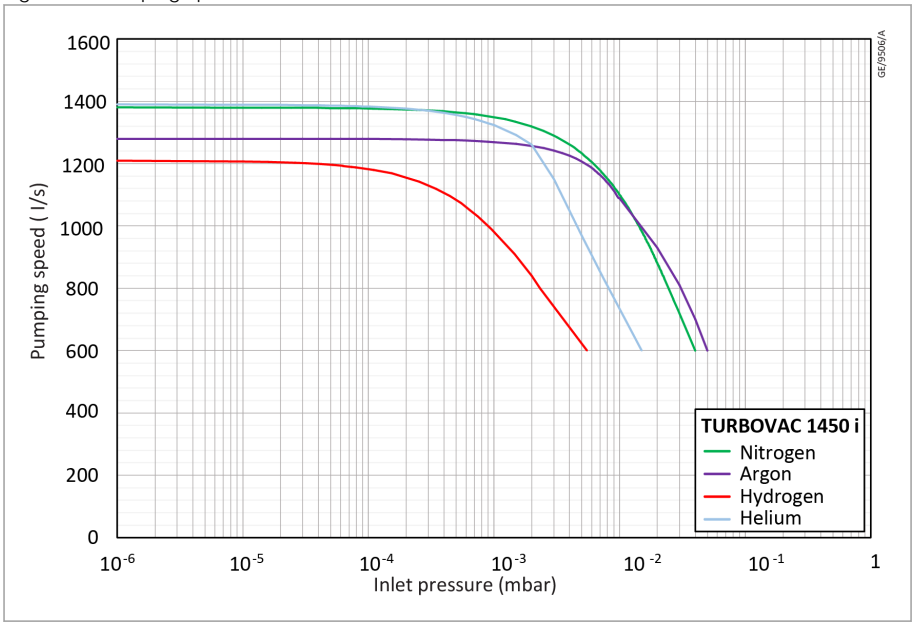


Figure 9. Pumping speed curves for the TURBOVAC 1450 i



4.4 Operation diagram

How to read the operating diagram:

With deploying a SCROLLVAC 7 plus backing pump, gas flows may be transported permanently with maximum throughput quantities of:

- 0.2 mbar·l/s (with convection cooling)
- 0.5 mbar·l/s (with air cooling at 40 °C) and
- approximately 5 mbar·l/s (with cooling water at 35 °C)

These values are a result of the intersection between the limitations of the individual cooling variant and the pumping speed of the backing pump. Maximum permanent gas flows are not only a turbomolecular pump characteristic but are also dependent on the installed backing pump.

Figure 10. Operation diagram for nitrogen for TURBOVAC 850 i

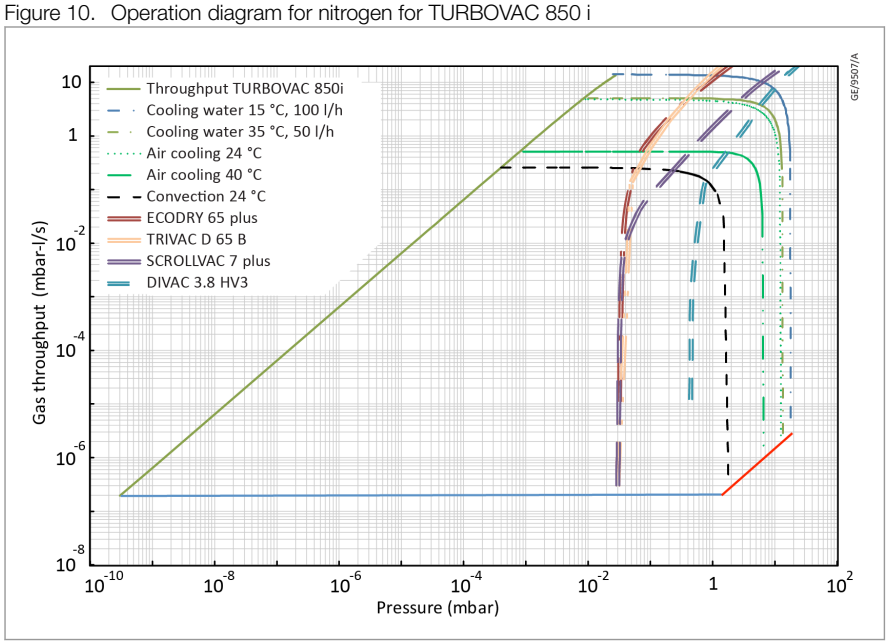
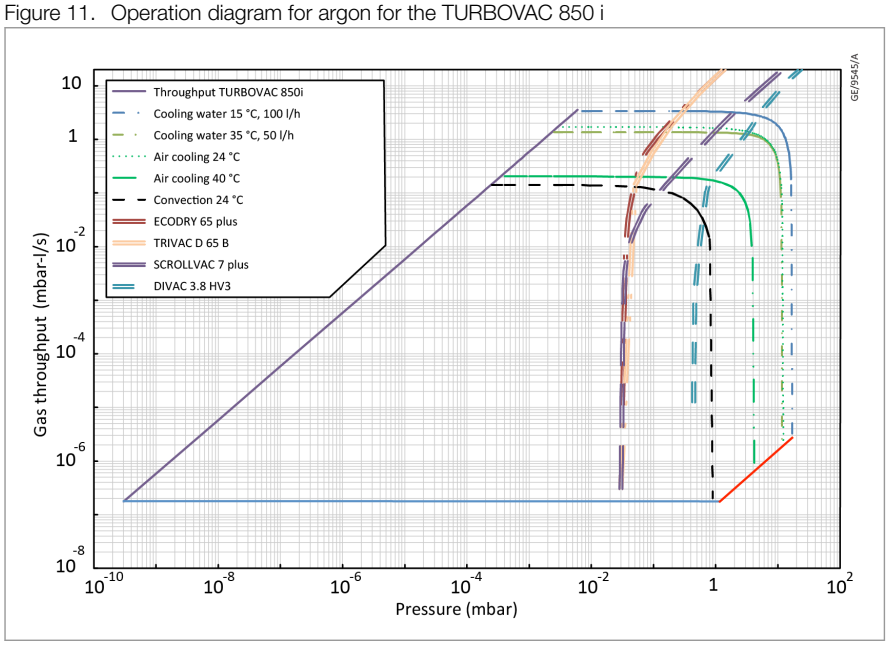


Figure 11. Operation diagram for argon for the TURBOVAC 850 i



Technical data

Figure 12. Operation diagram for nitrogen for the TURBOVAC 850 i UHV

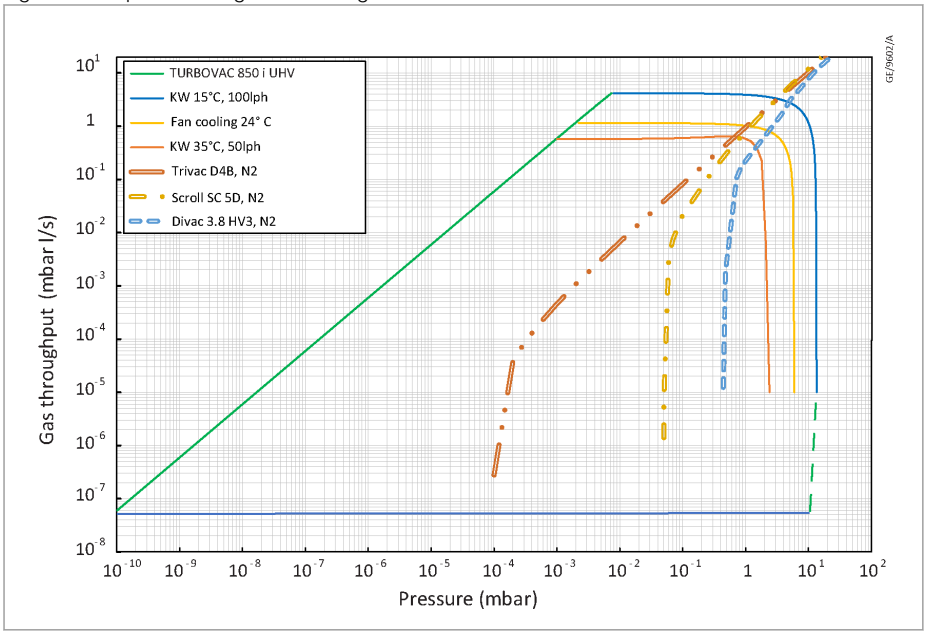


Figure 13. Operation diagram for argon for the TURBOVAC 850 i UHV

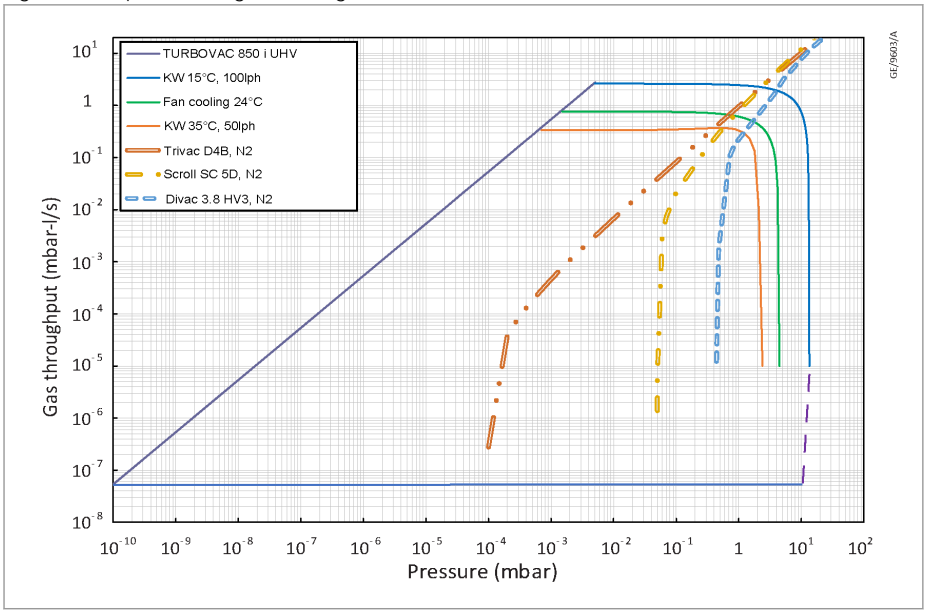


Figure 14. Operation diagram for helium for the TURBOVAC 850 i UHV

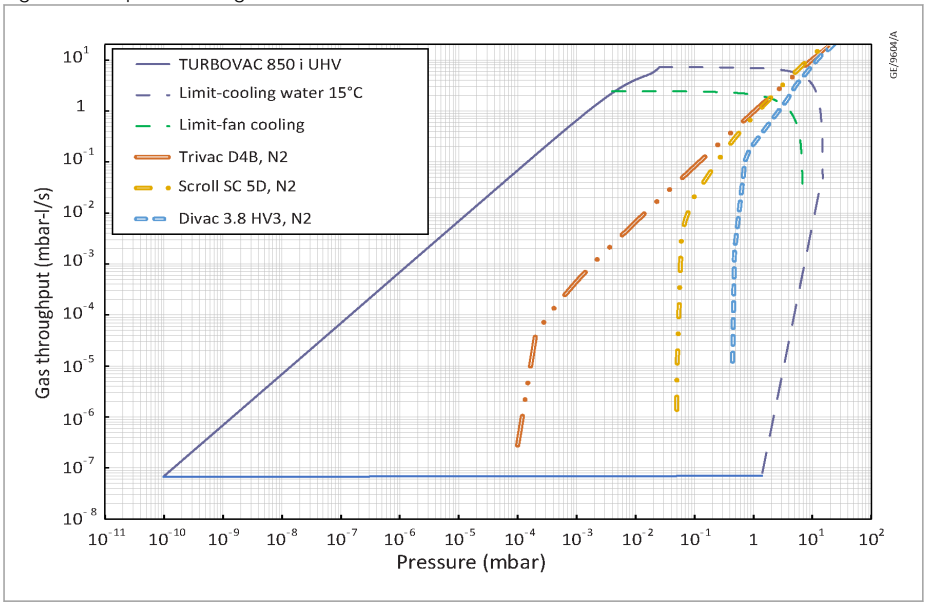
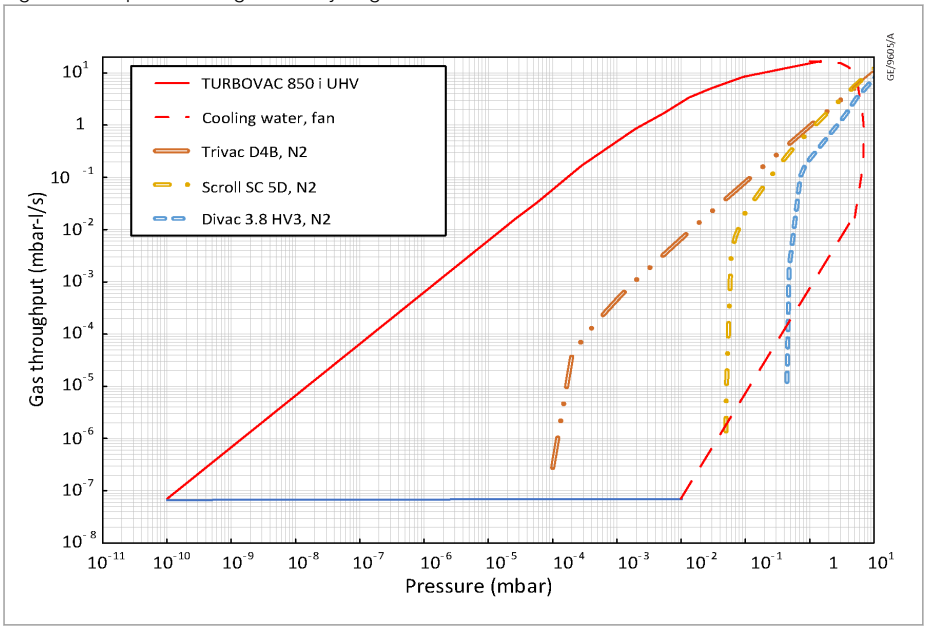


Figure 15. Operation diagram for hydrogen for the TURBOVAC 850 i UHV



Technical data

Figure 16. Operation diagram for nitrogen for the TURBOVAC 850/950 i IND

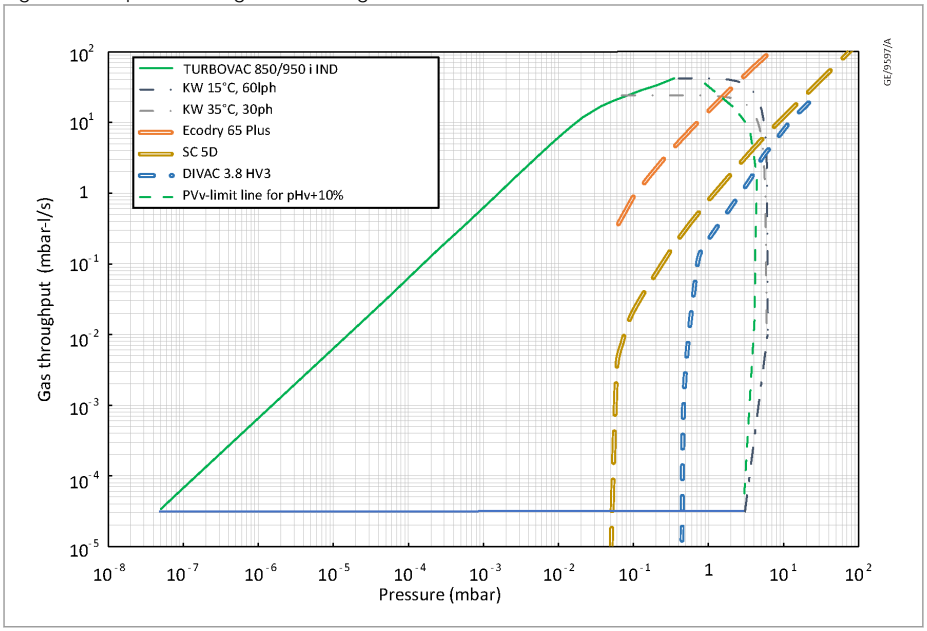


Figure 17. Operation diagram for argon for the TURBOVAC 850/950 i IND

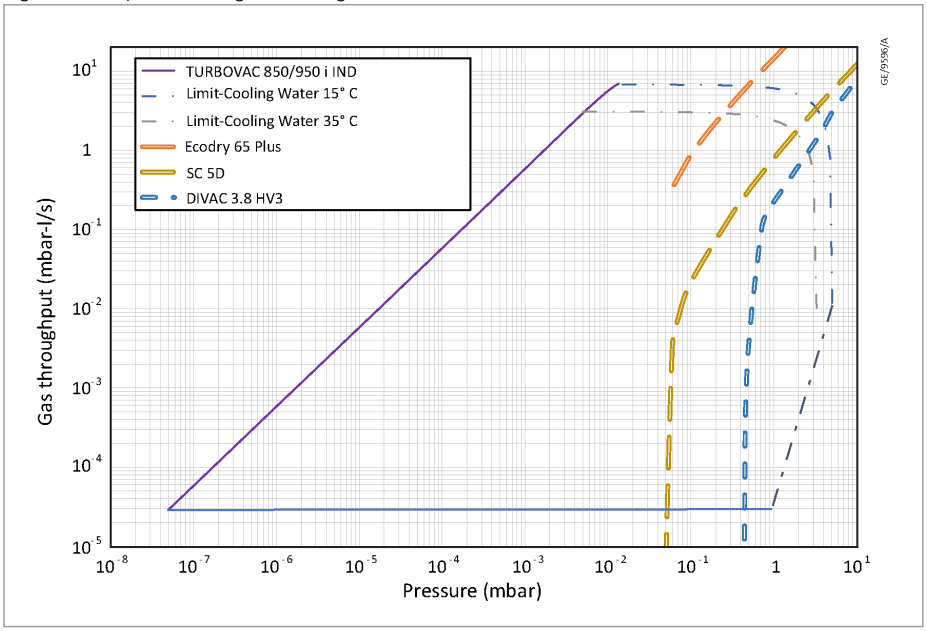


Figure 18. Operation diagram for hydrogen for the TURBOVAC 850/950 i IND

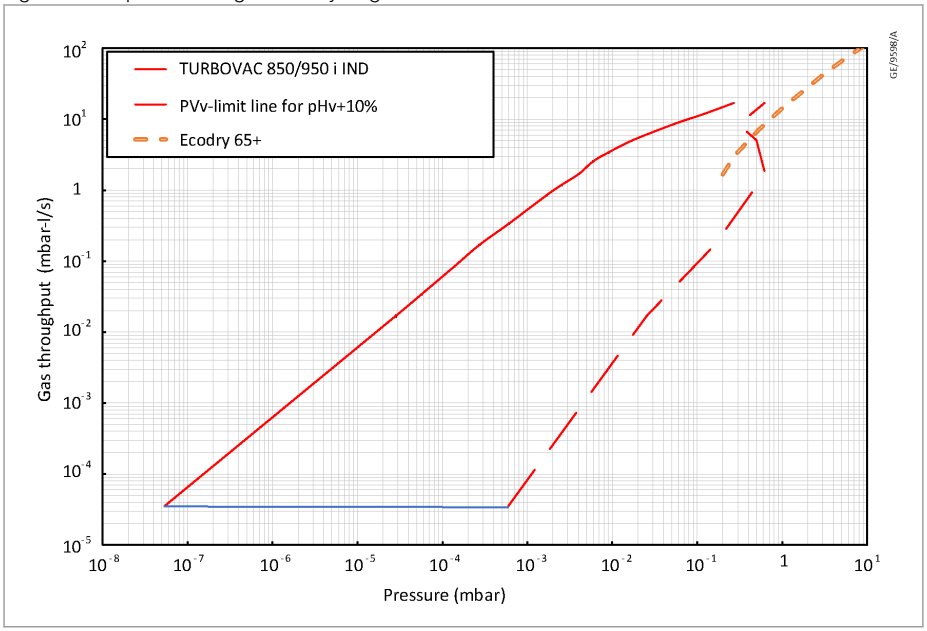
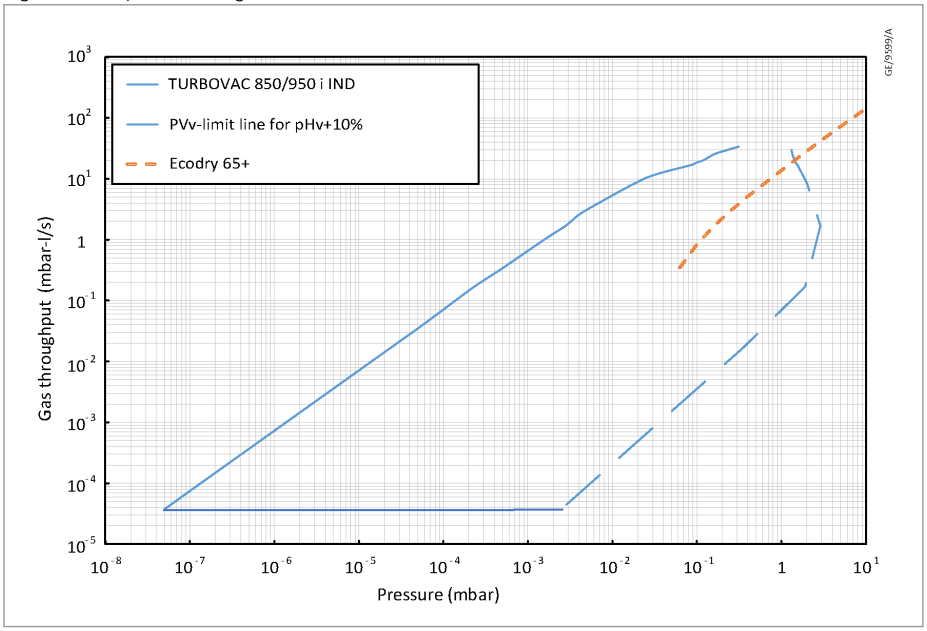


Figure 19. Operation diagram for helium for the TURBOVAC 850/950 i IND



Technical data

Figure 20. Operation diagrams for nitrogen for TURBOVAC 950 i

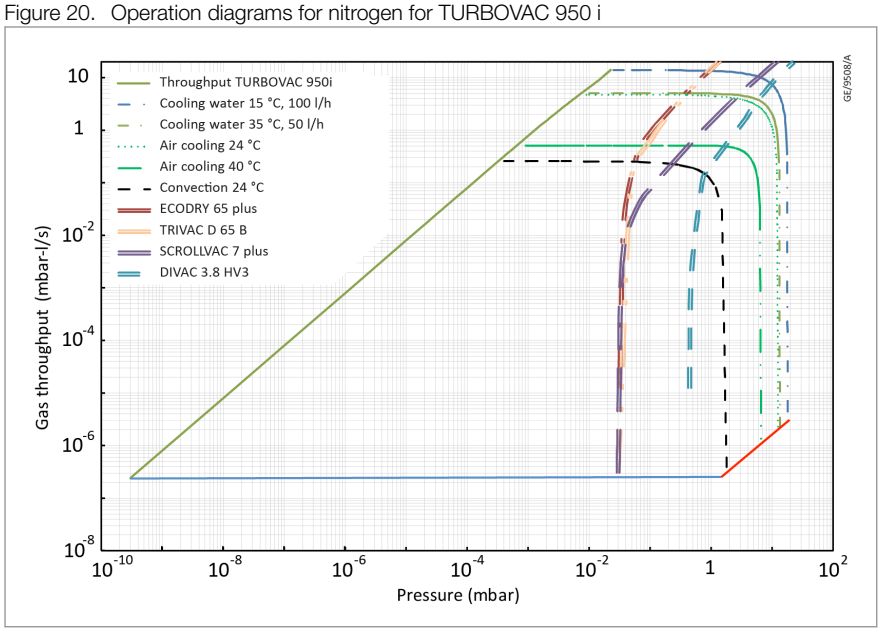


Figure 21. Operation diagrams for argon for TURBOVAC 950 i

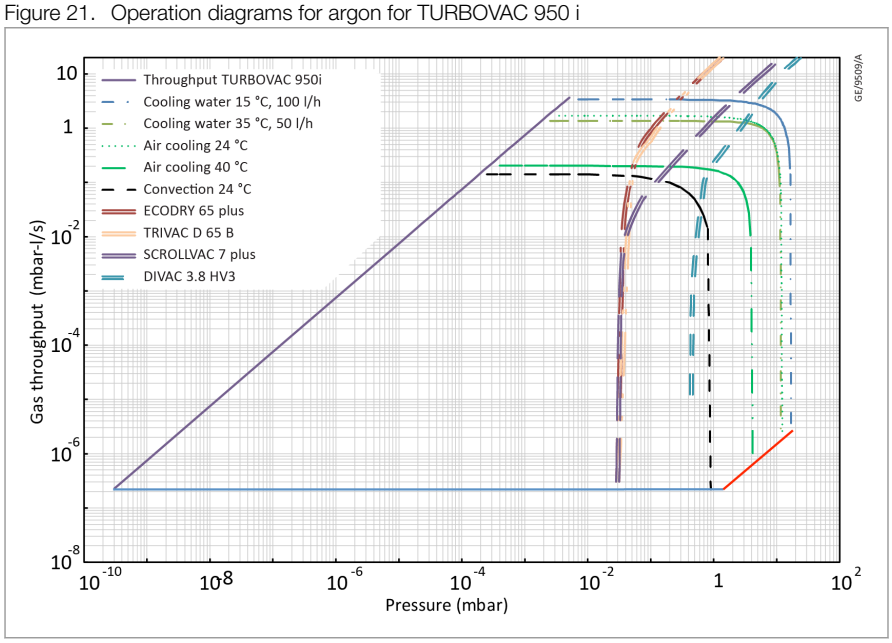


Figure 22. Operation diagrams for nitrogen for TURBOVAC 1350 i and 1450 i

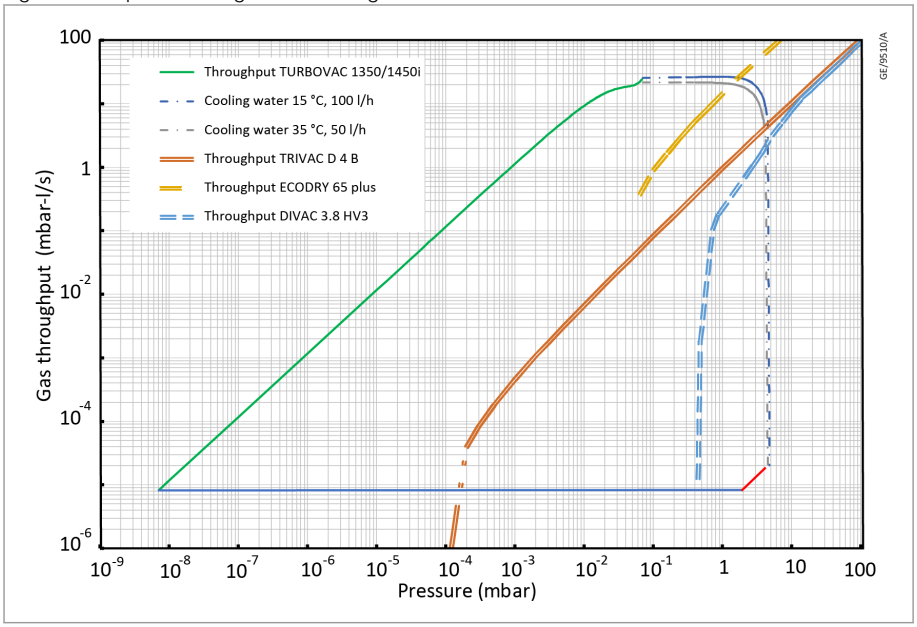
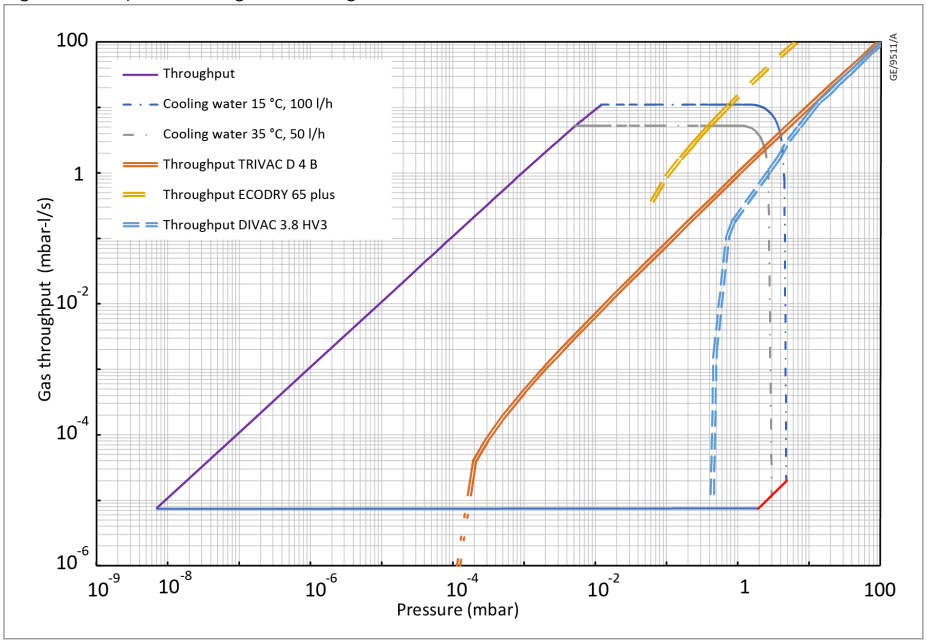


Figure 23. Operation diagrams for argon for TURBOVAC 1350 i and 1450 i



4.5 Technical data for the integrated drive electronics

Table 4 Technical data for the integrated drive electronics

Parameter	TURBOVAC i	TURBOVAC iX
	Drive electronics	Drive electronics and vacuum system control unit
Supply voltage	48 V d.c. +5% / -10%	48 V d.c. +5% / -10%
Maximum current consumption	11 A (default), 13 A (maximum) at 48 V d.c.	11 A (default), 13 A (maximum) at 48 V d.c.
Maximum power consumption		

Technical data

Parameter	TURBOVAC i	TURBOVAC iX
	Drive electronics	Drive electronics and vacuum system control unit
TURBOVAC 850/950 i	500 W (default), 600 W (maximum)	500 W (default), 600 W (maximum)
TURBOVAC 1350/1450 i	600 W (default), 800 W (maximum)	-
Interfaces	Refer to *Ordering data* on page 85	
Residual ripple	< 3%	< 3%
Maximum length of the d.c. cable (for variants with removable front end)	0.5 m	-
Maximum contact rating of the relays	48 V, 0.5 A 24 V, 1.0 A	48 V, 0.5 A 24 V, 1.0 A
Overvoltage category	II	II
Contamination grade	2	2
Accessory connections	1 pc. M8 connector, 24 V d.c.	3 pc. M8 connector, 24 V d.c.
Maximum load rating for the 24 V d.c. outputs (powering accessories, for example, cooling unit or valves)	24 V, maximum 18 W	24 V, maximum 18 W
Vacuum gauge head connection	-	15 pin Sub-D

5 Transportation

WARNING: SUSPENDED LOAD

Risk of injury. Do not stand below the pump while connecting or removing the turbomolecular pump.

The devices are delivered in safe transport packaging. Check whether the packaging has been damaged during transport. If that is the case, check the equipment immediately and notify the freight forwarder and us if necessary.

Keep transport packaging for any further transportation and storage of the pump. Be careful not to damage the sockets and connections during transport.

Unpacking

The turbomolecular pump is shipped in a sealed PE bag with desiccant. You must open the PE bag only when the pump is ready for installation. Do not remove the covers and blanking flanges until you are ready to make the connections, to make sure that the turbomolecular pump is installed under the cleanest possible conditions.

Lifting

The pump is equipped with four M8 holes for eye-bolts for lifting and moving. Remove the pump from the packaging using lifting equipment connected to the two eye-bolts provided, guiding it with one hand.

CAUTION: FALLING PARTS

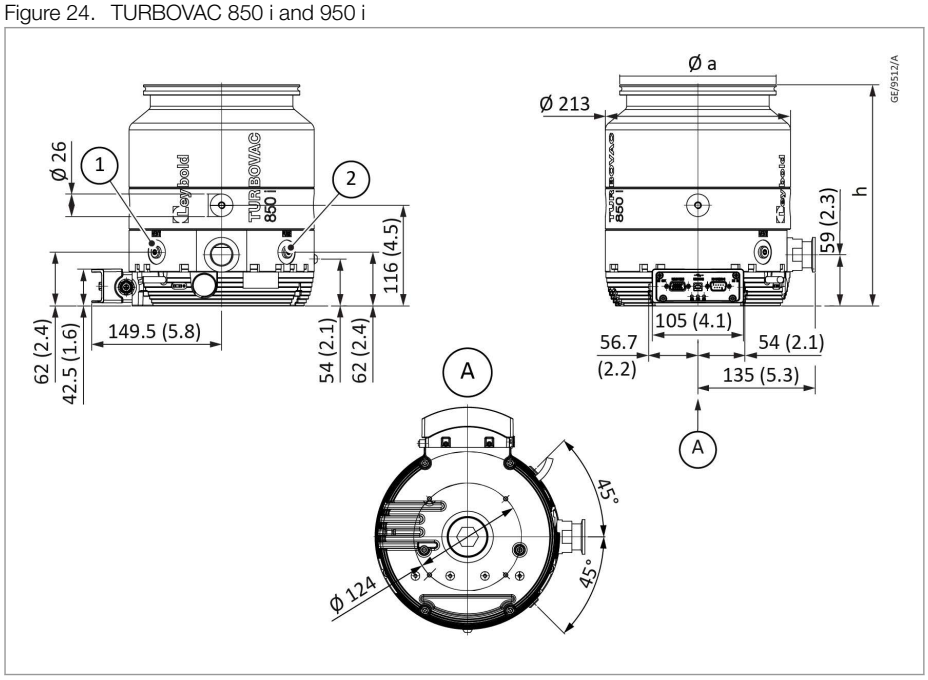
Risk of injury from falling parts. Mistakes made during transport can cause the pump to fall down. Transport the pump only in its transport packaging or using the eye-bolts provided for this purpose.

6 Installation

6.1 Dimension drawings

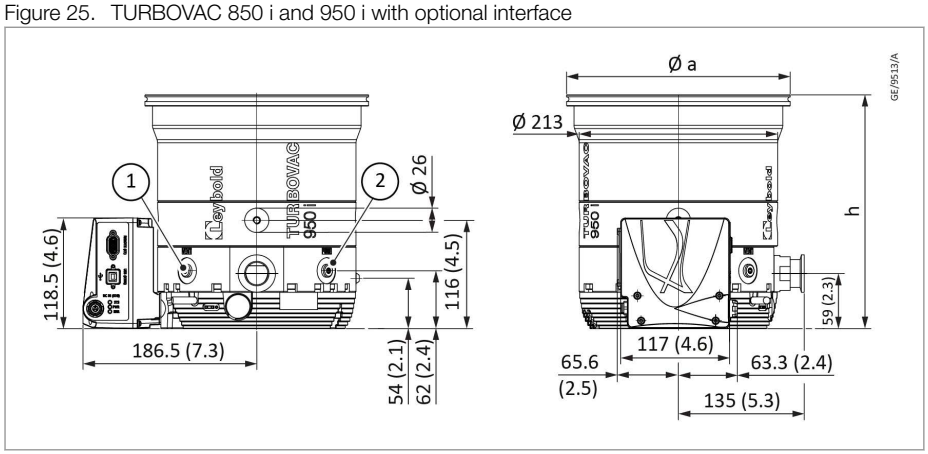
The dimensions given are in mm (inch).

Figure 24. TURBOVAC 850 i and 950 i



1. *VENT G 1/8"* 2. *PURGE G 1/8"*

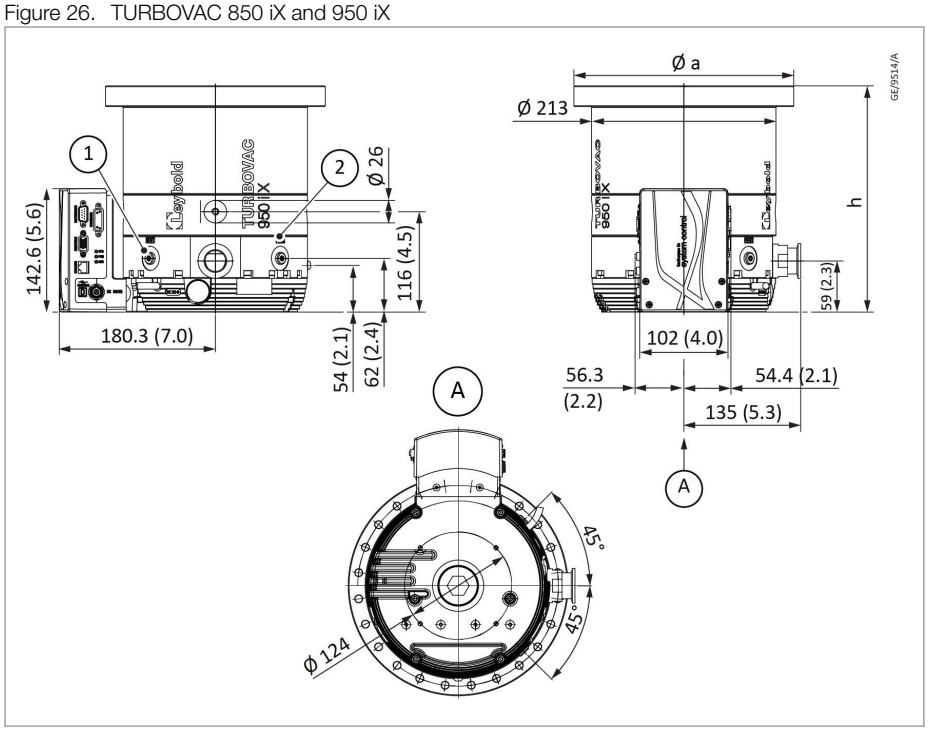
Figure 25. TURBOVAC 850 i and 950 i with optional interface



1. *VENT G 1/8"* 2. *PURGE G 1/8"*

	DN	a	h
850 i	160 ISO-K	180	255
850 i	160 CF	202.5	266
950 i	200 ISO-K	240	250.5
950 i	200 CF	254	261.3

Figure 26. TURBOVAC 850 iX and 950 iX

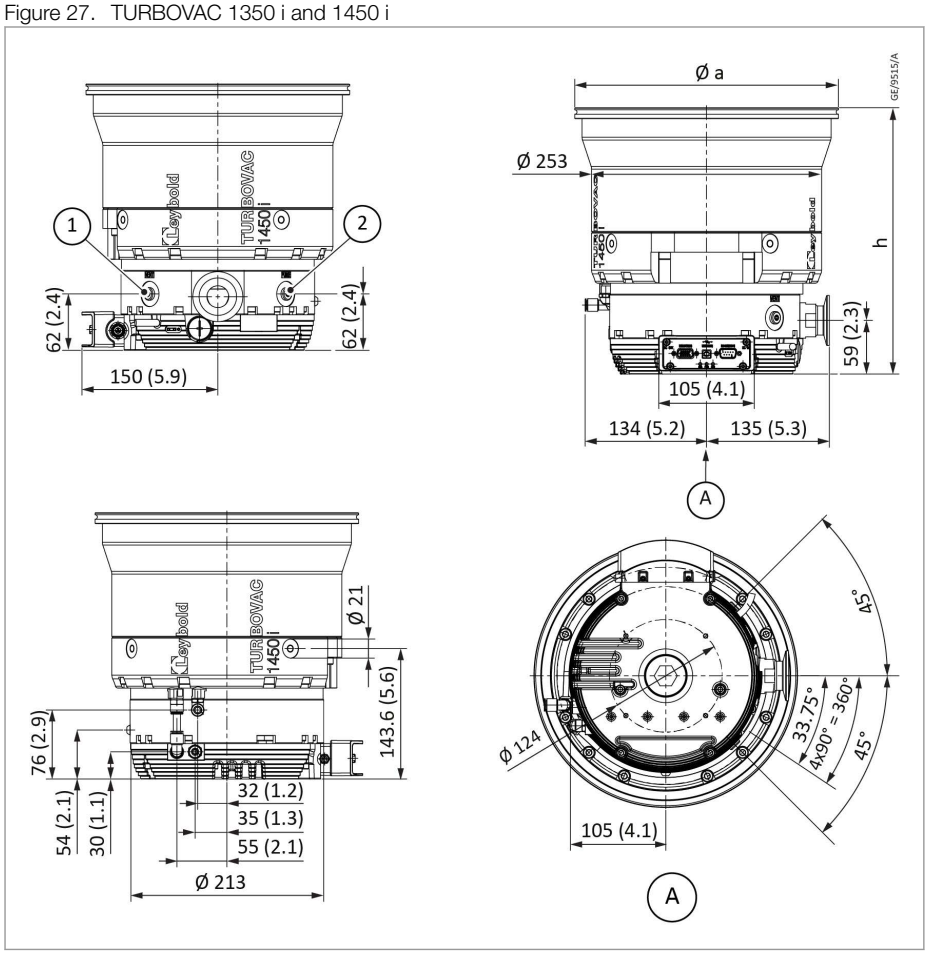


1. *VENT G 1/8"*
2. *PURGE G 1/8"*

	DN	a	h
850 iX	160 ISO-K	180	255
850 iX	160 CF	202.5	266
950 iX	200 ISO-K	240	250.5
950 iX	200 CF	254	261.3

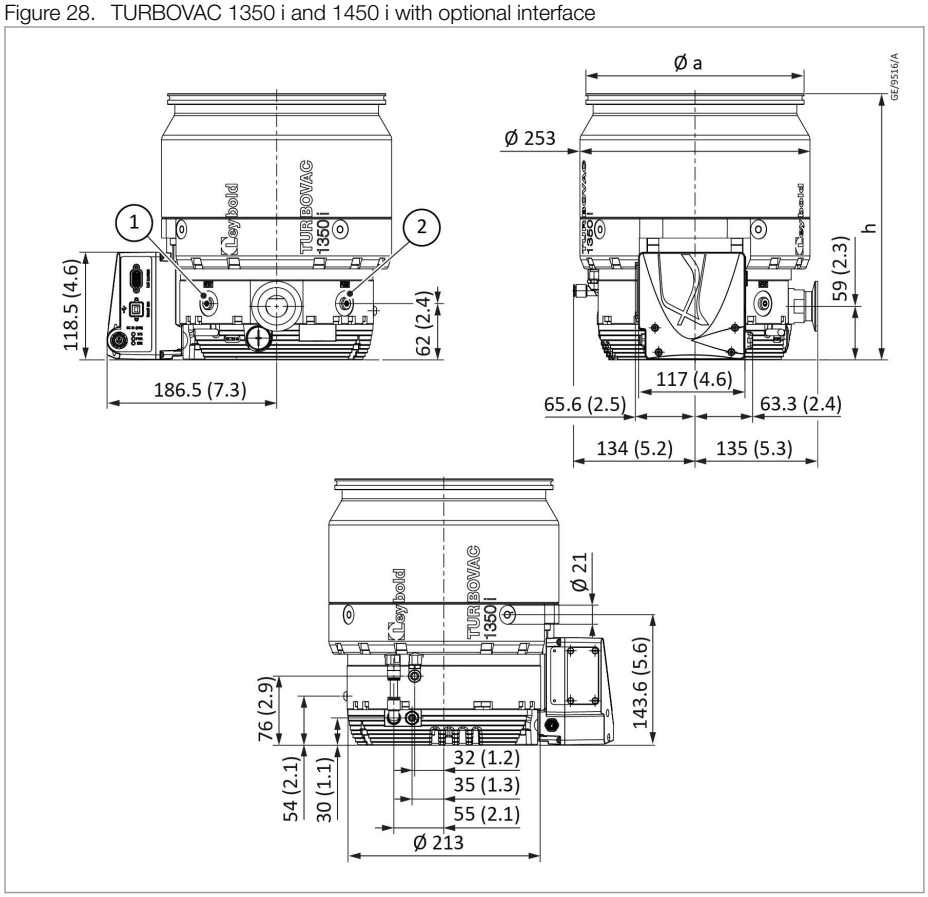
Installation

Figure 27. TURBOVAC 1350 i and 1450 i



1. *VENT G 1/8"*
2. *PURGE G 1/8"*

Figure 28. TURBOVAC 1350 i and 1450 i with optional interface



1. *VENT G 1/8"* 2. *PURGE G 1/8"*

	DN	a	h
1350 i	200 ISO-K	240	299.1
1350 i	200 ISO-F	285	301.6
1450 i	250 ISO-K	290	293
1450 i	250 ISO-F	335	299

6.2 Fitting accessories

Only for TURBOVAC i

Secondary devices are directly energised and activated through the accessory connection X201 (M8 plug), by means of a Y-cable 2 accessories can be connected at the same time.

In this case both devices will be switched parallelly (de-energised active/in-active). The factory-set accessories's interface features a plug-and-play mode, and is instantly ready for operation with the connected device (energised with pump switched on).

Only for TURBOVAC iX

Additional accessory components can be connected to the TURBOVAC iX:

- Pressure gauge
- Further 24 V d.c. operated equipment which may be driven depending on the pump status.

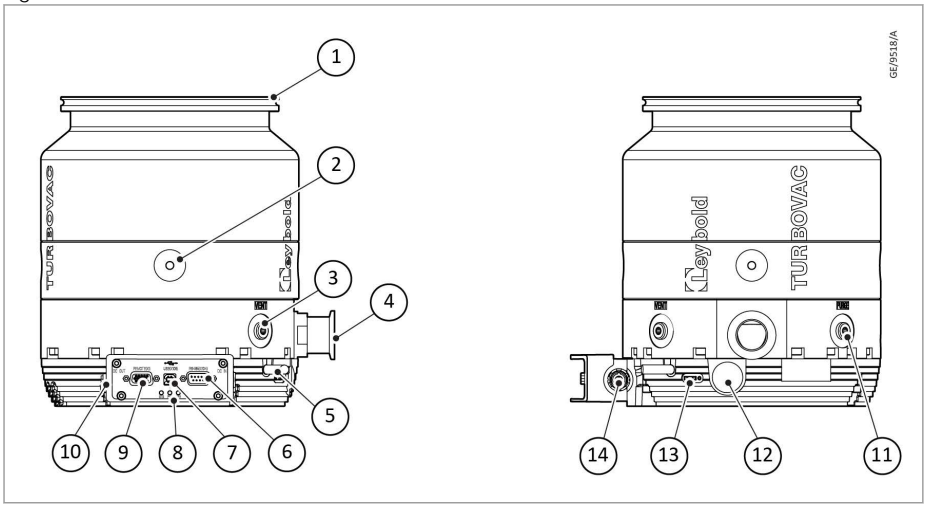
Installation

The accessory components can be electrically powered and driven through three accessory connections. Refer to on page 42.

Table 5. TURBOVAC iX configuration as delivered from the factory

Accessory connection	Pre-configured equipment	Reaction
X201	Air cooling	Air cooling unit is running when the TURBOVAC is running.
X202	Relay box for forevacuum pump	Forevacuum pump is running when the TURBOVAC has received the start command.
X203	Venting valve	The venting valve opens when the start command is revoked and the frequency drops below 999 Hz. At 5 Hz the valve is closed again (no power failure venting).

Figure 29. Connections



1. *High-vacuum flange*
2. *4x boreholes for eye-bolts*
3. *Venting connection G1/8"*
4. *Forevacuum connection*
5. *48 V d.c. power supply cable*
6. *RS 485 interface X104*
7. *USB interface X106*
8. *LEDs*
9. *REMOTE interface X1*
10. *Accessory connection DC OUT (M8) X201*
11. *Purge gas connection G1/8"*
12. *USB interface service*
13. *Bearing status indication (indicates when bearing service is recommended)*
14. *Do not connect a power supply to this connection*

6.3 Attach the pump to the vacuum chamber

WARNING: ROTOR DAMAGE

Risk of injury and damage to equipment. Do not touch the rotor, it can cause injury and damage the rotor bearing.

WARNING: EXPLOSIVE MATERIALS

Risk of injury. The high vacuum flange must be firmly mounted to the vacuum chamber. Observe safety information given in *Mechanical hazards* on page 11.

WARNING: HOT SURFACE

Risk of injury. During the operation, the pump can get so hot that there is the risk of suffering burns (up to approximately 65 °C). Protect the hot parts against being touched.

WARNING: EJECTION OF PARTS

If the mounting is not sturdy enough, pump blockage could cause the pump to break loose; internal pump components could be thrown in all directions.

Mount the pump firmly to the vacuum chamber. Never operate the pump without proper flanging to the vacuum chamber (in bench testing, for example). In case of rotor destruction a sudden twisting of the entire pump is possible. The vacuum chamber must be able to absorb the torque of max. 10 kNm around the rotor's axis of rotation in the event of sudden rotor destruction.

CAUTION: CUTTING AND CRUSHING

When reaching into open flanges there is a risk of cutting and crushing your fingers.

Do not operate the vacuum pump with open flanges. Do not reach into the pump.

When installing the vacuum pump, first mechanically connect the inlets and outlets and then make the electrical connections.

CAUTION: PUMP ROTATION

Risk of damage to equipment. Even the correct KF connector for the high-vacuum flange is not strong enough to keep the pump completely from rotating a little bit if it should suddenly seize. Rotation of the pump can cause leaks in the forevacuum line. Secure the pump additionally to prevent rotation in case it should suddenly seize.

Mounting position

TURBOVAC 850 i and 950 i pumps can be mounted in any orientation.

TURBOVAC 1350 i and 1450 i pumps can be mounted:

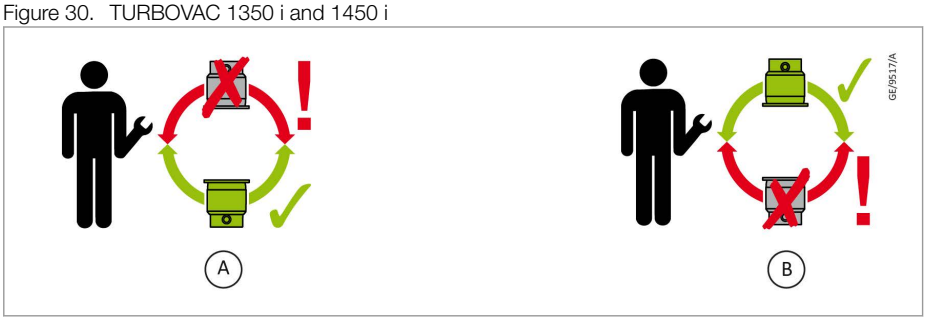
- horizontally or vertically, with the high-vacuum flange on top and in any orientation in between or
- horizontally or vertically, with the high-vacuum flange on the bottom and in any orientation in between (U versions)

NOTICE: PUMP DAMAGE

The pump can be damaged if it is operated in the incorrectly installed orientation.

Observe the sticker on the pump and install the pump only in the permitted orientation.

Figure 30. TURBOVAC 1350 i and 1450 i



A. Mounting position for part no. without U

B. Mounting position for part no. with U

Remove the transport seal from the intake flange and remove the desiccant.

Pay attention to maximum cleanliness when you make connections.

In the case of a sudden rotor vane rupture or rotor-stator contact which may occur in practise (caused, for example, by solid objects from the process chamber entering the pump through the high vacuum flange), the torques need to be absorbed by the system is given in *Table: Torque when the rotor seizes*.

In most applications, the pump is flanged to the high vacuum flange at the apparatus. The pump can be mounted and operated at any desired altitude.

When using flange connecting elements in accordance with DIN 28404 (ISO-F flange connection), ISO 1609 (ISO-K flange connection) or ISO 3669 (CF flange connection), which fit positively to the pump flange, check the maximum load capacity of the connecting element. Not all flange components can withstand the forces that occur in a crash.

If the strength of the component is not sufficient, there is the possibility of providing an additional safeguard through the four threaded holes for the eye-bolts for transport. Make sure that the mountings can withstand the braking torque.

The flange material to which the pump is bolted must have a minimum strength specification of 150 N/mm^2 at operating temperature.

If several turbomolecular pumps are attached to the vacuum chamber of the same system, there is the risk of interference (vibration interference between the pumps). If such a risk exists, contact our application support.

The standard mounting arrangement for the pump is adequate to make sure protection from the earthquake. If required mount the system to the floor or the walls.

Install a splinter guard or an inlet screen

To protect the turbomolecular pump against foreign material from the vacuum vessel we recommend to mount a centring ring with a fine or coarse inlet screen at the high vacuum flange, though this will reduce the pumping speed at the chamber flange.

Reduction of the pumping speed in %	H_2	He	N_2	Ar
Fine inlet screen DN 160/200/250	6	9	20	23
Coarse inlet screen DN 160/200/250	1	2	6	7

Note:

Damages caused during operation without the inlet screen are excluded from warranty.

Flange mounting for ISO-K flanges

Refer to:

FIgure: Mounting high vacuum flange ISO-K flange at ISO-K flange

Figure: Mounting high vacuum flange ISO-K flange at ISO-F flange with collar flange

Figure: Mounting high vacuum flange ISO-K flange at ISO-F flange with claws

When flanging on the high vacuum connecting flange, place the O-ring on the centring ring. The O-ring must remain in place, smooth and untwisted. Thereafter put the outer ring (support ring) in place.

Mount the turbomolecular pump and tighten the bolts crosswise step-by-step.

When using an ultra sealing ring, always use an outer support ring. The information on the number of bolts and clamps also applies to the ultra sealing rings.

Required for the installation:

- Mounting kit (accessories)
- Coarse or fine inlet screens (accessories, optional).

The contact surfaces of the pump housing, vacuum system and centring ring must be dry and free of grease to make sure adequate strength in case the rotor should seize.

Flange mounting for CF flanges

WARNING: HOT SURFACE

Risk of injury. During the operation, the pump can get so hot that there is the risk of suffering burns (up to approximately 65 °C). Protect the hot parts against being touched.

Refer to:

Figure: Mounting high vacuum CF flange connection with clearance hole

Figure: Mounting high vacuum CF flange connection with blind hole thread

Before fitting, check to make sure that the sealing edge is undamaged. Do not touch the copper gasket and the sealing edge with your bare hands.

The contact surfaces of the pump housing, vacuum system and centring ring must be dry and free of grease to make sure adequate strength in case the rotor should seize.

Mount the turbomolecular pump and tighten the bolts step-by-step.

When the pump is to be baked out, the threads of the bolts should have been lubricated with a high temperature lubricant.

Owing to the deformation of the copper gasket, the fastening torque of all bolts must be checked once more after you complete the installation work.

Installation

Required for the installation:

- Mounting kit (accessories)
- Coarse or fine inlet screens (accessories, optional).

Flange mounting for ISO-F flanges

Refer to:

Figure: Mounting high vacuum ISO-F flange connection with clearance hole

Figure: Mounting high vacuum ISO-F flange connection with blind hole thread

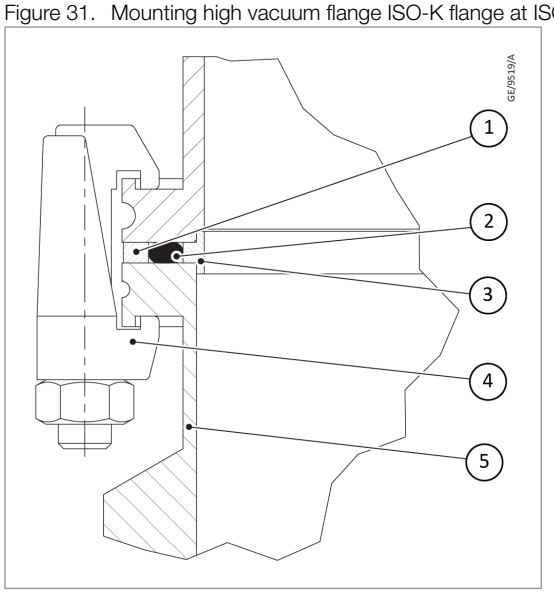
Mount the turbomolecular pump and tighten the bolts step-by-step.

The contact surfaces of the pump housing, vacuum system and centring ring must be dry and free of grease to make sure adequate strength in case the rotor should seize.

Table 6. Torque when the rotor seizes

Model	Maximum value
TURBOVAC 850/950 i(X)	5 kNm
TURBOVAC 1350/1450 i	9 kNm

Figure 31. Mounting high vacuum flange ISO-K flange at ISO-K flange

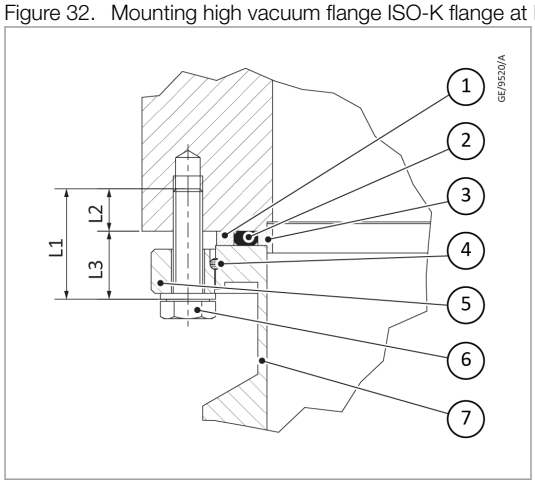


1. *Outer ring*
2. *O-ring*
3. *Centering ring*
4. *Clamp*
5. *Pump housing with ISO-K flange*

TURBOVAC	850/950 i		1350/1450 i	
Flange	**DN 160 ISO-K**	**DN 200 ISO-K**	**DN 200 ISO-K**	**DN 250 ISO-K**
Number of clamps	12 x M10	12 x M10	18 x M10	18 x M10
Fastening torque	20^{+3} Nm	20^{+3} Nm	27^{+3} Nm	27^{+3} Nm

The fastening torque levels apply to lubricated threads.

Figure 32. Mounting high vacuum flange ISO-K flange at ISO-F flange with collar flange



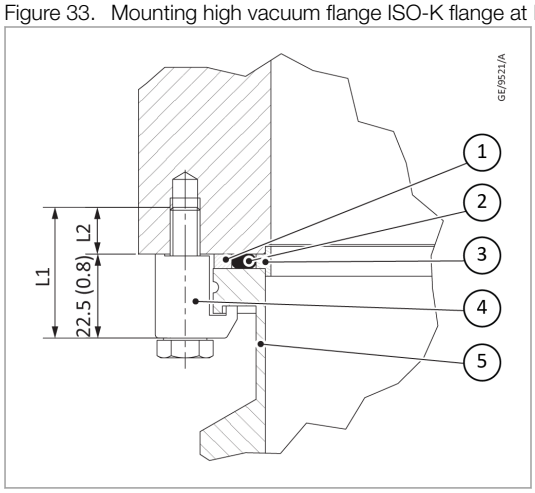
1. *Outer ring*
2. *O-ring*
3. *Centering ring*
4. *Retaining ring*
5. *Collar flange*
6. *Bolt with washer*
7. *Pump housing with ISO-K flange*

TURBOVAC	**850/950 i**		**1350/1450 i**	
Flange	**DN 160 ISO-K**	**DN 200 ISO-K**	**DN 200 ISO-K**	**DN 250 ISO-K**
Number of bolts	8 x M10	12 x M10	12 x M10	12 x M10
Minimum bolt strength, yield strength	> 640 N/mm^2			
Minimum screw in depth L2 for steel for aluminium L3	 13 mm 18 mm 23 mm			
Recommended bolts - ISO 4014 for steel flanges for aluminium flanges	 M10 x 40 M10 x 45			
Bolt quality	8.8			
Fastening torque	35^{+5} Nm			

The fastening torque levels apply to lubricated threads.

Installation

Figure 33. Mounting high vacuum flange ISO-K flange at ISO-F flange with claws

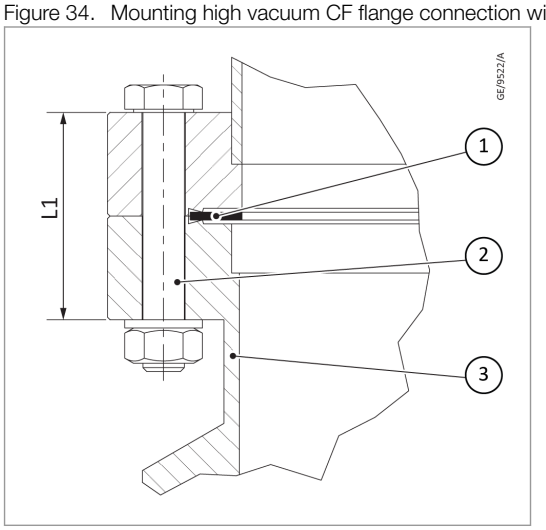


1. *Outer ring*
2. *O-ring*
3. *Centering ring*
4. *Claw with bolt*
5. *Pump housing with ISO-K flange*

TURBOVAC	**850/950 i**		**1350/1450 i**	
Flange	**DN 160 ISO-K**	**DN 200 ISO-K**	**DN 200 ISO-K**	**DN 250 ISO-K**
Number of clamps	12 x M10		not permitted	
Minimum bolt strength, yield strength	> 640 N/mm^2			
Minimum screw in depth L2 for steel for aluminium	 13 mm 18 mm			
Recommended bolts - ISO 4014 for steel flanges for aluminium flanges	 M10 x 35 M10 x 40			
Bolt quality	8.8			
Fastening torque	35^{+5} Nm			

The fastening torque levels apply to lubricated threads.

Figure 34. Mounting high vacuum CF flange connection with clearance hole



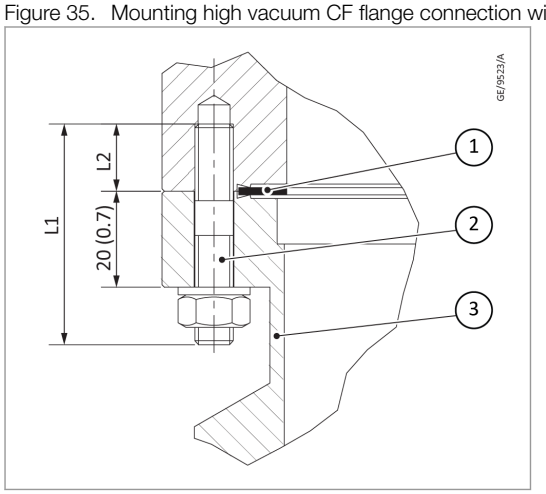
1. *Copper gasket*
2. *Bolt with washer and nut*
3. *Pump housing with CF flange*

TURBOVAC	**850/950 i**		**1350/1450 i**	
Flange	**DN 160 CF**	**DN 200 CF**	**DN 200 CF**	**DN 250 CF**
Number of bolts	20xM8	24xM8	24xM8	32xM8
Minimum bolt strength, yield strength	> 450 N/mm^2		> 450 N/mm^2	
Recommended bolts - ISO 4014 L1	M8x55 44	M8x60 49	M8x60 49	
Bolt quality stainless steel bolts	8.8 or A2(A4)-70		8.8 or A2(A4)-70	
Fastening torque	15^{+2} Nm		15^{+2} Nm	

The fastening torque levels apply to lubricated threads.

Installation

Figure 35. Mounting high vacuum CF flange connection with blind hole thread

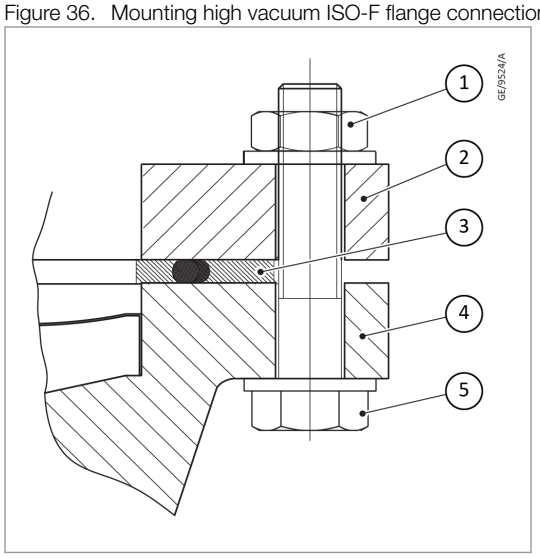


1. *Copper gasket*
2. *Stud bolt with washer and nut*
3. *Pump housing with CF flange*

TURBOVAC	**850/950 i**		**1350/1450 i**	
Flange	**DN 160 CF**	**DN 200 CF**	**DN 200 CF**	**DN 250 CF**
Number of bolts	20 x M8	24 x M8	24 x M8	32 x M8
Minimum bolt strength, yield strength	> 450 N/mm^2		> 450 N/mm^2	
Minimum screw-in depth for steel	12 mm		12 mm	
Recommended bolts for steel flanges - DIN 835 L1	M8x30 46	M8x30 51	M8x30 51	
Bolt quality stainless steel bolts	8.8 or A2(A4)-70		8.8 or A2(A4)-70	
Fastening torque	15^{+2} Nm		15^{+2} Nm	

The fastening torque levels apply to lubricated threads.

Figure 36. Mounting high vacuum ISO-F flange connection with clearance hole

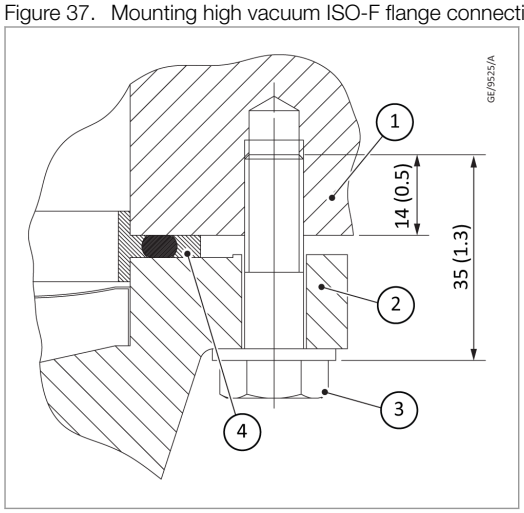


1. *Nut*
2. *ISO-F flange*
3. *Vacuum sealing disk consisting of centering ring and O-ring with outer support ring*
4. *ISO-F flange*
5. *Bolt*

TURBOVAC	**1350/1450 i**	
Flange	**DN 200 ISO-F**	**DN 250 ISO-F**
Number of bolts	12 x M10x50	
Minimum bolt strength, yield strength	>640 N/mm^2	
Bolt quality	8.8	
Fastening torque	35^{+5} Nm	

The fastening torque levels apply to lubricated threads.

Figure 37. Mounting high vacuum ISO-F flange connection with blind hole thread



TURBOVAC	1350/1450 i	
Flange	**DN 200 ISO-F**	**DN 250 ISO-F**
Number of bolts	12 x M10x35	
Minimum bolt strength, yield strength	>640 N/mm^2	
Bolt quality	8.8	
Fastening torque	35^{+5} Nm	

The fastening torque levels apply to lubricated threads.

6.4 Forevacuum connection

WARNING: TOXIC MATERIAL

Risk of injury. The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity. Observe safety information given in *Hazards caused by materials and substances* **on page 13.**

Connect the clean forevacuum line with the small flange connectors or the hose couplings, and take care not to constrict the forevacuum flange's diameter.

Make sure that the pump is sufficiently isolated against vibrations generated by the forevacuum pump.

No forces from the piping system may be allowed to affect the turbomolecular pump. Support the piping correspondingly or decouple through flexible joints.

Note:

Do not use the pump with a backing pressure below 5x10^{-4} mbar. Lower backing pressure will increase the evaporation rate of the lubrication reducing the bearing life.

Only for TURBOVAC i

The forevacuum pump can be energised at the accessories connection of the TURBOVAC through the relay box.

Only for TURBOVAC iX

A forevacuum pump may be electrically connected through the relay box to accessory connection X202 on the TURBOVAC iX.

The relay box switches the forevacuum pump on when a start command is present for the turbomolecular pump, and the relay box switches the forevacuum pump off when the start command is revoked.

Through parameter 643[1] the switch-on delay time and through parameter 644[1] a shutdown delay time in seconds can be set up (the default for both parameters is 0).

6.5 Connect the cooling

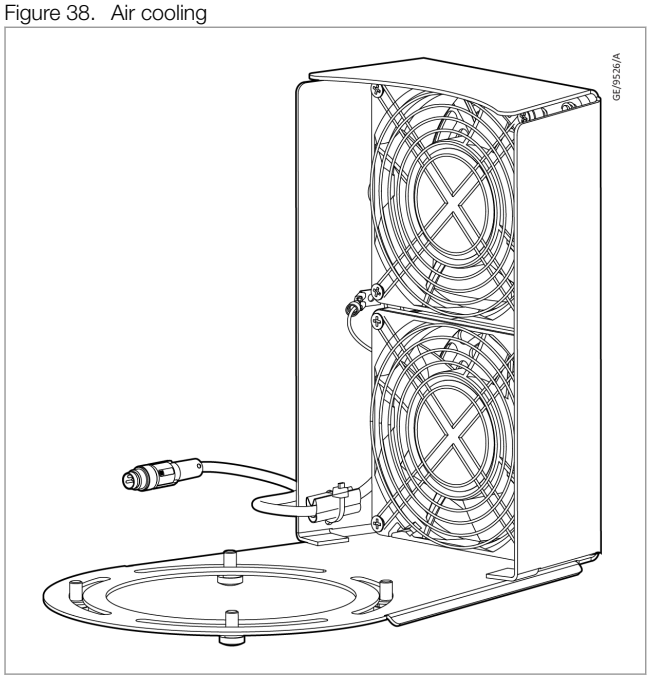
Cooling of the pump depends on the required pumping power and the ambient temperature. When the pump is insufficiently cooled it will shut down. High gas throughputs, cyclic operation or high ambient temperatures will necessitate air or water cooling.

6.5.1 Air cooling

When installing air cooled pumps within a system, make sure that sufficient quantities of fresh air are freely available. The air cooling facility is powered through the pump.

Use the 4 bolts which are included in the delivery to attach the air cooling unit at the bores provided on TURBOVAC, refer to the respective dimensional drawings. Plug in the control cable of the air cooler into the accessories connection (X201 for the TURBOVAC iX) and screw tightly. The accessory connection is pre-configured so that the air cooler will always be running when the pump is running. To change this setting, refer to *Interfaces* on page 67.

Figure 38. Air cooling



6.5.2 Water cooling

TURBOVAC 850 i and 950 i

Attach the cooling water block to the TURBOVAC with four M4 screws, tightening torque is 3^{+1} Nm. Connect the cooling water hoses.

TURBOVAC 1350 i and 1450 i

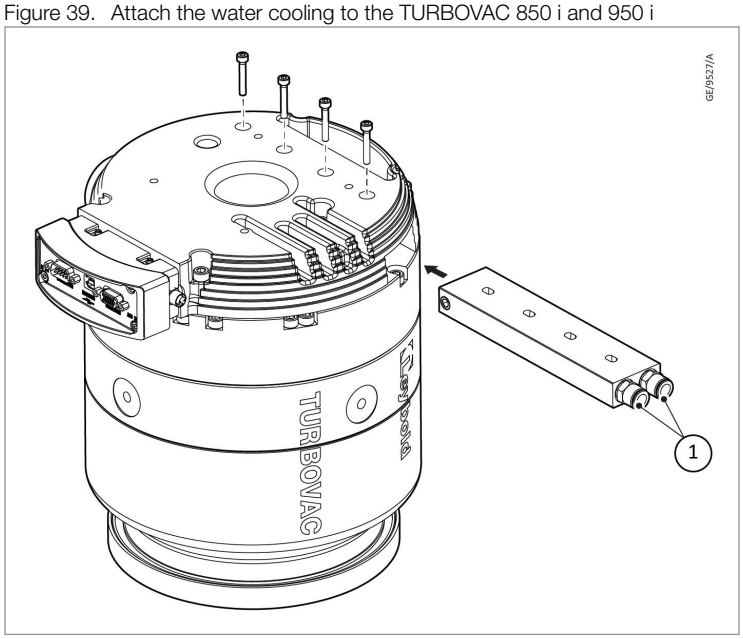
The TURBOVAC have water cooling as standard. Insert the cooling water hoses, refer to *Figure: Connect the water cooling to the TURBOVAC 1350 i and 1450 i*.

The hose connections may be unscrewed and removed, to make use of the integrated G1/8" threads.

Adjust the cooling water temperature to avoid condensation. With pump downtimes, the cooling water has to be turned off.

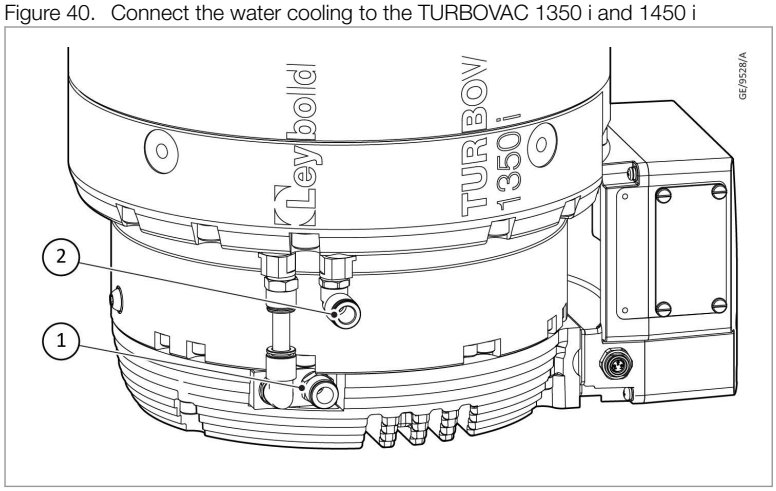
When switching the cooling water supply on and off with an electrically actuated valve, connect the valve so that it will be switched on and off together with the pump.

Figure 39. Attach the water cooling to the TURBOVAC 850 i and 950 i



1. *Hose connection for 6x1 hose*

Figure 40. Connect the water cooling to the TURBOVAC 1350 i and 1450 i



1. *Cooling water IN* 2. *Cooling water OUT*

6.5.3 Water quality

For trouble-free operation, the cooling water must not contain any oils, greases and suspended solids. Obey the limit values given in *Table: Water quality*.

If there is a risk of frost, you may use a water-glycol mixture of up to 30%.

DS water (softened or fully desalinated water) can be used for cooling the pump if the pH value corresponds to the range indicated below.

Table 7. Water quality

Parameter	Value
Appearance	Clear, free of oils and greases
Suspended matter	< 250 mg/l
Particle size	< 150 µm
Electrical conductivity	< 700 µS/cm
pH value	7.0 to 9.0
Total hardness (total alkaline earths)	< 8 °dH
Aggressive carbon dioxide	None, not detectable
Chloride	< 100 mg/l
Sulphates	< 150 mg/l
Nitrate	≤ 50 mg/l
Iron	< 0.2 mg/l
Manganese	< 0.1 mg/l
Ammonium	< 1.0 mg/l
Free chlorine	< 0.2 mg/l
8 °dH (degrees German hardness) 10 °e (degrees English hardness) 14 °f (degrees French hardness)	1.4 mmol/l

Figure 41. Cooling water requirements

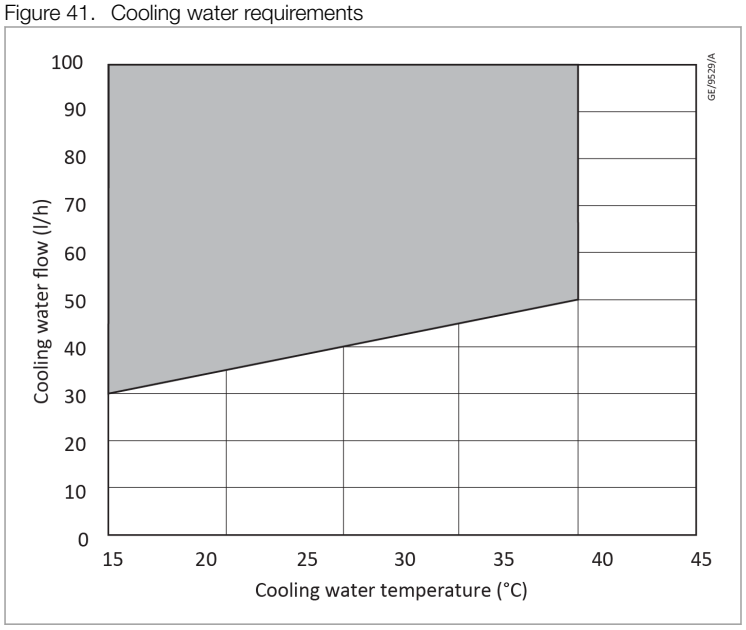
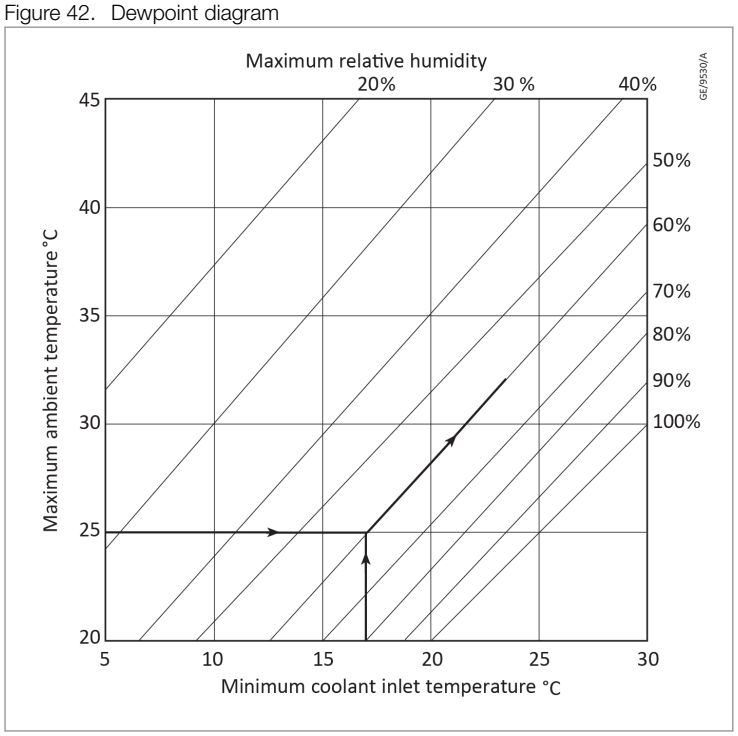


Figure 42. Dewpoint diagram



Minimum coolant inlet temperature at which condensation does not yet occur, as a function of maximum room temperature and maximum relative humidity.

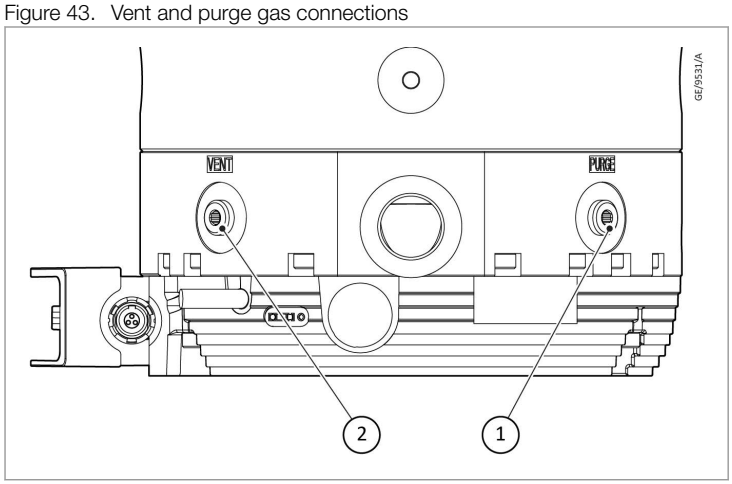
Example:

Maximum ambient temperature 25 °C

Minimum coolant inlet temperature 17 °C

⇒ Maximum relative humidity 60%

Figure 43. Vent and purge gas connections



A. *PURGE (purge gas connection G1/8")*
B. *VENT (venting connection G1/8")*

6.6 Connect a power failure venting valve or a venting valve

WARNING: EXPLOSIVE MATERIALS

Risk of injury and damage to equipment. The pressure in the pump must not exceed 1400 mbar (0.4 bar overpressure). Observe safety information given in *Mechanical hazards* **on page 11.**

The power failure venting valve (normally open) or venting valve (normally closed) vents the pump and the forevacuum line when the pump is switched off and thus keeps oil vapour from diffusing back from the forevacuum line. A choke nozzle in the vent port makes sure that the pump is not vented too fast.

The maximum permissible pressure in the pump must not exceed 1.4 bar (absolute).

1. Unscrew and remove the locking screw and the gasket from the venting connection of the TURBOVAC.
2. Screw in the venting valve and the gasket into the venting connection. To protect the threads, the maximum fastening torque is 5 Nm.
3. If applicable connect the venting gas supply at the valve's inlet (G1/8").

Note:

Connect a purge gas or venting valve to the correct flange. Interchanging the venting and purge gas flange can cause shock venting of the pump.

Only for TURBOVAC i

Plug in the corresponding control cable into the accessories connection.

For the electronic drive unit change the venting valve settings to venting operation (through the interfaces).

Only for TURBOVAC iX

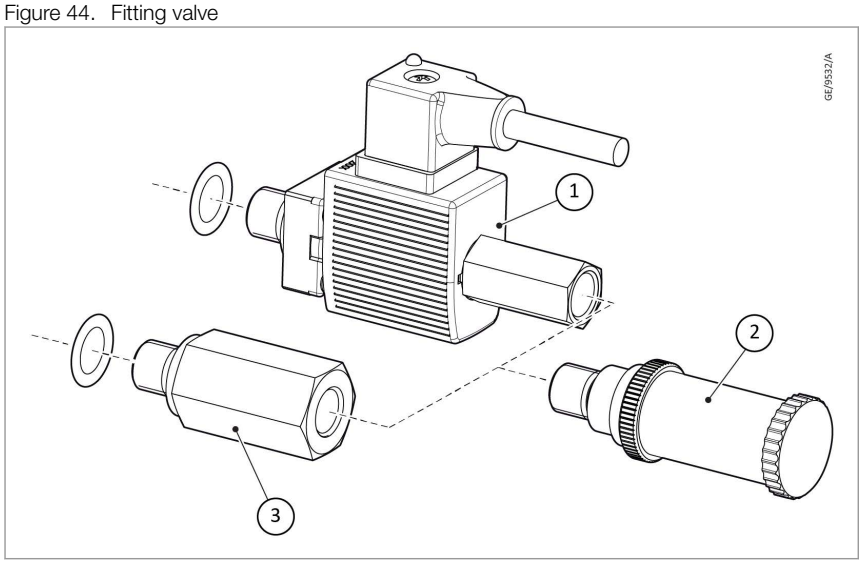
Refer to *Figure: Fitting valve*.

Plug in the corresponding control cable into the accessories connection X203. Accessory connection X203 is pre-configured so that the venting

valve opens when the start command is revoked and the frequency drops below 999 Hz. At 5 Hz this valve is closed again. This is no power failure venting. The limits can be changed through parameter 28[2] (upper switching threshold) and parameter 647[2] (lower switching threshold). For this refer to *Interfaces* on page 67.

Connect a power failure venting valve electrically separate or connect it to X201, X202 or X203 and change the function for the accessory connection. For this refer to *Interfaces* on page 67.

Figure 44. Fitting valve



A. *Valve*
B. *Air filter*
C. *Purge gas throttle G1/8"*

6.7 Purge gas connection

WARNING: EXPLOSIVE MATERIALS

Risk of injury and damage to equipment. The pressure in the pump must not exceed 1400 mbar (0.4 bar overpressure). Observe safety information given in *Mechanical hazards* on page 11.

Contact us for help to decide which gases need or do not need to be pumped with purge gas.

Refer to *Media compatibility / purge gas* on page 67 for suited gases.

Consider the additional purge gas flow when selecting a suitable backing pump.

We recommend a purge gas flow of 0.4 mbar·l/s (24 sccm) with nitrogen.

The purge gas is fed through an activated valve or a manually operated throttle.

Purge gas connection with purge gas valve

1. Unscrew and remove the locking screw and the gasket from the purge gas connection of the TURBOVAC.
2. Screw in the purge gas valve and the gasket into the thread.
3. Connect the purge gas supply at the valve's inlet (G1/8").

4. Connect the purge gas valve electrically separate or connect it to an accessory connection and thereafter change the function for the accessory connection. For this refer to *Interfaces* on page 67.

Purge gas connection with purge gas throttle

1. Unscrew and remove the locking screw and the gasket from the purge gas connection of the pump.
2. Then screw in the throttle and the gasket into the thread.

6.8 Connect a flange heater

Only for TURBOVACs with CF flange

If pressures in the range of 10^{-8} mbar or below are to be developed, the vacuum chamber and the components installed therein will have to be baked out. In addition, the TURBOVAC can be baked out using the flange heater provided for this purpose.

With the aid of the relay box, the heating jacket can be driven directly through the turbopump. For this, connect the heating jacket to the relay box and insert the connection cable of the relay box at the accessory connection (X201 for the TURBOVAC iX) and screw it down.

The accessory connection has been pre-configured so that the heating jacket will heat as long as the turbomolecular pump is running. To change this setting, refer to *Interfaces* on page 67.

Alternatively, the heating jacket may be connected through the corresponding mains power cable to the power supply.

Information on baking out is also given in *Bakeout* on page 73.

6.9 Connect a vacuum gauge head (only for TURBOVAC iX)

One of the listed vacuum gauge heads may be connected to connection X101.

Connect the vacuum gauge head only after you switch off the pump first.

The type of connected vacuum gauge head is detected automatically.

The measured value can be read out in millibar, Torr and Pascal through parameter as real value.

- P616: measured value in millibar
- P617: measured value in Torr
- P618: measured value in Pascal

Parameters (like filter time, CTR vacuum gauge head subtype, gas type correction factor) may be set up for the respective vacuum gauge head. For this refer to *Interfaces* on page 67.

Table 8. Connect a vacuum gauge head (only for TURBOVAC iX)

Vacuum gauge head	Connection cable	Pressure range
TTR 101, TTR 101 S2, TTR 101 N, TTR 101 N(S2)	Type F	$5x10^{-4}$ - 1500 mbar
ITR 200 S, ITR 200 SL, ITR 200 SP, ITR 200 SD	Type C	$5x10^{-10}$ - 1000 mbar

Vacuum gauge head	Connection cable	Pressure range
CTR 100/101, CTR 100 N, CTR 101 N	Type C	$1x10^{-1}$ - 1000 torr to $1x10^{-5}$ - 0.1 torr
TTR 91, TTR 91 S, TTR 96 S, TTR 91 N, TTR 91 N(S), TTR 96 N(S)	Type F	$5x10^{-4}$ - 1000 mbar
PTR 90, PTR 90 N	Type F	$5x10^{-9}$ - 1000 mbar
ITR 90, ITR 90 P	Type C	$5x10^{-10}$ - 1000 mbar

6.10 Electrical connection

WARNING: DANGEROUS VOLTAGE

Risk of injury. Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn.

Observe safety information given in *Electrical hazards* on page 12.

CAUTION: AUTOMATIC START-UP

The frequency converter is not equipped with its own emergency shut down switch. This may lead to an unwanted pump start-up.

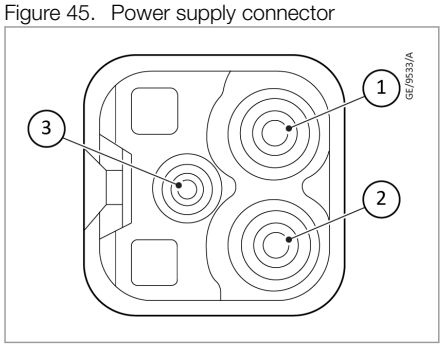
Install an emergency shut down switch in the system. The emergency shut down switch must be
- **present in the building installation**
- **suitably arranged and easily accessible for the user**
- **marked as the disconnecting device for this device..**

Note:

Make sure that you have correct polarity.
Pin 1 24/48 V
Pin 2 0 V
GND Housing
When pulling the d.c. IN connector first retract the retaining sleeve.

The pump can be operated with 48 V d.c. power supply. Take note of the performance data specified in *Table: Technical data for the integrated drive electronics*.

Figure 45. Power supply connector



1. *+48 V d.c.*
2. *0 V d.c.*
3. *Housing*

LEDs

- Green LED (Status)
  - off: Pump at standstill (< 3 Hz)
  - flashes slowly 1/s: Start command is present (about 10 s after start)
  - flashes fast 3/s: Running up
  - flashes slowly 0.5/s: Running down
  - on: Normal operation
- Yellow LED (Power)
  - off: No supply voltage
  - flashes 1/s: Supply voltage too low or too high
  - flashes 3/s: Running down and pump speed < 100 Hz
  - on: Supply voltage is present
- Red LED (Error)
  - off: No error, no warning
  - flashes: Warning is present, pump can be operated possibly with some restrictions or run-in procedure is running
  - on: Fault is present, pump stopped or can not be operated
- LED running light (green-yellow-red)

  Pump is in a state in which it cannot be controlled.

  Possible reasons:
  - Initialisation shortly after switching on the supply voltage
  - Memory procedure in progress (power supply must not be interrupted)
  - Reset of factory setting is ongoing
  - Firmware update is ongoing.

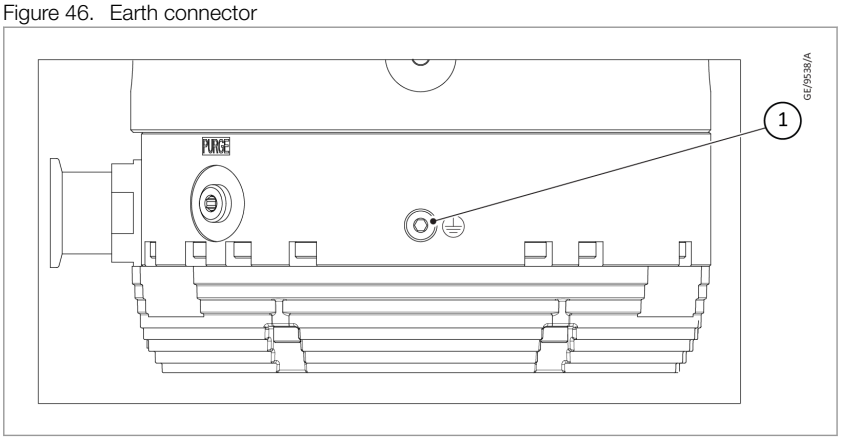
The cable protection and voltage drop and the minimum supply voltage must be adhered to when wiring.

When operating more than one pump with a single power supply, fuse each pump separately due to the line protection.

Earth (ground) connection

We recommend fitting a separate earth (ground) conductor. The impedance between the pump body and earth connection point must be < 0.1 Ω.

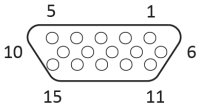
Figure 46. Earth connector

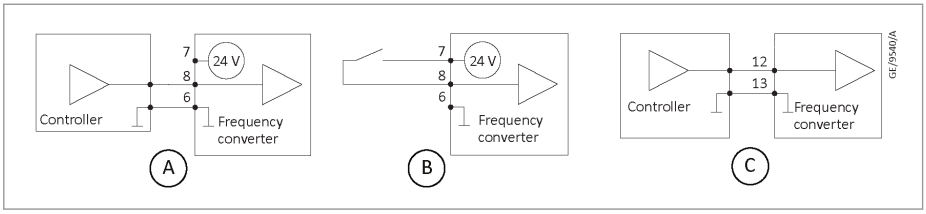


1. Earth (ground) connector M6-8

Installation

6.10.1 REMOTE Interface X1

REMOTE X1	Pin	Name	Description
15-pole Sub-D female High Density	1	Error relay	(com)
	2	Error relay	(n.c.)
	3	Normal operation relay	(n.o.)
	4	Normal operation relay	(com)
	5	Normal operation relay	(n.c.)
	6	Signal GND	
	7	High level output	24 V, 100 mA, Tolerance according to device supply voltage
Maintain pin 6 Signal GND and pin 13 Analogue GND separate so as to avoid equalisation currents.	8	Start input (High) Reset input (Low)	High > 10 V ± 0.5 V Low < 7.5 V ± 0.5 V
	9	Error relay	(n.o.)
	10	Standby input	High > 10 V ± 0.5 V Low < 7.5 V ± 0.5 V
	11	Cooling/Venting valve input (Low)	High > 10 V ± 0.5 V Low < 7.5 V ± 0.5 V
	12	Analog output (Default: Frequency)	0 - 10 V, 2 mA
	13	Analog GND	
	14	Warning relay	(n.c.)
	15	Warning relay	(com)
	Shield	Connected with the pump housing	



A. With controller (Start/Stop input)
B. Without controller (Start/Stop input)
C. Analog output

With controller (A)

0 V = STOP/Fehlerrese

24 V = START

Pin 10

0 V = no Standby operation

24 V = Standby operation

Without controller (B)

Contact open = STOP/Error reset

Contact closed = START

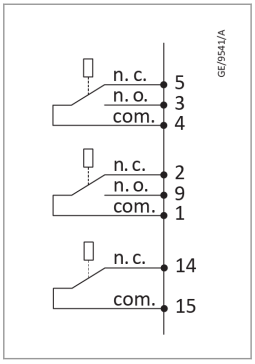
Pin 10

Contact open: no Standby operation

Contact closed: Standby operation

Pin 11	Pin 11
0 V = no function	Contact open: no function
24 V = Cooling or valve is activated	Contact closed: Cooling or valve is activated

Relay



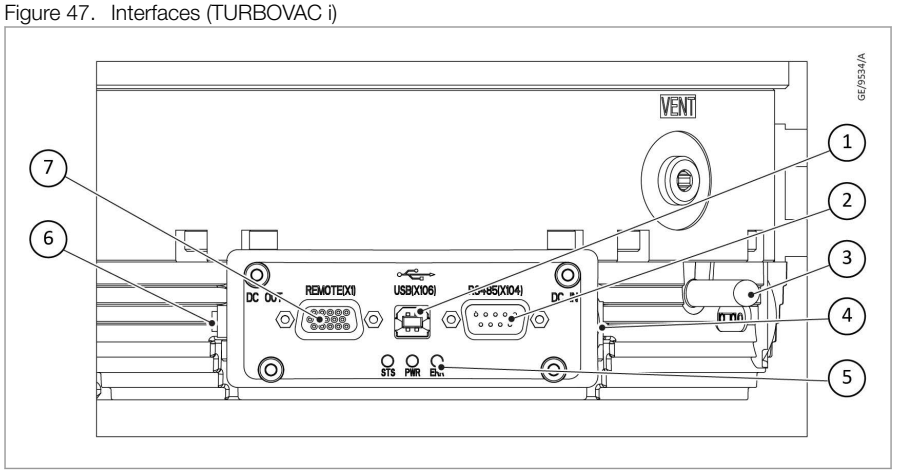
Refer to *Table: Technical data for the integrated drive electronics*.

Normal operation relay	
4 and 5 connected (normal position)	Run-down, run-up, stop
4 and 3 connected	Normal operation
Error relay	
1 and 2 connected (normal position)	No error
1 and 9 connected	Error
Warning relay	
14 and 15 connected (normal position)	No warning
14 and 15 open	Warning

Table 9 Relay status

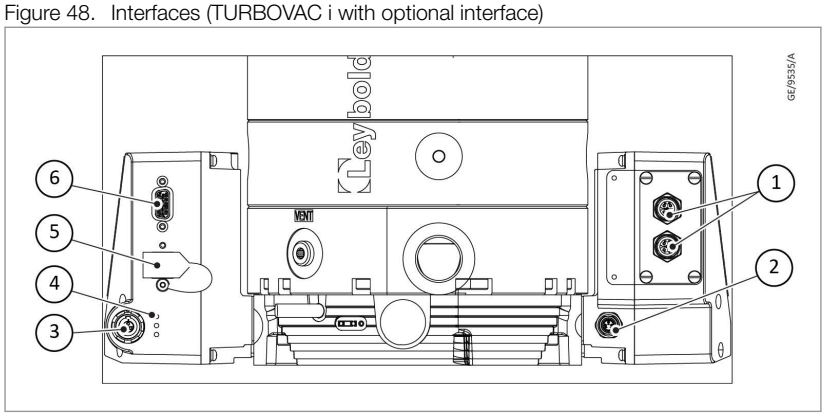
Input data / status			Output data						Operating mode
Start/ stop signal	Pump rotating	Normal frequency ≥ 90% of set-point frequency	Error is present	Motor drive	Relay NORMAL OPERATION	Relay ERROR	LED STATUS (green)	LED ERROR (red)	Other modes are not possible, they indicate a failure affecting the frequency converter.
Stop	no	no	no	off	passive	passive	off	off	Pump not operating
Stop	yes	no	no	off	passive	passive	flashes	off	Pump is decelerating
Stop	yes	yes	no	off	passive	passive	flashes	off	Just after stop, the pump was in the normal operating mode before stopping
Start	no	no	no	on	passive	passive	off	off	Just after start
Start	yes	no	no	on	passive	passive	flashes	off	Pump is accelerating
Start	yes	yes	no	on	active	passive	green	off	Pump is in the normal operating mode
Stop	no	no	yes	off	passive	active	off	red	Error is present, pump is at standstill
Stop	yes	no	yes	off	passive	active	flashes	red	Error is present, pump is decelerating
Stop	yes	yes	yes	off	passive	active	flashes	red	Error has just occurred
Start	no	no	yes	off	passive	active	off	red	Error is present, pump is at standstill
Start	yes	no	yes	off	passive	active	flashes	red	Error is present, pump is decelerating
Start	yes	yes	yes	off	passive	active	flashes	red	Error has just occurred

Figure 47. Interfaces (TURBOVAC i)



1. *USB interface X106*
2. *RS 485 interface X104*
3. *48 V d.c. DC input*
4. *Do not connect a power supply to this connection*
5. *LEDs*
6. *Accessory connection 24 V d.c. OUT X201*
7. *REMOTE interface X1*

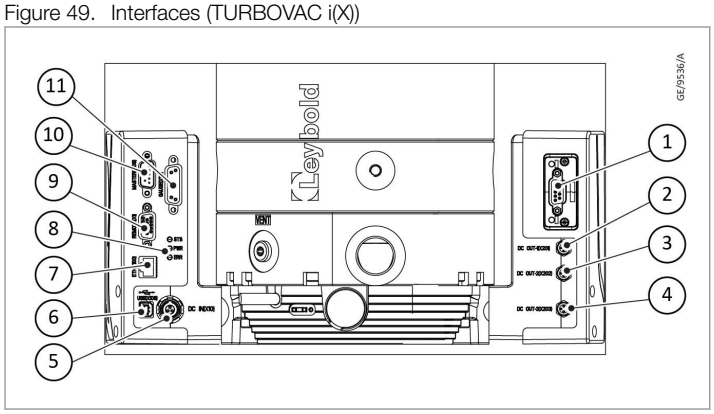
Figure 48. Interfaces (TURBOVAC i with optional interface)



1. *Optional interface X120*
2. *Accessory connection DC OUT (M8) X201*
3. *Do not connect a power supply to this connection*
4. *LEDs*
5. *USB interface X105 under the cover*
6. *REMOTE interface X1*

Installation

Figure 49. Interfaces (TURBOVAC i(X))



1. *Anybus interface X120*
2. *Accessory connection X201*
3. *Accessory connection X202*
4. *Accessory connection X203*
5. *Do not connect a power supply to this connection*
6. *USB interface X106*
7. *Ethernet interface (not usable for customers)*
8. *LEDs*
9. *Remote interface X1*
10. *RS-485 master (not usable for customers)*
11. *Gauge X101*

7 Operation

7.1 Media compatibility / purge gas

The TURBOVAC integra is suitable for pumping air and clean gases.

If reactive gases in low concentrations must be pumped, operate the pump with purge gas.

Contact us for the media which can safely be handled with this unit.

Install a micropore filter when pumping media which contains dust.

Suited for venting or purging are all gases,

- which will not cause corrosion or pitting in aluminium and steel
- which in connection with process deposits in the pump will not cause corrosion or sticking.

For venting and as the purge gas we recommend inert gases like nitrogen or argon. The temperature of these gases should be between 5 °C and 80 °C, maximum relative humidity should not exceed 10 ppm.

The gas must be clean.

In individual cases and after consultation also dry, filtered, oil-free air or filtered ambient air may be used (filter mesh < 1µm).

Change the filters annually.

7.2 Interfaces

The TURBOVAC i(X) is always equipped with the following interfaces for customers:

- USB (COM port) (X106)
- REMOTE (X1)

Some models are equipped with an Anybus interface which may be equipped with different interfaces (for example like a RS 485).

The control hierarchy is as follows: Anybus interface → USB → REMOTE (X1). See also parameter 179.

The frequency converter is configured through the parameters according to the parameter list. Pxxx denotes parameter value xxx.

The PC software LEYASSIST allows convenient access by the user to the parameters of the frequency converter.

Refer to Serial Interfaces for TURBOVAC i/i(X) (Publication number - 300450826) for a detailed description of the interfaces RS 232, RS 485, Profibus and USB of the TURBOVAC.

Table 10 Applications which can be implemented with the aid of the serial interface

Application	Benefits to the customer	How to do it
Networking of several pumps and other equipment	Savings relating to the costs for signalling cables	With Field Bus systems
Automation	Savings related to repetitive manual work	For example by a control computer
Avoiding warnings and warnings before overload operation and early detection of a failing pump	▪ Precise planning for maintenance ▪ Improved reliability of sensitive production processes in a vacuum	Monitoring of: ▪ Motor current P5 ▪ Motor temperature P7 ▪ Frequency converter temperature P11.
Standby operation	▪ Cutting process gas consumption ▪ Cutting energy consumption	Reducing the rotor's frequency through P
Troubleshooting	A quick analysis of problems	Reading of error memories P171, P174 and P176: error code, speed, operating hours for error Read out warning messages through P227.
Slow pressure control by changing the pumping speed	Dispensing with a flow controller	Changing the rotor frequency through parameter 24
Starting the pump with a delay if several consumers are connected to the same PSU	Cost savings through smaller power supply units if peak loads can be reduced	With P36, delay
Lowering the normal operation threshold	Normal operating mode is attained faster, processes can be started faster	Reduce frequency threshold through P25.
Only for TURBOVAC iX: Switch the fan depending on temperature or frequency	Saving electricity, reduce noise, optimise the pump temperature for the process	Configure accessory connection (X201, for example) correspondingly, for example, enter function code 30 in parameter 134[0] and set up the temperature limits in parameter 122[0] and 26[0].
Only for TURBOVAC iX: Individually adapt venting and purge gas (active venting, an adaptation of the delay time etc.)	Save gas, process speed-up	Correspondingly configure the function code for an accessory connection (X203, for example).
Control cooling water flow	Avoid condensation during cooling water operation	Connect cooling water valve at the accessory connection (X201, for example).

Application	Benefits to the customer	How to do it
Enable generator operation (power backup mode)	The power produced by the pump when running in the generator mode may be used for other electrical consumers and the pump is also decelerated faster.	With P249 This function is only changed after de-energising the pump and then restarting it.
Only for TURBOVAC iX: Changing the function of the accessory outputs	Different applications for connected accessories	Configure the accessory connection, refer to *Interfaces* on page 67.

7.3 Switch on

If the pumps have been stored for more than 12 months, refer to *Operation after a longer storage period* on page 73.

Switch on the power supply. All LEDs come on one after the other (sequential light), drive electronics (and vacuum system controller) are running up (for approximately 35 seconds).

The maximum starting pressure for the turbomolecular pump can be read from the graph in *Figure: Determine the starting pressure*.

Switch on the turbomolecular pump

- Through pins 7 and 8 of the socket REMOTE (X1) (for example through a remote control or with the aid of the plug with integrated ON/OFF switch).
- By a start command through the interface.

The turbomolecular pump accelerates. The green LED flashes. When the pump reaches normal operation the green LED lights up permanently.

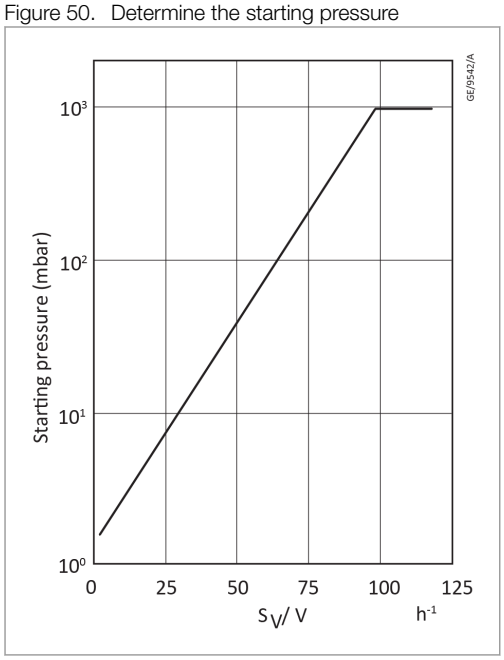
Avoid the influences of shock and vibration when the pump is running.

After a mains power failure the pump can run up automatically once more if a start command is present.

Note:

Exposure of the pump to accelerating forces must be avoided or reduced to such an extent that the rotor unit will not be excited by vibrations. In the case of critical applications you must consult our application department first.

Figure 50. Determine the starting pressure



For determining the starting pressure of a turbomolecular pump when evacuating large volumes

S_V = Pumping speed of the forevacuum pump ($m^3 \cdot h^{-1}$)

V = Volume of the vacuum chamber (m^3)

Example:

Pumping speed of the forevacuum pump, S_V = 3 $m^3 \cdot h^{-1}$,

Volume of the vacuum chamber, V = 60 l = 0.06 m^3

S_V / V = 50 h^{-1}

Starting pressure approximately 30 mbar.

7.4 Shut down

CAUTION: ELECTRICITY HAZARD

Risk of injury. Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn.

Switch off the pump.

- Through contacts 7 and 8 of the socket REMOTE (X1)
- Apply a stop command through the interface
- For the power supply units offered or recommended by us, switch off the d.c. voltage.

After switching off, the green status LED will flash until the rotor of the turbomolecular pump is at standstill. This may take several minutes. With the d.c. power supply off, the turbomolecular pump will act as a generator supplying the frequency converter and the control unit with the connected devices with energy as indicated by the yellow power LED. When the

generator mode is enabled, the turbomolecular pump supplies power back in to the d.c. power grid.

Switch off the forevacuum pump.

Vent

When using oil-sealed forevacuum pumps, vent the turbomolecular pump before it comes to a stop, refer to *Venting* on page 72.

When using TRIVAC pumps the built-in anti-suckback valve will close automatically, shutting off the forevacuum line. In forevacuum pumps without a vacuum retention valve, close the valve in the forevacuum line.

When the system is not operating, make sure that ambient air or cleaning media cannot enter the pump.

If a failure occurs the turbomolecular pump will be shut down automatically. The red LED at the frequency converter lights up.

Under vacuum conditions the pump may take up to one hour to run down, when venting to atmospheric pressure it may take up to one minute. During the time the pump is running down, the green LED will flash, indicating that the rotor has not yet arrived at standstill.

When shutting down by switching off the power supply voltage, there will be only enough power for the LEDs down to a speed of the pump of approximately 200 Hz. Thus the pump may still turn without a LED being on. For this reason, when switching off without venting, wait for approximately 15 minutes after the LEDs have turned off until the pump has arrived at standstill.

7.5 Venting

Refer to *Media compatibility / purge gas* on page 67 for suited gases.

Venting methods

There are three different methods of venting the turbomolecular pump and can be vented through the venting connection (VENT),

- With a venting valve
- A power failure venting valve
- A venting screw

Cautious venting of the pump is possible from the high vacuum side since here the bearing forces will be lowest. When doing so, no free jet of gas must be allowed to form on the rotor to avoid exposing the rotor to additional forces.

When venting the pump through its foreline connection, oil or particles should not be entrained in the gas flow from the forevacuum side into the pump.

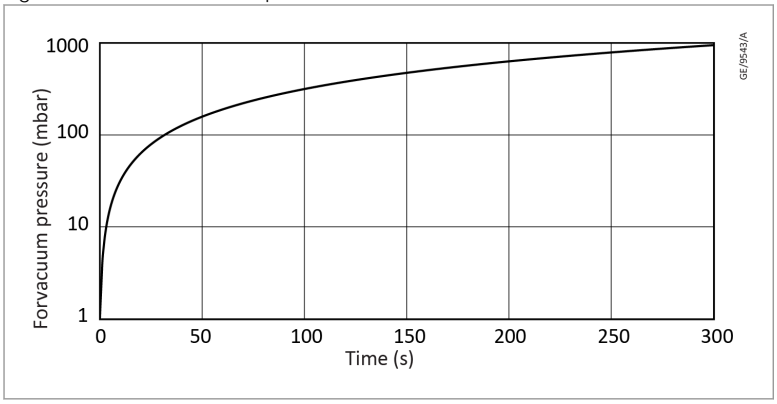
Speed of the pressure rise

All turbomolecular pumps may be vented at full speed. However, the pressure must not increase faster than specified through the pressure rise curve, refer to *Figure: Maximum rise in pressure*.

The pump must be vented significantly slower when there is the risk of particles entering the pump from the process. During venting, the flow must be of the laminar type in both the vacuum chamber and the turbomolecular pump.

The pump must not be vented to pressures above atmospheric pressure.

Figure 51. Maximum rise in pressure



7.6 Bakeout

Only for TURBOVACs with CF flange, refer to *Connect a flange heater* on page 59.

If pressures in the range of 10^{-8} mbar or below are to be developed, the vacuum chamber and the components installed therein will have to be baked out. In addition, the TURBOVAC can be baked out using the flange heater provided for this purpose.

Protect the rotor against intensive, direct heat radiation. When baking out at the forevacuum side - at adsorption trap, for example - ensure that the components attached directly are not heated to more than 100 °C (212 °F).

Operate the pump with water cooling when baking out.

7.7 Operation after a longer storage period

Note:

For pumps that have been stored for more than 12 months, a ball bearing run-in procedure for smooth ball bearing running must be carried out when putting into operation again. The procedure differs according to the firmware version of the pump, refer to the following sections.

To do this, set parameter P119 [0] to the value 1 using a serial interface and save the parameter change with parameter P8. Then start the pump.

This process takes approximately 4.3 hours, the red LED will flash during this time. The TURBOVAC may be operated only with low gas throughput during this time.

At the end, the pump accelerates to the nominal speed and parameter P119 [0] is written to 0 by the electronics.

For pumps that have been stored for more than 3 years, we recommend a preventive exchange of the ball bearings, refer to bearing replacement from *Maintenance* on page 75.

7.8 Remove the pump from the system

WARNING: HAZARDOUS GASES

Risk of injury. If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection.

Observe safety information given in *Hazards caused by materials and substances* on page 13.

Shut down the pump and vent as described in *Shut down* on page 71 and *Venting* on page 72.

Disconnect the pump only when it has completely stopped. The green LED must have gone out.

During run down the pump may still turn without a LED being on, observe the information on emergency shut down given in *Shut down* on page 71.

Then switch the mains power off and wait until the yellow power LED is off.

Then only disconnect any cable connections.

The pumps may be contaminated with process gases. These gases may be toxic and hazardous to health. In addition, deposits with similarly dangerous properties may have formed. Many of these gases and deposits form acids when they come into contact with humid air. This will result in serious corrosion damage to the pump.

To avoid health hazards and corrosion when the pumps are detached from the system, fasten a container of desiccant under the transport cover of the high vacuum connection and then close the pump immediately at all flange connections. Store the pump, with a desiccant, in an airtight PE bag.

Corrosion due to faulty packing will nullify the guarantee.

Pack the pump such that it cannot be damaged during shipping and storage. Pay particular attention to protection for the flanges and the electrical plug.

Observe the instructions in *Service* on page 83 if you forward the pump to us.

8 Maintenance

Bearing replacement

We recommend an exchange of the ceramic ball bearings at the forevacuum side after 35000 operating hours.

The ceramic ball bearings can be exchanged, if necessary, by our customer service, our nearest service centre or by the customer: contact us for this.

If you wish to exchange the bearings yourself, you will need our tool kit and spare ball bearings. Immediately after exchanging the bearings, let them run in, refer to *Operation after a longer storage period* on page 73.

We recommend an exchange of the rotor unit after 80000 operating hours.

Such maintenance work can only be done by us. If required contact our service centre nearest to your location. You can find the address on our internet page *www.leybold.com*.

At high pump loads - for example during cyclic operation, at high gas throughputs or at high ambient temperatures - the maintenance work should be carried forward. Consult us for recommendations.

Purge gas filter

Depending on the degree of contamination of the purge gas used the filter will clog and will have to be exchanged (our experience indicates that this will become necessary after 1 to 6 months).

Adsorption trap

When an adsorption trap is used, regenerate or renew the adsorption agent regularly, refer to the operating instructions provided with the trap.

8.1 Cleaning

If required clean the turbomolecular pump of dust with a dry cloth.

Cleaning the frequency converter internally

The converter essentially requires no servicing since it contains no components which could be adjusted.

8.2 Bearing monitoring and conditioning

To ensure maximum reliability and bearing life TURBOVAC 850i, 950i, 1350i and 1450i pumps have an integrated system to manage the bearing condition. The status is indicated by a blue LED on the pump.

TURBOVAC 850i, 950i, 1350i and 1450i pumps have an integrated battery-backed real time clock that is constantly monitoring pump storage time.

If the pump is stored without being run for more than 12 months, "Bearing Run in Mode" (BRIM) is triggered the next time the pump is started to condition the bearing.

If the pump is stored without being run for more than 3 years, the pump will indicate a bearing change is required before the pump is run.

Bearing on-site monitoring

The bearing of the TURBOVAC can be serviced on-site.

Maintenance

Instructions for bearing replacement can be found at *https://manuals.leybold.com/en/manual-frontend/products* under the part no. of the bearing exchange tool kit.

The following service tool kits and service parts are available.

TURBOVAC	850/950i	1350/1450i
Bearing kit part no.	EK6529255	EK6529260
Bearing exchange tooling part no.	EK850950	EK13501450

Bearing run in mode

Bearing run in mode (BRIM) is a start-up sequence for the pump designed to precondition the bearing to optimise bearing life. During the BRIM, the pump needs to be flanged. The pump goes through a number of speed steps before reaching full speed.

The BRIM process last around 4.3 hours and the LED indicates when this is running.

Do NOT cancel the BRIM process. This may invalidate the warranty.

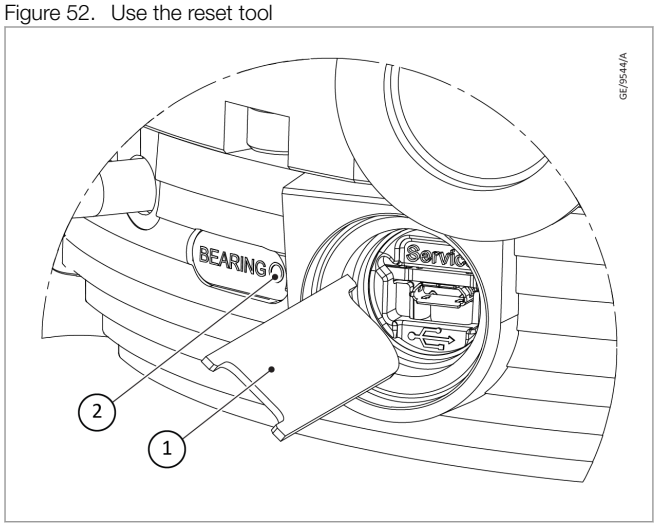
BRIM mode is either triggered:

- automatically by the pump
- LeyAssist software
- by pressing the push button (located behind the service cover) for 2s on the pump, or
- by changing parameter 119 through a serial interface, refer to Operating Instructions 300450826 Serial Interfaces for TURBOVAC i/iX

Table 11. Bearing LED

LED	Function
LED is not lit while pump is powered on	No bearing conditioning required
LED is flashing 0.25 s ON and 0.75 s OFF	Pump has been stored for more than 12 months, BRIM is required and will start on the next pump start
LED is permanently ON	BRIM is running
LED is flashing 0.25 s ON and 0.25 s OFF	Pump has been stored for more than 3 years, bearing replacement is required

Figure 52. Use the reset tool



1. Reset tool *2. Bearing LED*

9 Fault finding

CAUTION: ELECTRICITY HAZARD

Risk of injury. When the connector cable is attached, the outputs at the frequency converter are not free of voltage.

Before you start searching for the source of the problem, you should carry out a few simple checks:

Are the connections in good working order?

- Mains connection
- 48 V d.c. cable to the frequency converter.

Observe the polarity.

Is the forevacuum pressure sufficient?

After having removed the cause for the error reset the error message: By applying a STOP signal through the socket REMOTE (X1), or by a reset sequence through the serial interface or by switching the mains power off.

The error codes can only be read if a serial interface is present.

The *Table: Fault finding* has been provided as a guide when determining the causes of errors.

Table 12. Fault finding

Condition	Shut down
Yellow power LED is not on on page 78	-
Red LED flashes on page 79	No
Turbomolecular pump does not start, ERROR LED does not light on page 79	-
Turbomolecular pump produces loud running noises and vibrations on page 79	No
Pump overload, pump cannot keep up its speed on page 79	Yes
When the speed drops below 900 Hz the red LED flashes. When this continues for more than 12 minutes* the pump shuts down* on page 79	Yes
Turbomolecular pump does not reach ultimate pressure on page 80	No
Running pump can not be stopped through X1 on page 80	No
Connected accessories do not operate as intended on page 80	No

Fault	Yellow power LED is not on
Cause	**No d.c. power**
Remedy	Check cables and power supply.
Cause	**The d.c. power miswired**
Remedy	Ensure correct polarity of the d.c. cable.

Cause	**Frequency converter defective**
Remedy	Have the pump repaired. The following may damage the frequency converter: - Disconnection of the d.c. cable while the pump was still rotating - Non-compliance with the note related to connecting several pump to a single power supply.

Fault	**Red LED flashes**
Cause	**Warning message**
Remedy	The pump can continue to run, as long as operation limits are only exceeded for a short time. In case of longer time, send pump and frequency converter to our service.

Fault	**Turbomolecular pump does not start, ERROR LED does not light**
Cause	**Interface protocol error**
Remedy	Use USS protocol.
Cause	**No communication through the serial interface**
Remedy	Connect bus as shown in the interface instructions.
Cause	**REMOTE connector (X1) connected wrongly**
Remedy	Observe *REMOTE Interface X1* on page 62.

Fault	**Turbomolecular pump produces loud running noises and vibrations**
Cause	**Rotor out of balance**
Remedy	Balance the rotor. Refer to *Maintenance* on page 75.
Cause	**Bearing defective**
Remedy	Replace the bearing. Refer to *Maintenance* on page 75.

Fault	**Pump overload, pump cannot keep up its speed**
Cause	**Forevacuum pressure too high**
Remedy	Check the ultimate pressure of the backing pump and install a bigger backing pump if required.
Cause	**Gas flow too high**
Remedy	Seal leak, check process.

Fault	**When the speed drops below 900 Hz* the red LED flashes. When this continues for more than 12 minutes* the pump shuts down**
Cause	**Fan defective**
Remedy	Replace the fan.

Fault finding

Cause	**Water cooling switched off**
Remedy	Switch on water cooling.

** Default values for normal operation threshold (P25) and maximum run-up time (P32), can be changed through serial interface.*

Fault	**Turbomolecular pump does not reach ultimate pressure**
Cause	**Measuring instrument defective**
Remedy	Inspect the measurement sensor.
Cause	**Measurement sensors soiled**
Remedy	Clean or replace the sensors.
Cause	**Leaks at the equipment, lines or the pump**
Remedy	Check for leaks.
Cause	**Pump soiled**
Remedy	Clean the pump.
Cause	**Forevacuum pump provides insufficient pumping speed or ultimate pressure which is too high**
Remedy	Check the ultimate pressure of the forevacuum pump and install a higher-capacity vacuum pump if necessary.
Cause	**Frequency parameters programmed wrongly**
Remedy	Check parameters.

Fault	**Running pump can not be stopped through X1**
Cause	**Pump has been started through the serial interface, the interface controls the pump**
Remedy	Disconnect the d.c. supply or connect serial interface and stop through bus.

Fault	**Connected accessories do not operate as intended**
Cause	**Accessories incorrectly connected or wrong function code has been set up or function code dependent parameters have not been properly set up.**
Remedy	Check the settings for the function codes and the corresponding parameters or check to ensure that the accessories have been connected to the correct accessory connection.

10 Storage

To store the devices, place them in a sealable PE bag containing a drying agent and use the supplied transport packaging. Do not store the pump and accessories in a moist atmosphere to prevent it from corrosion. Take note of details in *Remove the pump from the system* on page 74.

For pumps that have been stored for more than 12 months, a ball bearing run-in procedure must be carried out before operation, refer to *Operation after a longer storage period* on page 73.

For pumps that have been stored for more than 3 years, we recommend a preventive exchange of the ball bearings, refer to bearing maintenance from *Maintenance* on page 75.

11 Disposal

WARNING: CONTAMINATED PARTS

Risk of injury. Contaminated parts can be detrimental to health and the environment. Before beginning with any work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Waste disposal

The equipment may have been contaminated by the process or by environmental influences. In this case, the equipment must be decontaminated in accordance with the relevant regulations. We offer this service at fixed prices.

Separate clean components according to their materials, and dispose of these accordingly. We offer this service. Further details are available on request.

When sending us any equipment, observe the regulations given in *Service* on page 83.

12 Service

12.1 Return the equipment or components for service

Before you send your equipment to us for service or for any other reason, you must complete a Declaration of Contamination Form. The form tells us if any substances found in the equipment are hazardous, which is important for the safety of our employees and all other people involved in the service of your equipment. The hazard information also lets us select the correct procedures to service your equipment.

If you are returning equipment note the following:

- If the equipment is configured to suit the application, make a record of the configuration before returning it. All replacement equipment will be supplied with default factory settings.
- Do not return equipment with accessories fitted. Remove all accessories and retain them for future use.
- The instruction in the returns procedure to drain all fluids does not apply to the lubricant in pump oil reservoirs.

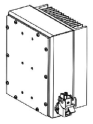
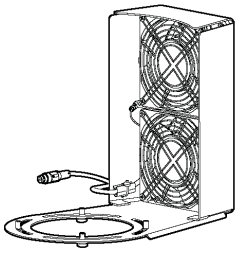
Download the latest documents from *leybold.com/en/downloads/download-documents/declaration-of-contamination/*, follow the procedure in HS1, fill in the electronic HS2 form, print it, sign it, and return the signed copy to us.

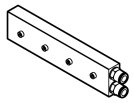
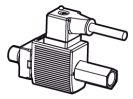
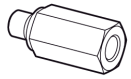
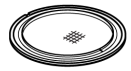
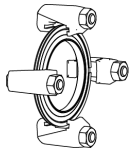
NOTICE:

If we do not receive a completed form, your equipment cannot be serviced.

13 Accessories

Table 13 Accessories

Accessory	Part number	Graphic
Power supply, cables and accessories		
TURBO.POWER 800	800100V0010	
Mounting kit TURBO.POWER 800	800100V0110	
Cable TURBOVAC i/iX – TURBO.POWER 800, 3 m	800096V0303	
Cable TURBOVAC i/iX – TURBO.POWER 800, 5 m	800096V0503	
Cable TURBOVAC i/iX – open end, 1 m	800096V0101	
Cable TURBOVAC i/iX – open end, 3 m	800096V0301	
Cable TURBOVAC i/iX – open end, 5 m	800096V0501	
Mains cable for TURBO.POWER 800, 2.5 m		
▪ EU plug	411310V03	
▪ US plug 5-15 P	411330V03	
▪ UK plug	411340V03	
Accessory cable TURBOVAC i, M8-M8, 2m	800110V0016	
Y cable TURBOVAC i/iX, M8	800110V0020	
Start stop switch for TURBOVAC i/iX	800110V0021	
USB cable 2.0 Type A/B, 1.8 m	800110V0108	
Relay box for forevacuum pump, 1-phase, 10 A incl. 2 m M8-M8 cable	800110V0030	
Control		
TURBO.CONTROL i	800100V0004	
Table top housing	800110V0028	
Power supply 24 V d.c. / 1.5 A	800110V0027	
Cooling		
Air cooling radial TURBOVAC 850 i(X) and 950 i(X)	800136V0011	

Accessory	Part number	Graphic
Water cooling TURBOVAC 850 i(X) and 950 i(X)	800135V0007	
Water cooling TURBOVAC 1350 i and 1450 i	Standard	
Venting and purge		
Venting valve, 24 V d.c. G 1/8"	800120V0012	
Power failure venting valve 24 V d.c. G 1/8"	800120V0022	
Purge gas valve, 24 V d.c. G 1/8", 24 sccm	800120V0013	
Purge gas throttle 24 sccm	800120V0014	
Air filter for TMP, G 1/8"	800110V0022	
Heating		
Flange heater DN 160 CF, 230 V	800137V0007	
Flange heater DN 160 CF, 115 V	800137V0008	
Centring ring with coarse inlet screen DN 160 ISO-K	800133V0031	
Centring ring with splinter guard DN 160 ISO-K	800133V0032	
Coarse inlet screen DN 160 CF (3.2 mm)	800132V0031	
Splinter guard DN 160 CF (0.8 mm)	800132V0032	
Mounting kit TURBOVAC		
▪ DN 160 ISO-K	800134V0030	
▪ DN 160 CF	800134V0031	
▪ DN 160 ISO-K to ISO-F	800134V0035	
Anybus Modules		
Anybus RS232 Module	410300V0902	
Anybus RS485 Module	410300V0903	
IP54 Anybus Profibus M40 Module	410300V0908	
IP54 Anybus Profinet IRT Module	410300V0909	
IP54 Anybus Ethernet Module	410300V0910	
IP54 Anybus EtherCAT Module	410300V0911	

** Part number for other flanges: on request.*

13.1 Ordering data

TURBOVAC	850 i	950 i
RS 485, USB+ 15-pin digital I/O interface		

Accessories

High-vacuum flange	160 ISO-K	200 ISO-K
Pump with optional interface	840071V1000 840071V2000 840072V1000 840072V2000 840073V1000 840073V2000	840091V1000 840091V2000 840092V1000 840092V2000
High-vacuum flange	160 CF	200 CF
Pump with optional interface	840081V1000 840081V2000 840083V1000 840083V2000	840111V1000 840111V2000

Optional interface (RS 232, Profibus, Ethernet/IP, Profinet, EtherCAT), USB+, 15-pin digital I/O interface: on request

TURBOVAC	**850 iX**	**950 iX**
RS 485, USB+ 15-pin digital I/O interface		
High-vacuum flange	160 ISO-K	200 ISO-K
Pump with dummy in Anybus slot Pump with RS 485 in the Anybus slot	840071V3000 840071V3300	840091V3000 840091V3300
High-vacuum flange	160 CF	200 CF
Pump with dummy in Anybus slot	840081V3000 840083V3000	840111V3000
Pump with RS 485 in the Anybus slot	840081V3300	840111V3300

TURBOVAC	**1350 i**	**1450 i**
RS 485, USB+ 15-pin digital I/O interface		
High-vacuum flange	200 ISO-K	250 ISO-K
Pump with optional interface	850092V1000 850092V1000U 850092V2000 850092V2000U	850122V1000 850122V1000U 850122V2000 850122V2000U
High-vacuum flange	200 ISO-F	250 ISO-F
Pump with optional interface	850102V1000 850102V1000U 850102V2000 850102V2000U	850132V1000 850132V1000U 850132V2000 850132V2000U
High-vacuum flange	200 CF	250 CF
Pump with optional interface	850112V1000 850112V1000U 850112V2000 850112V2000U	850142V1000 850142V1000U

Optional interface (RS 232, Profibus, Ethernet/IP, Profinet, EtherCAT), USB+, 15-pin digital I/O interface: on request

TURBOVAC 850 i and 950 i pumps can be mounted in any orientation.

TURBOVAC 1350 i and 1450 i pumps can be mounted

- horizontally or vertically with the high-vacuum flange on top and in any orientation in between or

- horizontally or vertically with the high-vacuum flange on the bottom and in any orientation in between (U versions)

Certificates

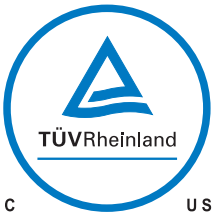
Certificates
The TURBOVAC i have been tested by the TÜV Rheinland of North America according to the requirements of

- UL 61010-1:2012
  CSA C22.2 No. 61010-1-12

  cTUVus Certificate No. CU 72191742.02

The components are in compliance to the tested standards.

The TÜV Rheinland of North America is a “Nationally Recognized Testing Laboratory” (**NRTL**) for the USA and Canada.



P20010456B

EU Declaration of Conformity

Leybold GmbH
Bonner Strasse 498
D-50968 Koln
Germany

Documentation Officer
T: +49(0) 221 347 0
documentation@leybold.com

The product specified and listed below

- Turbomolecular Pumps with Integrated Frequency Converter

Type Designation	*Part Numbers*	*Description*
< 3 Inlets *TURBOVAC a1 a2 a3 x f1 f2* *X = i, iX, iC* *a1 = 850 or 950 or 1350 or 1450* *a2 = 10 to 1000* *a3 = 1 to 500* *(a2, a3 optional)* *f1 = 100 to 250* *f2 = ISO-K, ISO-F or CF*	*8xxxxxVxxxxy* *x= 0 to 9* *y = blank or U*	*a1* = *Pumping speed (first Inlet)* *a2* = *Pumping speed (second Inlet)* *a3* = *Pumping speed (third Inlet)* *f1* = *High Vacuum flange* *f2* = *Flange type* *i* = *Communication electronic Frontend or Frontend Anybus* *iX* = *Communication electronic Extensionbox* *U* = *Upside Down* *iC / C* = *Cartridge - Housing for Customer Application* *m* = *Customer-Variants Multi-Inlet*
> 3 Inlets *TURBOVAC numeral m y* *numeral = quad, penta, hexa, hepta, octa, nona, deca (number of inlets)* *m = 1 to 99* *y= i or iC*	*8xxxxxVxxxxy* *x= 0 to 9* *y = blank or C*	

Is in conformity with the relevant requirements of European CE legislation:

2006/42/EC	Machinery directive *Note: The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Annex 1 No. 1.5.1 of this directive.*
2014/30/EU	Electromagnetic compatibility (EMC) directive Class B Emissions, Industrial Immunity
2011/65/EU	Restriction of certain hazardous substances (RoHS) directive as amended by Delegated Directive (EU) 2015/863

Based on the relevant requirements of harmonised standards:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61010-1:2010/A1:2019	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2023-07-19*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Ian Keech – VP Engineering, Scientific Vacuum Division
Burgess Hill

Rene Rose Stueber – General Manager
Product Company Cologne

P200104568

Declaration of Conformity

Leybold GmbH
Bonner Strasse 498
D-50968 Koln
Germany

Documentation Officer
Innovation Drive
Burgess Hill
West Sussex
RH15 9TW
documentation@leybold.com

This declaration of conformity is issued under the sole responsibility of the manufacturer.
Turbomolecular Pumps with Integrated Frequency Converter

Type Designation	*Part Numbers*	*Description*
< 3 Inlets *TURBOVAC a1 a2 a3 x f1 f2* *X = i, iX, iC* *a1 = 850 or 950 or 1350 or 1450* *a2 = 10 to 1000* *a3 = 1 to 500* *(a2, a3 optional)* *f1 = 100 to 250* *f2 = ISO-K, ISO-F or CF*	*8xxxxxVxxxxy* *x= 0 to 9* *y = blank or U*	*a1* = *Pumping speed (first Inlet)* *a2* = *Pumping speed (second Inlet)* *a3* = *Pumping speed (third Inlet)* *f1* = *High Vacuum flange* *f2* = *Flange type* *i* = *Communication electronic Frontend or Frontend Anybus* *iX* = *Communication electronic Extensionbox* *U* = *Upside Down* *iC / C* = *Cartridge - Housing for Customer Application* *m* = *Customer-Variants Multi-Inlet*
> 3 Inlets *TURBOVAC numeral m y* *numeral = quad, penta, hexa, hepta, octa, nona, deca (number of inlets)* *m = 1 to 99* *y= i or iC*	*8xxxxxVxxxxy* *x= 0 to 9* *y = blank or C*	

The object of the declaration described above is in conformity with relevant statutory requirements:

Supply of Machinery (Safety) Regulations 2008
The objectives of the Electrical Equipment (Safety) Regulations 2016 are governed by Annex 1 1.5.1 of this regulation.

Electromagnetic Compatibility Regulations 2016
Class B Emissions, Basic Industrial Immunity

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Relevant designated standards or technical specifications are as follows:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61010-1:2010/A1:2019	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Statutory Instruments and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2023-07-19*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Signed for and on behalf of Leybold GmbH

Ian Keech – VP Engineering, Scientific Vacuum Division Burgess Hill

Rene Rose Stueber – General Manager Product Company Cologne

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

RoHS (EU, UK): Material Exemption Information
This product is compliant with the following Exemptions
Annex III:

- 6(a) **Lead** as an alloying element in steel for machining purposes and in galvanised steel containing up to 0.35 % lead by weight
- 6(b) **Lead** as an alloying element in aluminium containing up to 0.4% by weight
- 6(c) Copper alloy containing up to 4% **lead** by weight

REACH (EU, UK)
This product is a complex article which is not designed for intentional substance release. To the best of our knowledge the materials used comply with the requirements of REACH. The product manual provides information and instruction to ensure the safe storage, use, maintenance and disposal of the product including any substance based requirements.

Article 33.1 Declaration (EU, UK)
This product contains Candidate List Substances of Very High Concern above 0.1%ww by article as clarified under the 2015 European Court of Justice ruling in case C-106/14.

- Lead (Pb)
  This substance is present in certain steel / aluminium / brass components.

Additional Applicable Requirements

The product is in scope for and complies with the requirements of the following:

2012/19/EU	Directive on waste electrical and electronic equipment (WEEE)
Product is certified to CSA-C22.2 No.61010-1-12	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
Product is certified to UL61010-1 3rd Edition	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
cTUVus Certificate No.	CU 72191742

The product is certified by TÜV Rheinland of North America which is a “Nationally Recognized Testing Laboratory” (NRTL) for USA and Canada.

材料成分声明

China Material Content Declaration

	有害物质 Hazardous Substances					
部件名称 Part name 	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr VI)	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
铸铝及铝合金制品 Aluminium alloys	X	O	O	O	O	O
钢合金制品 Steel alloys	X	O	O	O	O	O
铜管管件 Brass pipe fitting	X	O	O	O	O	O

O: 表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求。
O: Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572.

X: 表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 标准规定的限量要求。
X: Indicates that the hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T26572.

This product has been manufactured under a quality management system certified to ISO 9001:2015

Leybold

Pioneering products. Passionately applied.

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