Leybold

Oil Diffusion Pumps

DIJ 10 / 320
DIJ 16 / 500
DIJ 20 / 630
DIJ 32 / 800
DIJ 35 / 1000

Operating Instructions 300665180_002_C5

Part Nos.

222 13 /Vxxx
222 14 /Vxxx
222 23 /Vxxx
222 24 /Vxxx
222 27 /Vxxx
222 28 /Vxxx
222 37 /Vxxx
222 38 /Vxxx
222 43 /Vxxx
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Obligation to Provide Information
Before installing and commissioning the DIJ, carefully read these Operating Instructions and follow the information so as to ensure optimum and safe working right from the start.

The Leybold **DIJ** pumps have been designed for safe and efficient operation when used properly and in accordance with these Operating Instructions. It is the responsibility of the user to carefully read and strictly observe all safety precautions described in this section and throughout the Operating Instructions. The pump **must only be operated in the proper condition and under the conditions described in the Operating Instructions**. It must be operated and maintained by trained personnel only. Consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to our nearest office.

"Trained personnel" for the operation of this pump are

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

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to notify users of installation, operation, programming or maintenance information that is important, but not hazard related.

We reserve the right to alter the design or any data given in these Operating Instructions. The illustrations are not binding.

Retain the Operating Instructions for further use.

0 Safety Information

Explanation of Safety Symbols

	General warning sign
	Warning - automatic start-up!
	Warning - slipping hazard!
	Warning - electrical voltage!
	Warning - toxic substances!
	Warning - hot surface!
	Warning - explosive substances!
	General mandatory sign

Safety information

0.1 Mechanical Hazards

DANGER 1

Ejection of parts through bursting of the vacuum system due to excessive pressure, caused by errors like malfunction at the gas inlet into the vacuum system

When venting the DIJ pump at > 100 °C danger of explosion!

The pump must be securely locked during operation.

The DIJ pump may be vented only if the pump fluid temperature is < 100 °C.

Any rearward venting must be carried out by means of a max. 6 mm opening. The cooled pump should be vented from the high vacuum side.

Turn off the cooling water supply only once the DIJ pump has cooled down to < 100 °C.

DIJ pump operation with closed high vacuum and fore-vacuum side and simultaneously switched off cooling water supply is a dangerous condition and must be reliably ruled out (e.g. by locking circuit).

DANGER 2

Loss of stability during transport

Uncontrolled movement through incorrect fastening/raising/lifting of the pump system.

Use all crane eyes when lifting the pump body. Pay attention to the centre of gravity!

Transportation flanges (blank flanges) and claws may be used only for transportation purposes; they are not suitable for the assembly of the pumps in systems.

Uncontrolled movement through inertia of mobile pump systems (wheels / mobile frame)

Mount and move mobile pumps with roles only on flat, solid, horizontal surfaces.

Pay attention to appropriate slow speed when moving the pump.

CAUTION 3

Getting dragged into the vacuum system

Do not operate the pump system with opened intake and outlet port.

During installation first connect the system mechanically via the inlets and outlets and only then make the electrical connections.

4 **Ejection of parts through implosion of a part of the pump or the pump system**

If the boiler overheats due to too little or no oil or too little cooling water flow, the boiler can implode.

The water cooling system may not be interrupted in the case of a malfunction.

Observe the installation regulations.

5 **Hazard of slipping, tripping or falling due to oil leakage from the pump**

CAUTION

Depending on the work process, oil may escape from the pump.

Check the pump for any oil that has run out. Take appropriate security measures.

6 **Hazards that may occur through independent restart of a pump after a shutdown due to an error**

CAUTION

Connect the pump in such a way that if a monitoring element is triggered (thermostat, thermal protective switch, water flow guard) it does not automatically restart after the inadmissible operating condition has ended.

Safety information

0.2 Electrical Hazards

DANGER 1 **Electric shock through direct or indirect contact of live parts**

Electric shock by touching active electrical components. Voltage spreading through incorrect electrical connection.

The electrical connection may be carried out only by a trained person. Observe the national regulations in the country of the user, e.g. for Europe EN 50110-1.

A protective earth check between the PE connection and every touchable part that requires a protective connection, must be carried out before initial operation. Do this for the test current, use 10A DC or AC (RMS), while 0.1 Ohm impedance must not be exceeded.

The temperature sensor (Pt 100 heating cartridge temperature) may take on voltage that is dangerous to touch. The operator must take suitable precautions for protection in case of indirect touching. For example, a temperature transducer with double or reinforced isolation may be used for this purpose.

Connect a second protective earthing conductor.

There are hazardous voltages present on the mains cables (danger to life).

Before carrying out maintenance or service work on the product, take it off the mains supply. After mains power off, wait for 5 minutes!

DANGER 2 **Loss of power supply**

Explosion hazard due to uncontrolled venting!

The valves must be closed in the event of a power failure.

Air infiltration in an operation-ready, warm diffusion pump are a dangerous condition and must be reliably ruled out.

If electro-pneumatically propelled high- and fore-vacuum valves are used, these must be used shut in the specification “de-energised” and “unpressurised”. Also for these valves, the ventilation of a ready-to-operate, hot diffusion pump must be ruled out through appropriate latch circuits.

The components must be connected correctly and properly. Electrical safety examinations, in particular the insulation and protective grounding conductor examination, must be carried out.

3 **High electrical fault currents due to moisture absorption by mineral insulating material of the heating elements**

CAUTION

The hygroscopic insulation of the heating element could lead to a burn-out of the heater cartridge. Risk occurs through longer shut-off cycles and humid ambient conditions.

Take note of the installation instructions for the replacement and connection of the heater cartridge.

Check stock before changing/inserting (measured value: 49 to 55 ohms) and degas if necessary.

In case of standstill, check heater cartridge after one year.

0.3 Thermal Hazards

1 **Burns from touching hot surfaces**

CAUTION

Burning of fingers, hands, arms on hot surfaces up to +140°C. Hazard of burns with open covers.

Handle the pump only in ventilated and cooled down condition. Wear suitable protective equipment. Take note of the cooling time after switching off.

2 **Scalding by touching hot equipment or lubricants**

Risk of scalding when opening the hot pump through pump fluid steam

Only open fluid drain port or inlet port if the pump is vented and is cooled down to room temperature.

Let cooling water pipes cool down before removing and then shut off the feed line.

Wear suitable protective equipment.

Safety information

0.4 Danger through substances and materials that are transported, used or expelled by the vacuum pump

DANGER

1 **Danger through expulsion of transported toxic gases/vapours. Fire or explosion in case of transport or ejection of flammable gases/vapours, oxidizing agents or pyrophoric gases**

Transported process gases can escape out of the exhaust pipe and from leaking areas of the vacuum system.

Transport of toxic gases/vapours, flammable gases/vapours, oxidizing agents or pyrophoric gases is generally excluded.

In its standard version, the pump system is not suitable for operation in ex-zones.

The operator is responsible for the assessment of the hazard potential of the process media and/or mixtures. For this purpose, the operator must perform a risk or hazard assessment. The operator must take appropriate measures to ensure that there is no danger to man and the environment.

Do not use any easily flammable materials near the hot pump area.

2 **Hazards through emission of harmful gases/vapours**

During the start-up and the new installation of the heater cartridge, smoke and an unpleasant smell may develop. Therefore, turn on new pumps and pumps after successful servicing of the heater cartridges only in well-ventilated areas. Avoid direct contact with the smoke or gases that can develop during start-up.

DANGER

3 **Danger as a result of contact with toxic decay/reaction products of lubricants, equipment or pumped substances during the maintenance of the pump**

In the event of servicing, there may be deposits in the pump.

The pumping of toxic gases and vapours is basically excluded.

The operator is responsible for the assessment of the hazard potential of the process media and/or mixtures. For this purpose, the operator must perform a risk or hazard assessment. The operator must take appropriate measures to ensure that there is no danger to man and the environment.

For this purpose, we recommend that the pump is flushed for a longer time with inert gas before opening. Wear appropriate protective clothing (gloves, goggles, respiratory protection, personal protective equipment).

Avoid body contact with plant oil, process residues and contaminated surfaces. Perform maintenance in preferably clean, dry and well-ventilated rooms.

4 **Danger as a result of contact with toxic decay/reaction products of lubricants, equipment or pumped substances during the maintenance of the pump**

Vacuum pumps which are operated with the lubricant Perfluorinated Polyether (PFPE) may in the case of thermal decomposition release toxic and corrosive gases.

Wear appropriate protective clothing (gloves, goggles, respiratory protection, personal protective equipment).

Avoid body contact with plant oil, process residues and contaminated surfaces. Perform maintenance in preferably clean, dry and well-ventilated rooms.

Do not smoke with PFPE on your fingers.

Description

1 Description

The pumps in the DIJ series are high-vacuum pumps (<10^{-2} mbar). They are always operated in conjunction with forevacuum pumps.
The DIJ series pumps are water cooled and utilize the oil diffusion principle in their operation. They are employed in high-vacuum technology to evacuate vacuum chambers.
They achieve their highest pumping speeds in pressure ranges from 10^{-2} to 10^{-7} mbar.

1.1 Design and Function

The diffusion pumps in the DIJ series comprise the following component assemblies:

- Water-cooled pump housing with high-vacuum, and forevacuum connection flanges
- Nozzle assembly
- Vaporization chamber with heating elements
- Cold cap baffle
- Forevacuum baffle
- Energy Efficiency Control, electrical junction box, or Harting plug

Nozzle system

The DIJ pumps are fitted with a five-stage nozzle system made of light-alloy metal and with an integrated heating system comprising heating cartridges. The housing for the DIJ pump is made of standard grade steel; the high-vacuum connection flange and the forevacuum connection are made of stainless steel (alloy 1.4301), the cold cap baffle of nickel-plated copper, whereas the cooling coils are made of pure copper.

Heat diffusion fins

The heat diffusion coil of the cartridge is made of stainless steel and is immersed for the most part in the pump fluid in the vaporization chamber. The section of the heat diffusion fins immersed in the pump fluid is dimensioned so that that intense but surge-free vaporization of the pump fluid is achieved.
The sections of the heat dissipation fins located above the level of the pump fluid apply additional energy to the pumping vapor.

Thermostat

To protect the heating element, a thermostat sensor is attached to a heat diffusion coil which protrudes from the fluid. The sensor must be integrated within the latch circuit in such a way that it will switch off the pump's heaters as soon as the temperature set at the bimettalic switch is exceeded.

NOTICE

The sensor has to be installed into the system control by the customer so that it will safely switch off the power.

Heating cartridges

The heating cartridges can be easily replaced when required. It is not necessary to dismantle the pump to do so.

Cold cap baffle

To prevent fluid from flowing back into the vacuum vessel, the DIJ series pumps are fitted with a water-cooled cold cap baffle in the area of the intake port.

A water-cooled forevacuum baffle located on the forevacuum side effectively prevents fluid being swept into the forevacuum unit.

1 Forevacuum connection flange
2 Forevacuum baffle
3 Nozzle assembly
4 Coolant line
5 High-vacuum connection flange
6 Cold cap baffle
7 Pump housing
8 Electrical junction box or EEC
9 Sheet metal cladding for heating

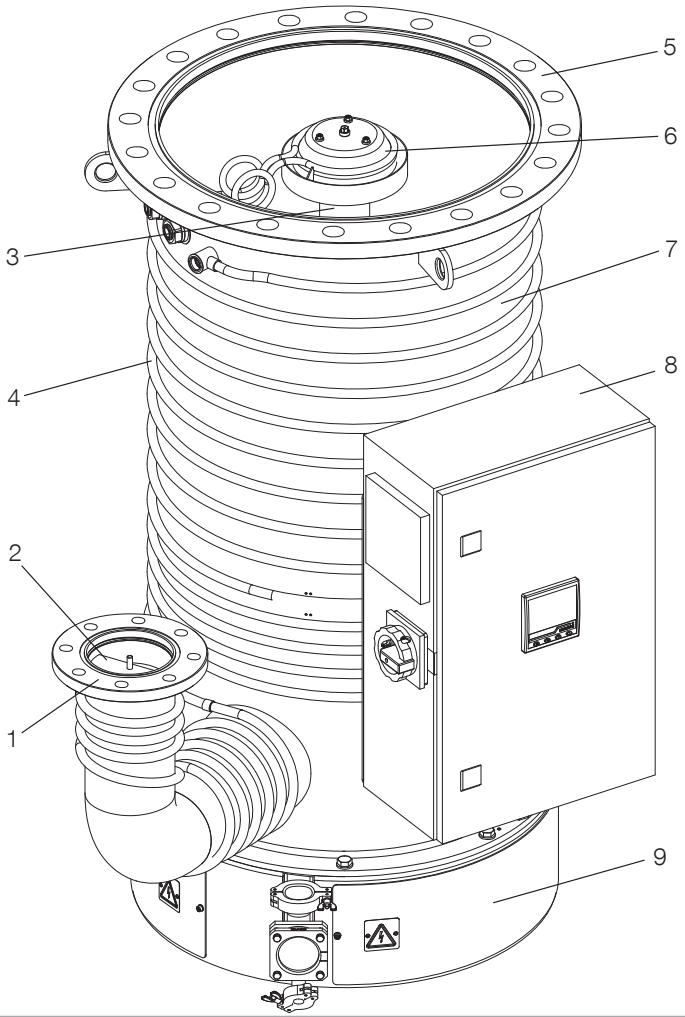


Fig. 1 Overview of a DIJ 20 diffusion pump with EEC; other models similar (cf. Fig. 3)

1.2 Supplied Equipment

All DIJ pumps are shipped from the factory without pump fluid installed.

Included as standard equipment with the pump are

- centering ring or O-ring and outer ring for the high-vacuum flange,
- forevacuum baffle, O-ring and outer ring for the forevacuum flange.

The high-vacuum and forevacuum flanges are closed with shipping flanges and claws. The insides of the pumps have been cleaned; they are evacuated prior to shipment.

Description

1.3 Technical Data

	DIJ 10	DIJ 320	DIJ 16	DIJ 500	DIJ 20	DIJ 630
High-vacuum connection (DN)	10″ ANSI	320 ISO-K	16″ ANSI	500 ISO-F	20″ ANSI	630 ISO-K
Forevacuum connection (DN)	2″ ANSI	63 ISO-K	3″ ANSI	100 ISO-K	4″ ANSI	160 ISO-K
Pumping speed[1] for						
Air < $8 \cdot 10^{-4}$ mbar	3 000 l · s^{-1}		6 800 l · s^{-1}		10 800 l · s^{-1}	
Argon < 10^{-4} mbar	2 750 l · s^{-1}		6 350 l · s^{-1}		9 500 l · s^{-1}	
Max. gas throughput	8 mbar · l · s		11 mbar · l · s		17 mbar · l · s	
Working range	< 10^{-1} - 10^{-7} mbar		< 10^{-1} - 10^{-7} mbar		< 10^{-1} - 10^{-7} mbar	
Ultimate total pressure [2]	< $5 \cdot 10^{-7}$ mbar		< $5 \cdot 10^{-7}$ mbar		< $5 \cdot 10^{-7}$ mbar	
Max. permissible forevacuum pressure	0.5 mbar		0.5 mbar		$6 \cdot 10^{-1}$ mbar	
Pump fluid fill, min./max.	3.0 / 4.0 l		3.5 / 4.5 l		5.5 / 7.0 l	
Mains voltage [3] [4]	3 ~ 400V /N/PE		3 ~ 400V /N/PE		3 ~ 400 V /N/PE	
depending on variant, 50/60 Hz	3 ~ 460V /N/PE		3 ~ 460V /N/PE		3 ~ 460 V /N/PE	
Heating power	3.6 kW		7.2 kW		10.8 kW	
Heating cartridges	3		6		9	
Warm-up period	< 15 min				< 25 min	
Coolant (minimum)						
for the pump [5]	500 l · h^{-1}		700 l · h^{-1}		900 l · h^{-1}	
for the cold cap baffle	80 l · h^{-1}		80 l · h^{-1}		80 l · h^{-1}	
Number of cooling circuits (including cold cap baffle)	2		2		2	
Coolant connection						
Pump	G3/8”		G1/2”		G1/2”	
Cold cap baffle	G1/4”		G3/8”		G3/8”	
Weight, approx. (kg)	95		152		230	
Recom. forevacuum pumps [6]						
at working pressures > 10^{-4} mbar	SV 120 & W 1001		SV 200 & W 1001		SV 300 & WAU 1001	
at working pressures < 10^{-4} mbar	DV 300 & W 501		DV 300 & W 1001		DV 450 & WAU 1001	
as supporting pump	D 40B		D 40B		D 65B	
IP Code (control cabinet [7])	IP20 IP65					

	DIJ 32	DIJ 800	DIJ 35	DIJ 1000
High-vacuum connection (DN)	32˝ ANSI	800 ISO-K	35˝ ANSI	1000 ISO-F
Forevacuum connection (DN)	6˝ ANSI	200 ISO-K	6˝ ANSI	200 ISO-K
Pumping speed[1] for Air < $8 \cdot 10^{-4}$ mbar Argon < 10^{-4} mbar		$21\,000\ l \cdot s^{-1}$ $18\,000\ l \cdot s^{-1}$		$33\,000\ l \cdot s^{-1}$ $26\,000\ l \cdot s^{-1}$
Max. gas throughput		36 mbar · l · s		36 mbar · l · s
Working range		$< 10^{-1}$ - 10^{-7} mbar		$< 10^{-1}$ - 10^{-7} mbar
Ultimate total pressure [2]		$< 1 \cdot 10^{-6}$ mbar		$< 1 \cdot 10^{-6}$ mbar
Max. permissible forevacuum pressure		$5 \cdot 10^{-1}$ mbar		$5 \cdot 10^{-1}$ mbar
Pump fluid fill, min./max.		9 / 11 l		9 / 11 l
Mains voltage [3] [4] depending on variant, 50/60 Hz		3 ~ 400V /N/PE 3 ~ 460V /N/PE		3 ~ 400 V /N/PE 3 ~ 460 V /N/PE
Heating power		21.5 kW		21.5 kW
Heating cartridges		18		18
Warm-up period		< 25 min		
Coolant (minimum) for the pump [5] for the cold cap baffle		$900\ l \cdot h^{-1}$ $80\ l \cdot h^{-1}$		$900\ l \cdot h^{-1}$ $80\ l \cdot h^{-1}$
Number of cooling circuits (including cold cap baffle)		3		3
Coolant connection Pump Cold cap baffle		G1/2” G3/8”		G1/2” G3/8”
Weight, approx. (kg)		570		610
Recom. forevacuum pumps [6] at working pressures > 10^{-4} mbar at working pressures < 10^{-4} mbar as supporting pump		SV 630 & W 2001 DV 650 & W 2001 D 65B		SV 630 & W 2001 DV 650 & W 2001 D 65B
IP Code (control cabinet [7])		IP20 IP65		

1) Measured as per DIN 28 427 using LVO 520 as the pump fluid.

2) Measured as per DIN 28 427 using LVO 520 as the pump fluid. When using the LVO 520 pump fluid and FPM (fluoroelastomer) gaskets, the DIJ pumps with water-cooled baffles will achieve pressures below $1 \cdot 10^{-7}$ mbar following suitable bake-out procedures.

3) The EEC is connected both with a load voltage, and a supply voltage (of 1~115VAC ± 15%, 50/60Hz, 50VA, 6A or 1~230VAC ± 15%, 50/60Hz, 50VA, 6A).
Both voltages will be disconnected safely from the mains via the EPO / main switch.

4) Mains voltage tolerance ± 10%

5) The coolant water volume is referenced to ΔT = 10 K. The discharge temperature should normally not exceed 50 °C. Depending on the application, the discharge temperature can also be set higher. However, it must be ensured that the corresponding coolant lines are suitable for these temperatures.

6) Single- and two-stage rotary vane pumps (TRIVAC; SOGEVAC), or dry-compressing pumps (DRYVAC) from our line of forevacuum pumps in conjunction with roots pumps (RUVAC) in pumping systems.

7) The control unit is designed and manufactured to comply with a degree of contamination 2 and an overvoltage category 2.

8) Leybold recommends to connect an existing neutral conductor.

Description

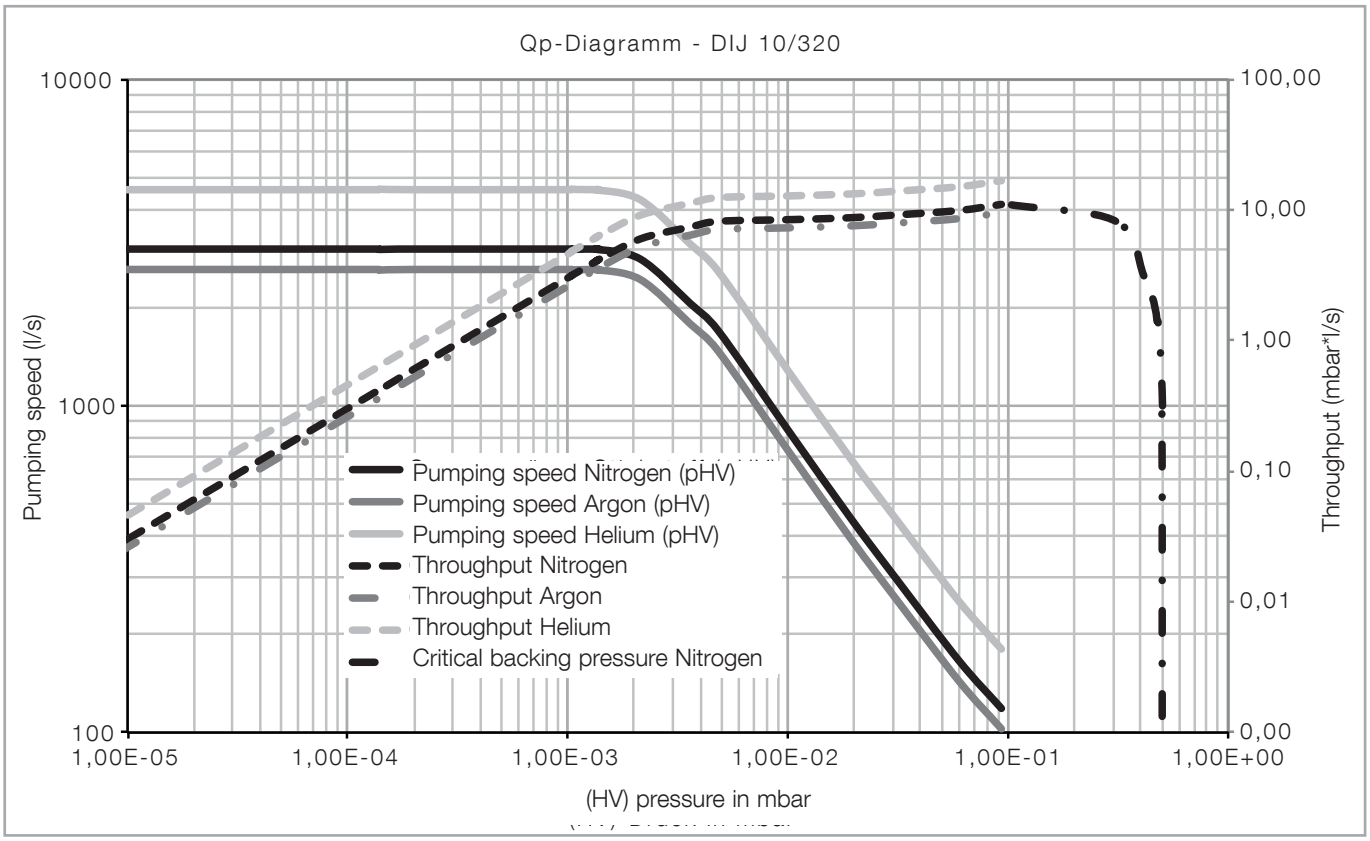


Fig. 2a Pumping speed overview for nitrogen, argon, and helium

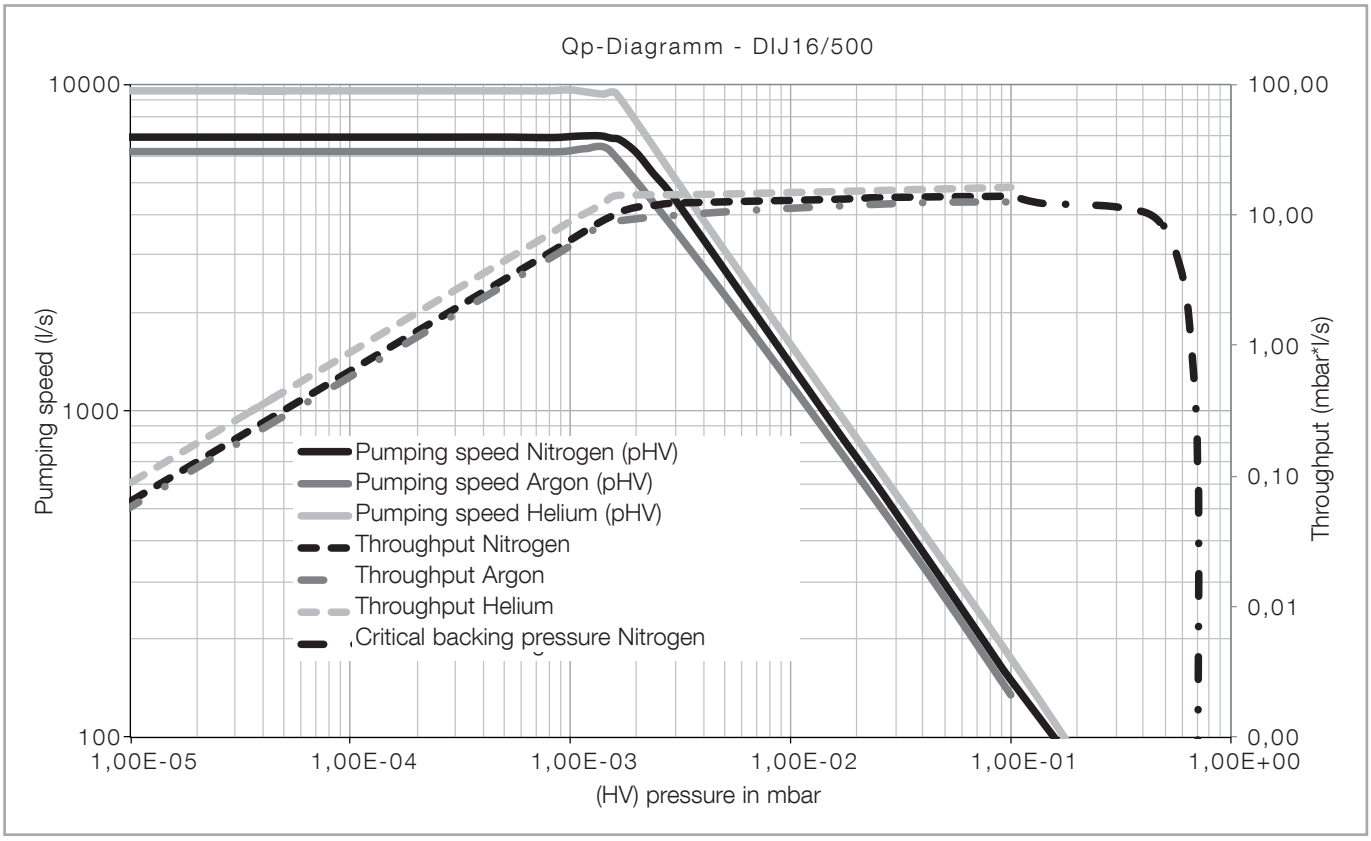


Fig. 2b Pumping speed overview for nitrogen, argon, and helium

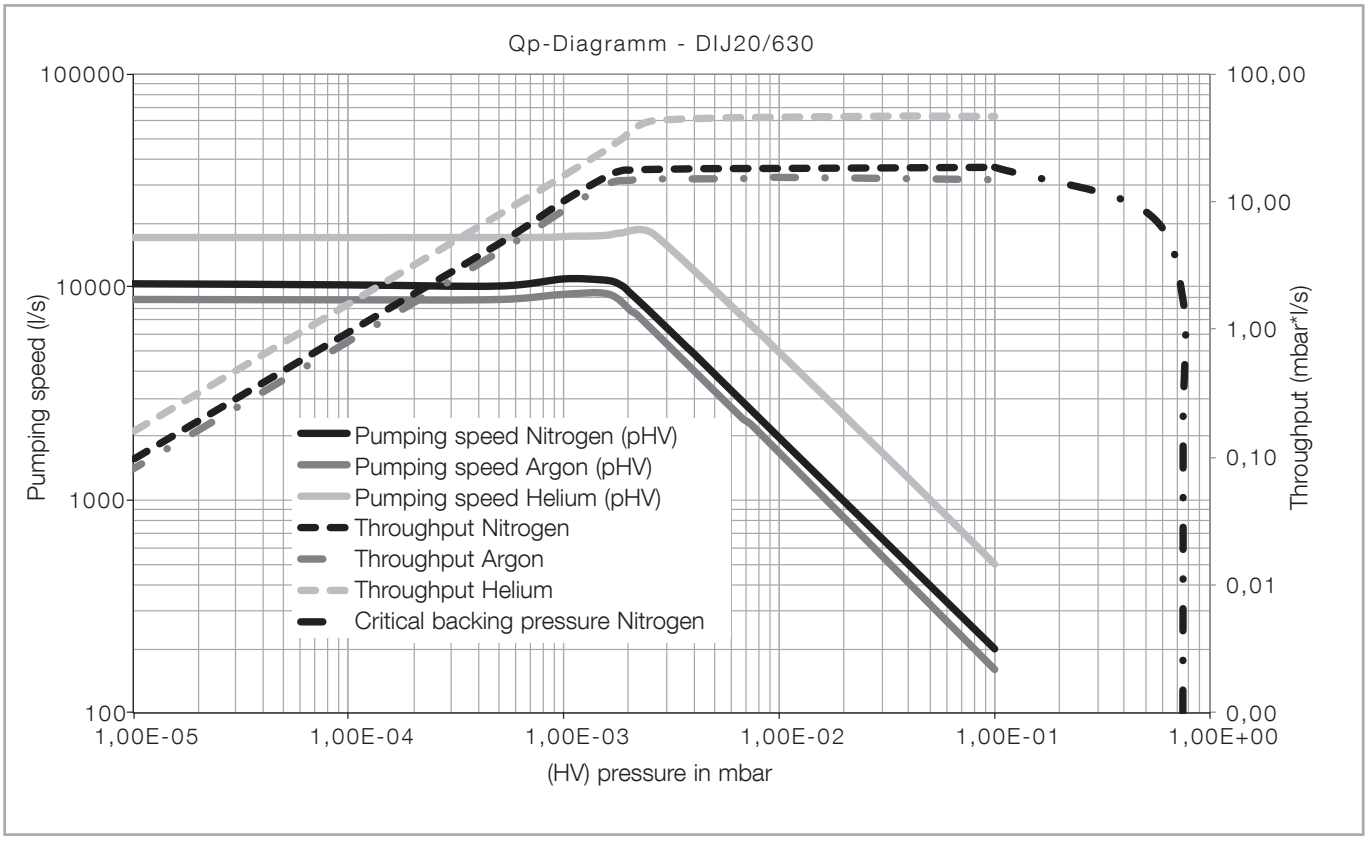


Fig. 3a Pumping speed overview for nitrogen, argon, and helium

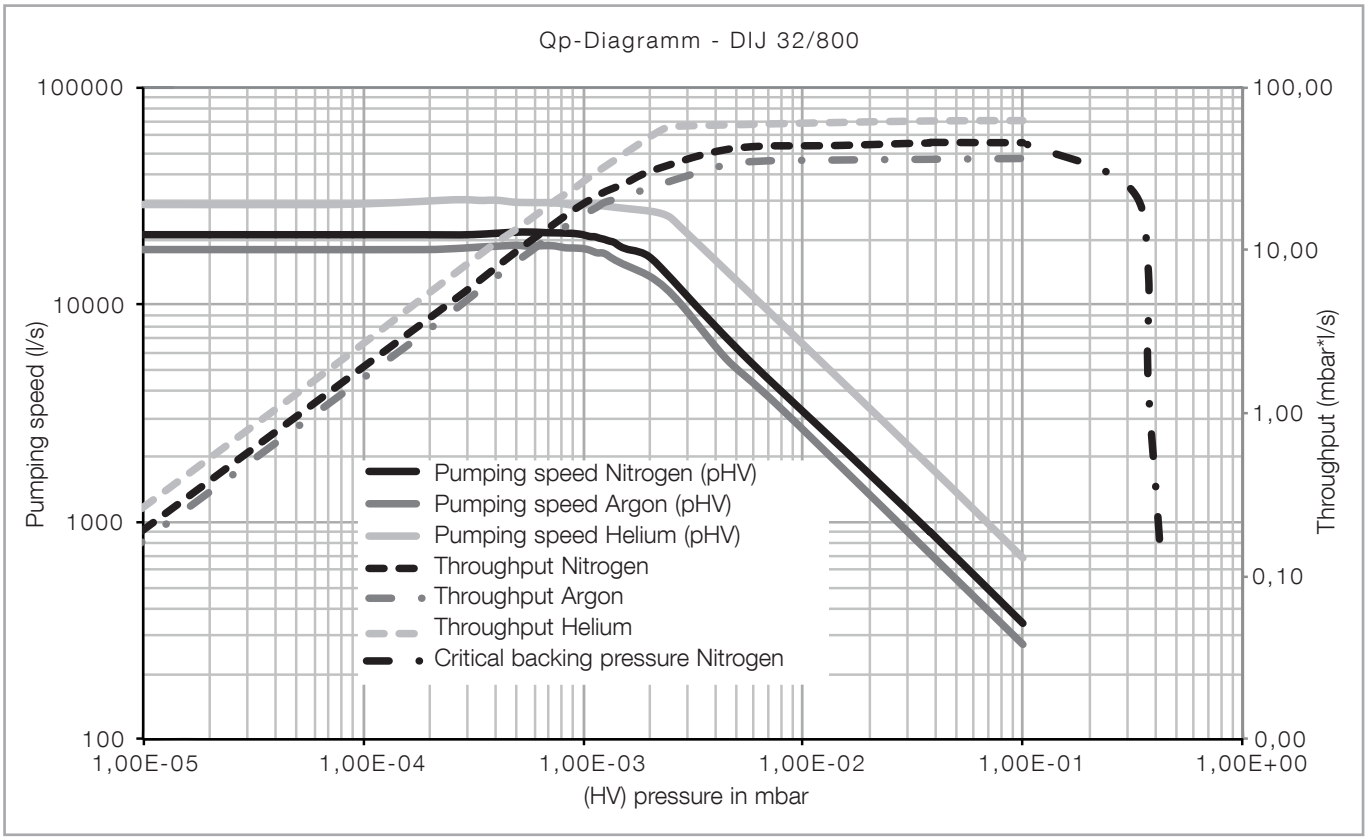


Fig. 3b Pumping speed overview for nitrogen, argon, and helium

Description

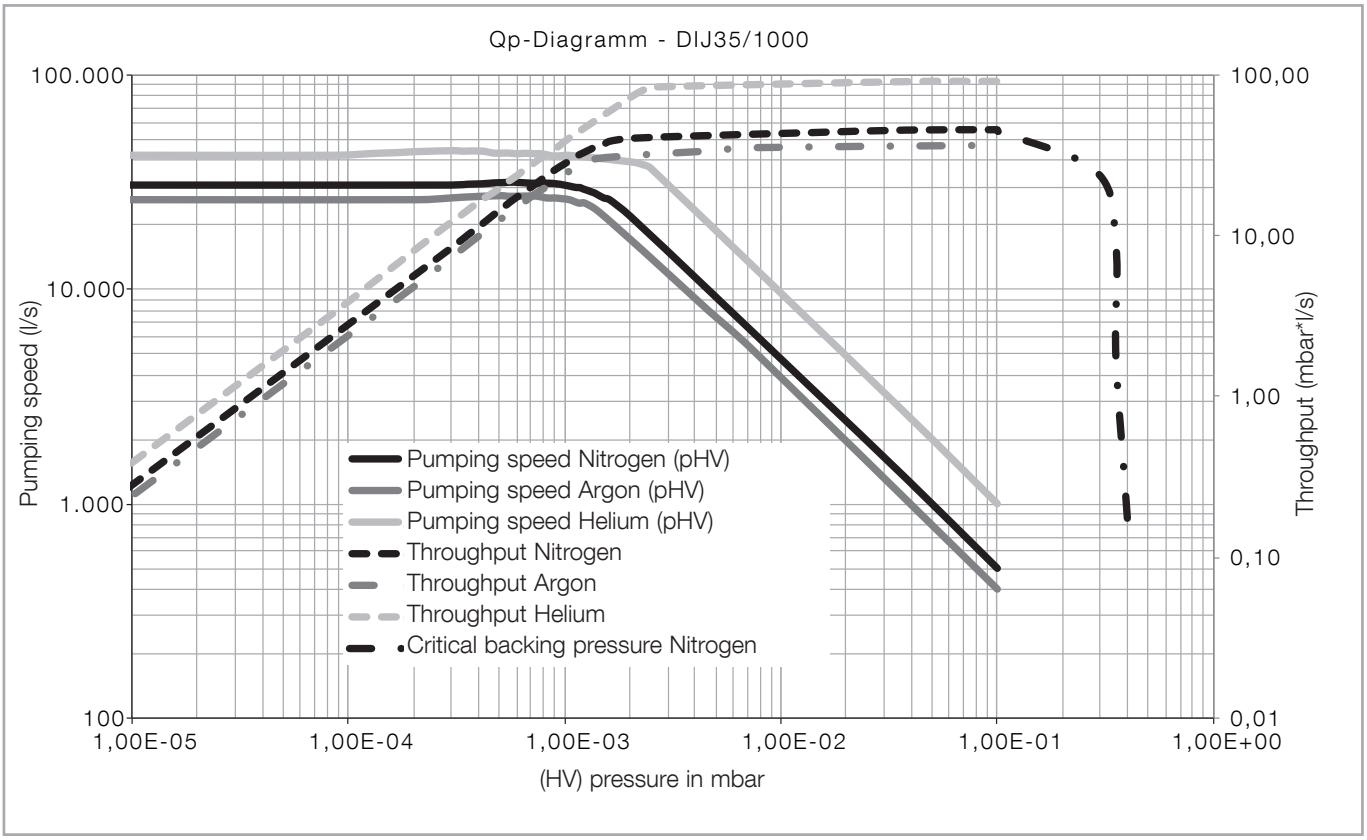


Fig. 3c Pumping speed overview for nitrogen, argon, and helium

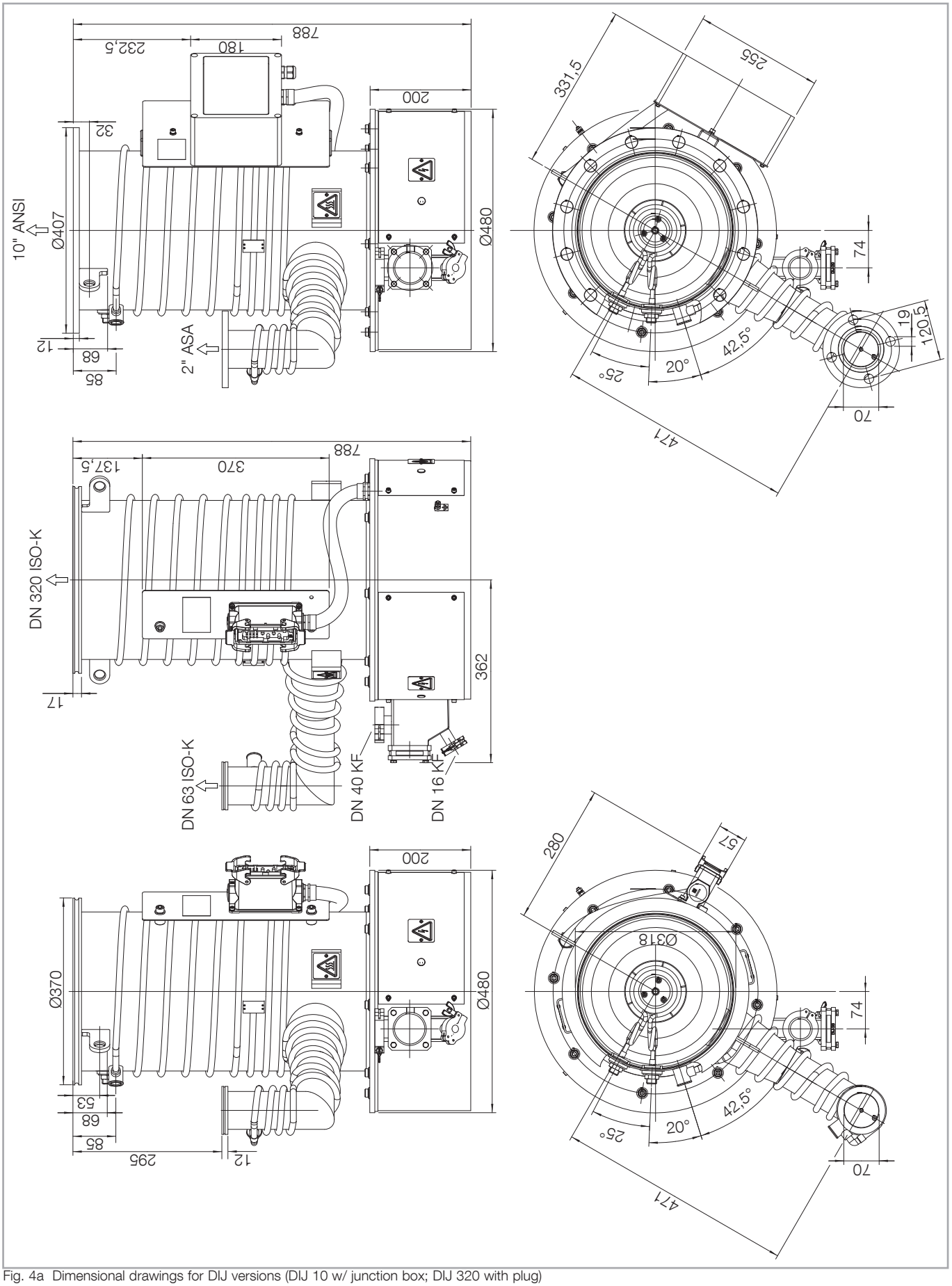


Fig. 4a Dimensional drawings for DIJ versions (DIJ 10 w/ junction box; DIJ 320 with plug)

Description

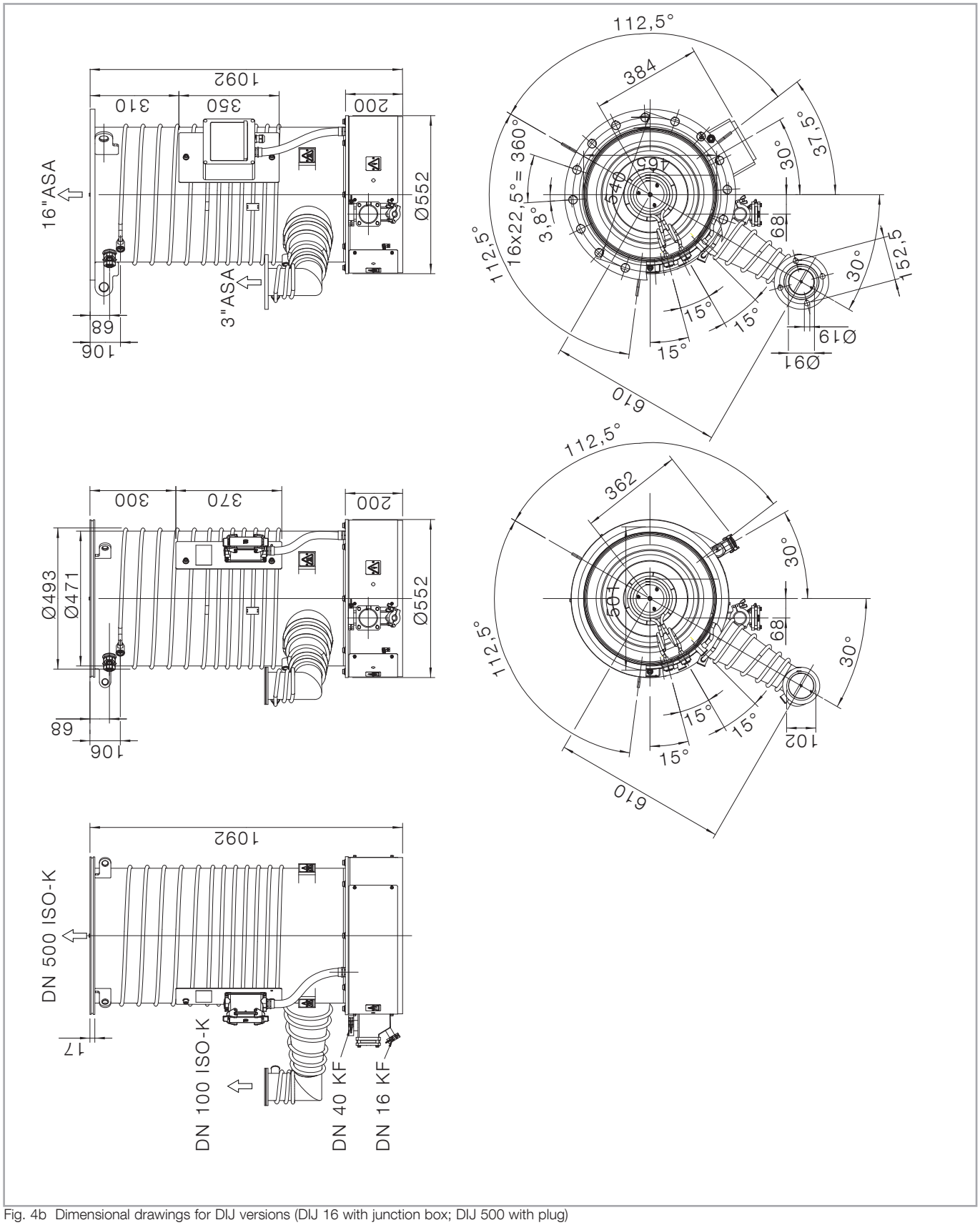


Fig. 4b Dimensional drawings for DIJ versions (DIJ 16 with junction box; DIJ 500 with plug)

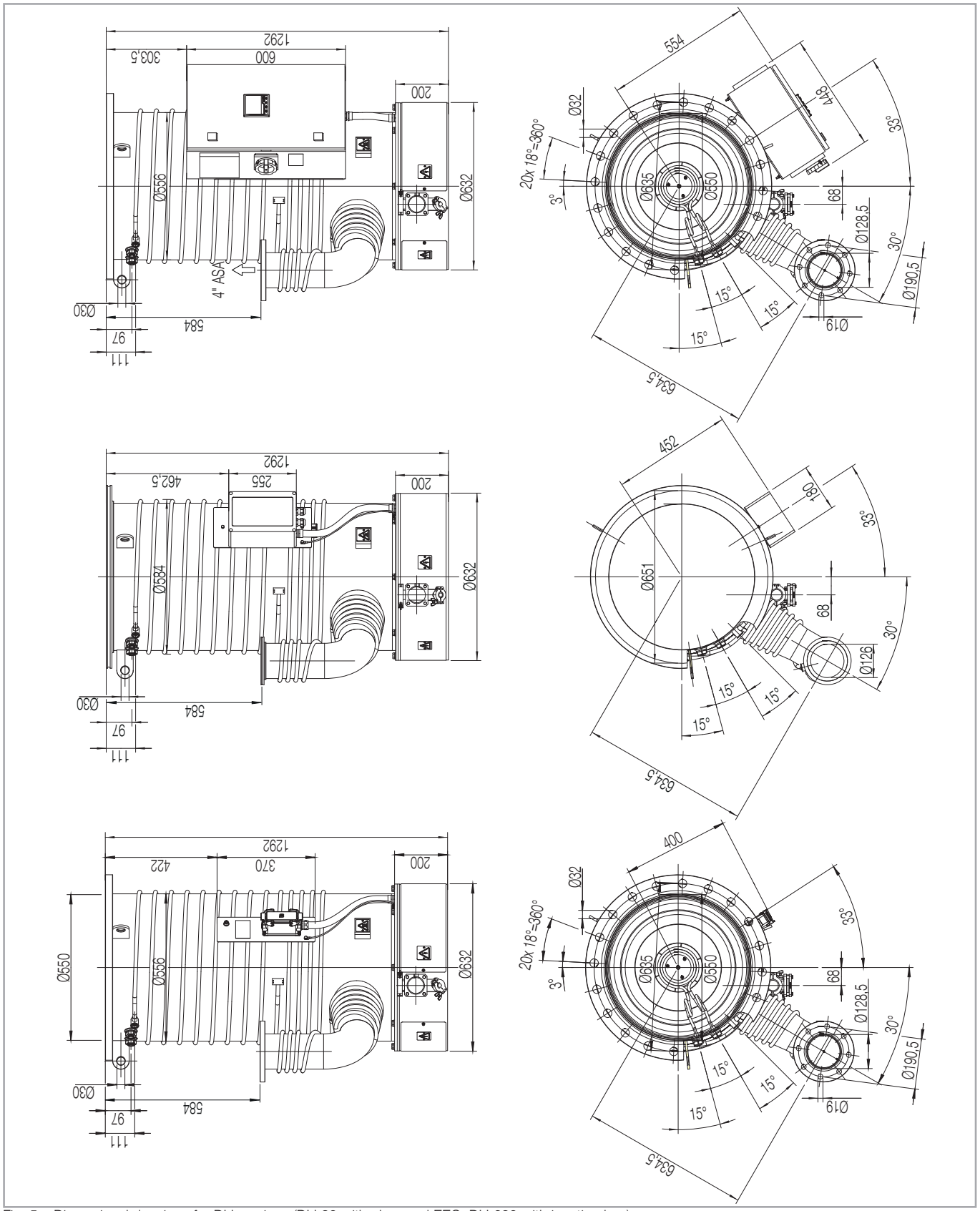


Fig. 5a Dimensional drawings for DIJ versions (DIJ 20 with plug, and EEC; DIJ 630 with junction box)

Description

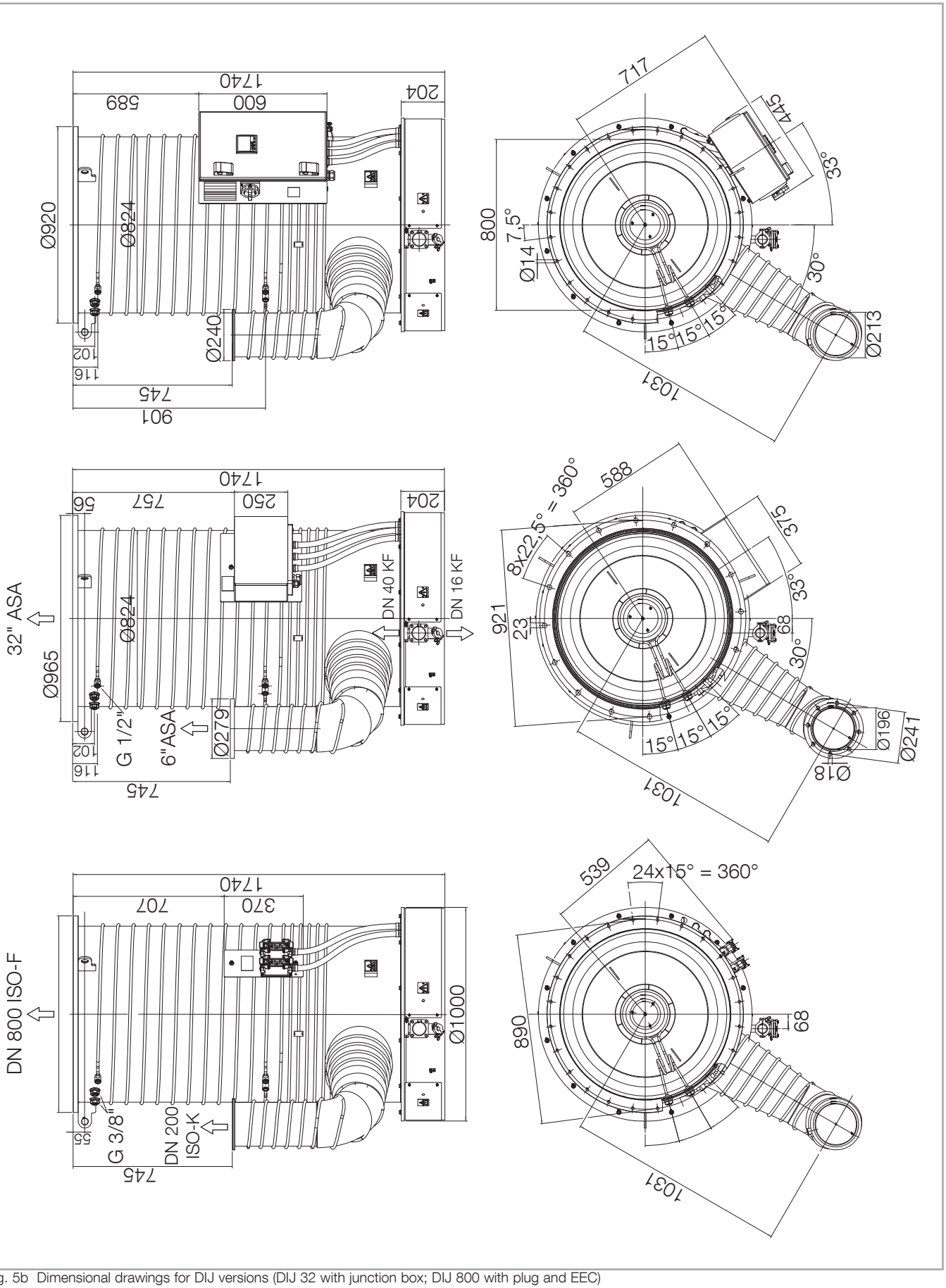


Fig. 5b Dimensional drawings for DIJ versions (DIJ 32 with junction box; DIJ 800 with plug and EEC)

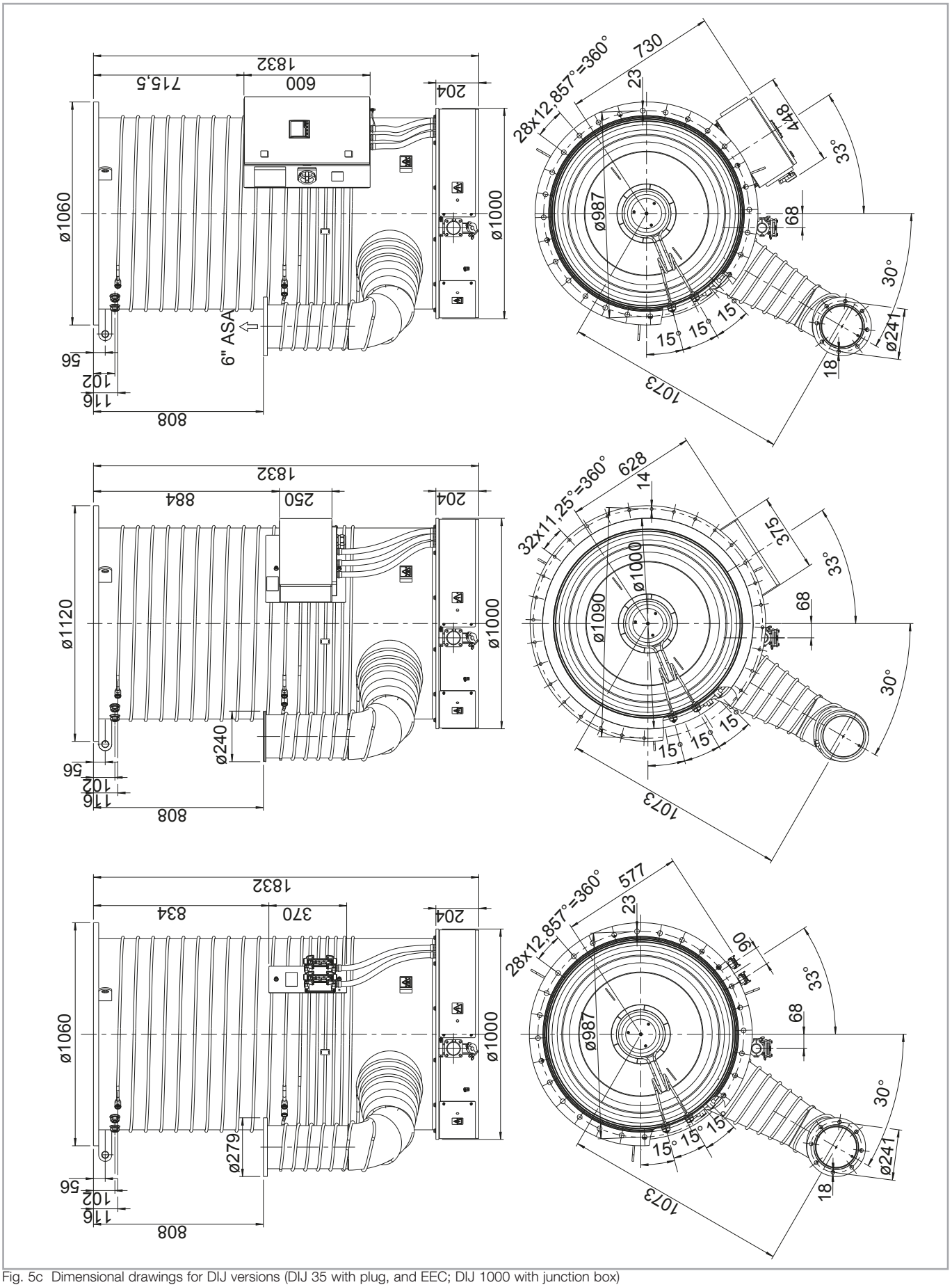


Fig. 5c Dimensional drawings for DIJ versions (DIJ 35 with plug, and EEC; DIJ 1000 with junction box)

Description

Dimensions

	DIJ 10	DIJ 320	DIJ 16	DIJ 500	DIJ 20	DIJ 630	DIJ 32	DIJ 800	DIJ 35	DIJ 1000
DN	ANSI 10″	320 ISO-K	ANSI 16″	500 ISO-F	ANSI 20″	630 ISO-K	ANSI 32″	800 ISO-F	ANSI 35″	1000 ISO-F
DN_1	ANSI 2″	63 ISO-K	ANSI 3″	100 ISO-K	ANSI 4″	160 ISO-K	ANSI 6″	200 ISO-K	ANSI 6″	200 ISO-K
d	407	370	597	550	700	690	965	920	1060	1120
b_1	341*		384*		554		717		730	
h	788		1092		1292		1740		1832	

* w/ fuse box

1.4 Ordering Information

Variants	DIJ 10	DIJ 320	DIJ 16	DIJ 500	DIJ 20	DIJ 630	DIJ 32	DIJ 800	DIJ 35	DIJ 1000
	22213~	22214~	22223~	22224~	22227~	22228~	22237~	22238~	22243~	22244~
w/ plug 400V / 50/60Hz / 3ph PN / Y	~V000	~V000	~V000	~V000	~V000	~V000	~V000	~V000	~V000	~V000
w/ plug 460V / 50/60Hz / 3ph PN / Y	~V001	~V001	~V001	~V001	~V001	~V001	~V001	~V001	~V001	~V001
w/plug & EEC 400V / 50/60Hz / 3ph PN / Y					~V002	~V002	~V002	~V002	~V002	~V002
w/plug & EEC 460V / 50/60Hz / 3ph PN / Y					~V003	~V003	~V003	~V003	~V003	~V003
w/ fuse box 400V / 50/60Hz / 3ph PN / Y	~V005	~V005	~V005	~V005	~V005	~V005	~V005	~V005	~V005	~V005
w/ fuse box 460V / 50/60Hz / 3ph PN / Y	~V006	~V006	~V006	~V006	~V006	~V006	~V006	~V006	~V006	~V006
w/ EEC 400V / 50/60Hz / 3ph PN / Y					~V009	~V009	~V009	~V009	~V009	~V009
w/ EEC 460V / 50/60Hz / 3ph PN / Y					~V010	~V010	~V010	~V010	~V010	~V010
Water-flow monitor	500006623									
Thermostatic safety switch	122 84									
Pump fluid (see next page)										

1.5 Overview of Pump Fluids

Prior to using PFPE (Leybonol LVO 400 or LVO 410) consult with Leybold.

NOTICE

		Mineral oils/ LEYBONOL	Silicone oils
Technical data		**LVO 500**	**LVO 521**
Vapor pressure at 20 °C	mbar	$1 \cdot 10^{-8}$	$3.0 \cdot 10^{-10}$
Relative molecular mass	$g \cdot mol^{-1}$	510	546
Flash point (DIN ISO 2592)	°C	> 240	> 240
Viscosity at 25 °C	$mm^2 \cdot s^{-1}$	115	175 / 8 [1]
Density at 20 °C	$g \cdot cm^{-3}$	0.862	1.097 [2]

[1] at 30 / 100 °C
[2] at 25 °C

Ordering info		**LVO 500**	**LVO 521**
Pump fluid / oils	1 l	L 500 01	L 521 01
	5 l	L 500 05	L 521 05
	20 l	L 500 20	–

LEYBONOL Oils	Characteristics	DIJ all sizes
LVO 400	PFPE synthetic oil, chemically inert, high thermal stability	possible
LVO 410	PFPE synthetic oil, chemically inert, high thermal stability	possible
LVO 500	white mineral oil, free of additives, good thermal stability	default
LVO 521	silicone oil, very high thermal stability, high resistance against oxidation	default

Transport and Storing

2 Transport and Storing

DANGER

Loss of stability during transport

Uncontrolled movement through incorrect fastening/raising/lifting of the pump system.

Use all crane eyes when lifting the pump body. Pay attention to the centre of gravity!

Transportation flanges (blank flanges) and claws may be used only for transportation purposes; they are not suitable for the assembly of the pumps in systems.

Uncontrolled movement through inertia of mobile pump systems (wheels / mobile frame)

Mount and move mobile pumps with roles only on flat, solid, horizontal surfaces.

Pay attention to appropriate slow speed when moving the pump.

The DIJ pump is shipped upright on a pallet and packed in a wooden crate. Proceed as follows to unpack the unit; also see Figure 6.

- Remove the shipping papers from the pocket (6/4).
- Position the pallet on a flat and level surface.
- Remove the tightening straps (6/2).
- Loosen the upper part of the wooden crate and turn the brackets (6/4) up. Affix the lifting gear at the brackets and lift the wooden crate up and away.
- Remove the plastic wrapper.
- The DIJ pump is now freely accessible on the pallet on the floor.
- Remove the bag containing the desiccant.

The DIJ pump may be moved only when it is standing upright on a pallet or suspended from the lifting eyes. After unpacking the unit, examine the shipment for completeness and any possible shipping damage (see Section 1.2, “Standard equipment”).

After removing the transport securing devices between cover and cold cap baffle, handle with care.

The pumps are shipped evacuated (corrosion protection). Do not air the pumps until immediately before installation.

To vent the pump, pull the closure plug out of the hose nozzle in the forevacuum shipping flange.

The ambient temperature range of -20 to +70 °C must not be exceeded during transport and storing.

1 Stabilizing cross
2 Tightening straps
3 Hex-head bolts
4 Brackets
5 Pocket for shipping papers

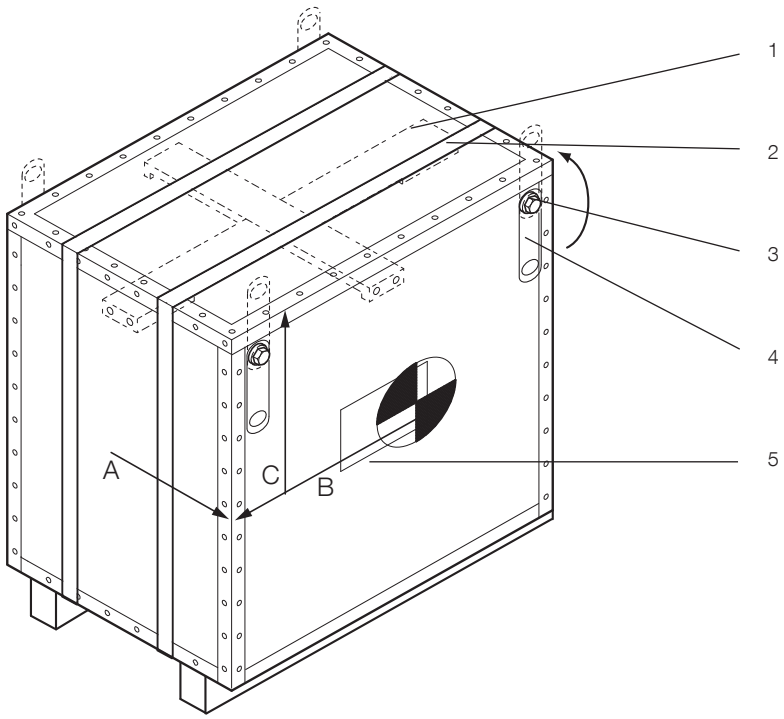


Fig. 6 DIJ pump in the shipping case

Storing

Maintain the pump in stock so that it is dry and not exposed to frost. The cooling coils need to be blown out and must be dry.

Keep the pump in stock standing upright.

Pumps having a filling of PFPE should be sealed off in a gas-tight manner and vented with nitrogen.

Center of gravity overview

	Case size LxWxH (mm)	Gross / net weight (kg)	COG A, B, C (mm)
DIJ 10 / 320	700 x 700 x 1000	123 / 95	291, 291, 450
DIJ 16 / 500	1000 x 900 x 1300	198 / 152	416, 391, 550
DIJ 20 / 630 w/ EEC	1210 x 1020 x 1574	340 / 230	462, 472, 770
DIJ 32 / 800	1500 x 1800 x 2200	620 / 570	570, 582, 925
DIJ 35 / 1000	1500 x 1800 x 2200	660 / 610	570, 582, 950

3 Installation

3.1 Conforming Utilisation

The pumps in the DIJ series are high-vacuum pumps. They are always operated in conjunction with forevacuum pumps.

They are employed in high-vacuum technology to evacuate vacuum chambers.

They are not suitable for handling oxygen above normal atmospheric concentration.

In the case of inflammable and explosive gases, please discuss with Leybold beforehand.

The pumps are suitable for the pumping of gas mixtures containing oxygen concentrations of < 21%.

They are suitable for conveying of oxidative substances in combination with the suitable pump fluid.

Fore-vacuum pressure range of use < $5 \cdot 10^{-1}$ mbar.

3.1.1 Ambient Conditions

Ambient conditions for the pump must not exceed or underrun the following values:

- Temperature: 0 – 55 °C
- Humidity: 85 %
- Altitude of installation site < 1500 m (NHN)

With using the Energy Efficiency Control variant the aforementioned values change accordingly to:

- Temperature: 5 – 40 °C
- max. altitude 1000 m (NHN)

3.1.2 Non-conforming Utilisation

The DIJ pumps are not suitable for pumping of:

- Oxygen in concentrations of > 21%
- Radioactive substances
- Ignitable gas mixtures
- Pyrophoric gases
- Liquids
- Toxic gases according to GHS category I and II

The transport of the following gasses is only permitted after consulting Leybold:

- Corrosive gases
- Toxic gases according to GHS category III and IV
- Oxidative gases

3.1.3 Risk of Damaging the Pump

NOTICE

1 When deviating too far from the vertical installation orientation (>1°), there is the risk that the heating cartridges will run dry thereby damaging the pump.

2 Switching the heating cartridge on and off repeatedly will result in its premature failure.

3 Missing or wrong connections for the safety thermostats can cause the pump to overheat or destroy the heating cartridges.

4 Connect the pump in such a way that it will not start again spontaneously once a monitoring component (thermostat, overheating protection switch, coolant flow monitor) has been tripped.

5 All the pump's interior surfaces must be carefully cleaned before filling the pump with a different oil compound (e.g. from mineral oil LVO 500 to silicone oil LVO 521).

6 The DIJ may be vented only after the pump fluid temperature has fallen to below 100 °C.

Ventilation should preferably be from the high-vacuum side, into the cool pump.

7 The pressure of the steam cleaner may
- only amount to 4 bar when cleaning the heat conducting panels of the heater inserts
- only amount to 10 bar for the remainder of the pump.

8 The nozzle assembly must only be dismantled by qualified and trained personnel. Please contact our Service Centre.

9 Do not use any chlorine based decalcifier since this will damage the cooling coils due to crevice corrosion.

10 Only install heater cartridges which are dry. During longer storage periods the heater cartridges attract humidity due to the hygroscopic nature of the insulation materials used, In this case the cartridges may be dried in a drying oven for 8 hours at 180 °C. After longer system downtimes slowly startup the diffusion pump by a cyclic and gradual heating up.

Installation

1 Oil level sight glass with pump fluid inlet and outlet ports
2 Coolant outlet from pump
3 Forevacuum connection flange
4 Coolant inlet and outlet for cold cap baffle
5 Coolant inlet for pump
6 High-vacuum connection flange
7 Harting plug, electrical terminal box or Energy Efficiency Control (depending on version)
8 Sheet metal cladding, heating

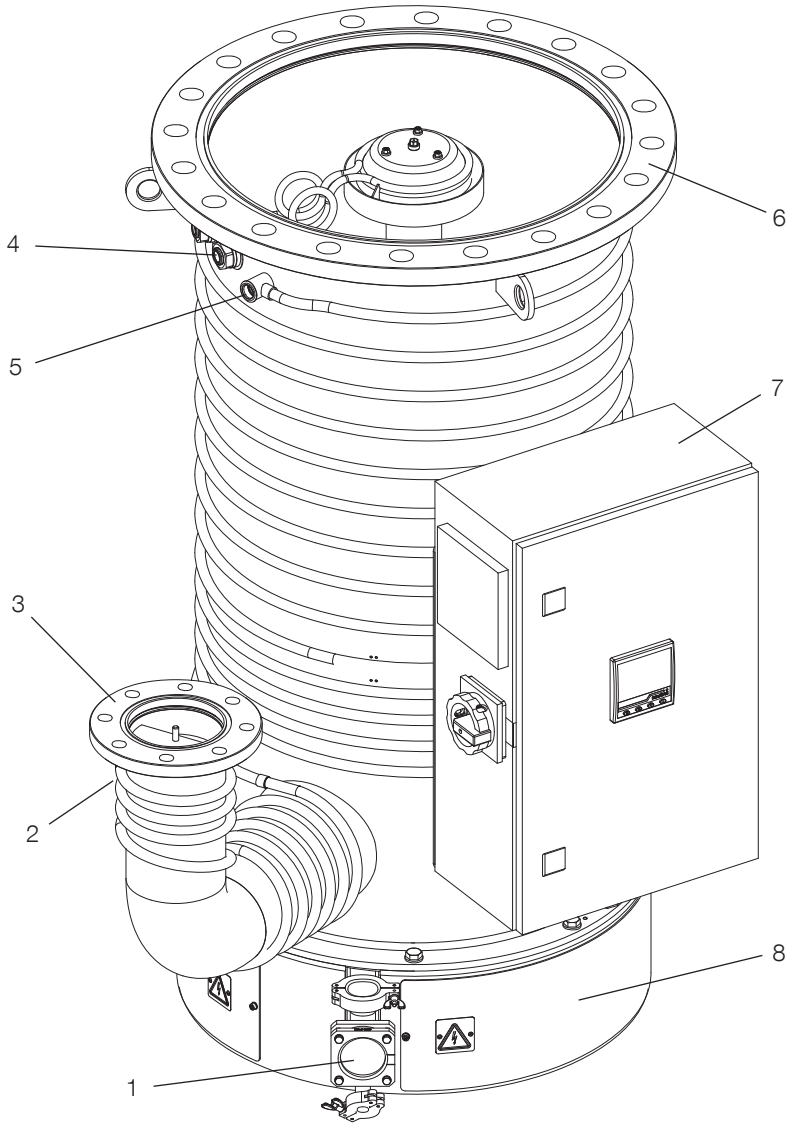


Fig. 7 Connection elements

3.2 High-vacuum Connection

The DIJ pumps are shipped evacuated. Do not air the pump until immediately before it is installed; to do so, open the closure plug at the forevacuum shipping flange.

Remove the high-vacuum shipping flange.

The pump must be standing flat and level or vertically suspended from the high-vacuum connection flange when installed in the system.

NOTICE

When deviating too far from the vertical installation orientation (> 1°), there is the risk that the heating cartridges will run dry thereby damaging the pump.

We recommend maintaining a clearance of 500 mm on top and around the pump to other system components as well as a ground clearance of 100 – 150 mm. This facilitates maintenance work on the pump's heating unit with the pump left in place in the system.

Make sure that the control side is easily accessible and does not expose the operator to a potentially dangerous situation.

Check to ensure that the centering ring, together with the O-ring and the outer ring are seated securely in the high-vacuum flange (15/6).

Use the 20 bolts and nuts (1 1/8“ * 3“), to fasten the DIJ 20 ASA flange to the customer's plant. DIJ 630: use the 12 clamped flange connectors or claws (P/N 21061, and 26711), to join the ISO-K flange.

WARNING

The shipping flange (blank flange) and claws may be used only for shipping purposes; they are not suitable for mounting the pumps in systems.

Where maintaining uniform pressure is of special importance, and particularly when working in pressure ranges of less than 10^{-6} mbar, we recommend using at all flange connections at the high-vacuum side the “ultra” sealing plate instead of the centering ring with an O-ring.

Necessary to achieve maximum conductance at the high-vacuum line is that it exhibit the largest possible nominal diameter and be as short as possible. The DIJ pump must be suspended vertically.

3.3 Forevacuum Connection

A forevacuum system is required for operating the DIJ pumps. We recommend our TRIVAC, SOGEVAC, or DRYVAC pumps in conjunction with roots booster pumps.

Remove the forevacuum shipping flange.

Connect the forevacuum line with the centering ring, O-ring and outer ring at the forevacuum port (5/3).

The centering ring (7/3) also serves at the same time as the attachment point for the water-cooled baffle (1/2) in the forevacuum port.

WARNING

The shipping flange (blank flange) and claws may be used only for shipping purposes; they are not suitable for mounting the pumps in systems.

The diameter of the forevacuum line should be at least as large as the forevacuum flange nominal diameter; the line should be as short as possible in order to achieve the maximum conductance value.

3.4 Coolant Connections

CAUTION

Ejection of parts through implosion of a part of the pump or the pump system

If the boiler overheats due to too little or no oil or too little cooling water flow, the boiler can implode.

The water cooling system may not be interrupted in the case of a malfunction.

Observe the installation regulations.

It is necessary to connect the coolant system prior to operating the DIJ pump.
Coolant pressure should not exceed 6 bar.
We recommend coolant feed temperatures of between 15 °C and 20 °C.
Coolant return temperature should normally not exceed 50 °C at the outlet. It is important to pay attention to this in particular where the DIJ pump is connected to a closed coolant circuit. Depending on the application, the discharge temperature can also be set higher. However, it must be ensured that the corresponding coolant lines are suitable for these temperatures.

We recommend using conditioned water to avoid the formation of scale deposits (which would impair cooling performance).

The DIJ pumps have two coolant circuits which can be connected in series.

- 1. Cold cap baffle: coolant inlet and outlet (cf. Fig. 7)
- 2. Pump: coolant inlet: (7/6)
  Coolant outlet: (7/2)

Important is that the coolant flow first into the cold cap baffle.

NOTICE

In case of an operational disruption it must be ensured that the water cooling will remain in function.

3.4.1 Water Quality

In order to ensure long trouble-free operation the cooling water must not contain any oils, greases and suspended solids. Moreover, we recommend compliance with the following limit values:

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
Sulfate	< 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) = 1.4 mmol/l = 10 °e (degrees English hardness) = 14 °f (degrees French hardness)	
If there is the danger of frost, you may use a water glycol mixture of up to 30 %.	
DS water can be used for cooling the pump, if the pH value corresponds to the range indicated above.	

3.5 Electrical Connections

DANGER

Electric shock through direct or indirect contact of live parts

Electric shock by touching active electrical components. Voltage spreading through incorrect electrical connection.

The electrical connection may be carried out only by a trained person. Observe the national regulations in the country of the user, e.g. for Europe EN 50110-1.

A protective earth check between the PE connection and every touchable part that requires a protective connection, must be carried out before initial operation. For the test current use 10A DC or AC (RMS), while 0.1 Ohm impedance must not be exceeded.

The temperature sensor (Pt 100 heating cartridge temperature) may take on voltage that is dangerous to touch. The operator must take suitable precautions for protection in case of indirect touching. For example, a temperature transducer with double or reinforced isolation may be used for this purpose.

Connect a second protective earthing conductor.

There are hazardous voltages present on the mains cables (danger to life).

Before carrying out maintenance or service work on the product, take it off the mains supply. After mains power off, wait for 5 minutes!

DANGER

Loss of power supply

The pump fluid is no longer heated in case of failure of the power supply. There is no risk from the DIJ. The pump fluid cools down. The risk of the entire system cannot be assessed. In the worst case, the system will be vented rearward and can explode.

The valves must be closed in the event of a power failure.

Air infiltration in an operation-ready, warm diffusion pump are a dangerous condition and must be reliably ruled out.

If electro-pneumatically propelled high- and fore-vacuum valves are used, these must be used shut in the specification “de-energised” and “unpressurised”. Also for these valves, the ventilation of a ready-to-operate, hot diffusion pump must be ruled out through appropriate latch circuits.

The components must be connected correctly and properly. Electrical safety examinations, in particular the insulation and protective grounding conductor examination, must be carried out.

CAUTION

High electrical fault currents due to moisture absorption by mineral insulating material of the heating elements

The hygroscopic insulation of the heating element could lead to a burn-out of the heater cartridge. Risk occurs through longer shut-off cycles and humid ambient conditions.

Take note of the installation instructions for the replacement and connection of the heater cartridge.

Check stock before changing/inserting (measured value: 49 to 55 ohms) and degas if necessary.

In case of standstill, check heater cartridge after one year.

3.5.1 Grounding

The external grounding connection M6 is located left beside the oil sight glass. Properly ground the pump there.

3.5.2 Connecting the Heaters

CAUTION

Hazards that may occur through independent restart of a pump after a shutdown due to an error

Connect the pump in such a way that if a monitoring element is triggered (thermostat, thermal protective switch, water flow guard) it **does not** automatically restart after the inadmissible operating condition has ended.

Installation

General installation notes

There is a basic insulation between the mains supply and the temperature sensor (Pt100 heater cartridge's temperature). The operator has to provide suitable protection measures against indirect contact; e.g. a temperature transmitter with electrical insulation between the input and output circuits. With EEC-equipped DIJ pumps the inputs and outputs show a reinforced insulation.

In all the DIJ pumps the heating cartridges are normally wired in a "star" (Y) circuit; this means that they are pump-type dependent prepared for connection to a 400 V (±10 %), 3-phase, 50/60 Hz, or a 460 V (±10 %) power source.

The power consumption figures required to make this selection are given in the following table. The appropriate circuit breakers shall be installed during installation; their specifications are also given in the following table.

DIJ	Connection voltage ±10%	Main fuse	Individual fuses size / number (plug or fuse box)	Individual fuses size / number (EEC)	Cable cross-section
10 / 320	**400 V, 3~** 460 V, 3~	**10 A** 10 A	6 **A / 3** 6 A / 3	6.3 **A / 3** 6.3 A / 3	4 mm^2 installation type C
16 / 500	**400 V, 3~** 460 V, 3~	**20 A** 20 A	**6 A / 6** 6 A / 6	**6.3 A / 6** 6.3 A / 6	
20 / 630	**400 V, 3~** 460 V, 3~	**25 A** 25 A	**6 A / 9** 6 A / 9	**6.3 A / 9** 6.3 A / 9	
32 / 35 800 / 1000	**400 V, 3~** 460 V, 3~	**50 A** 50 A	**6 A / 18** 6 A / 18	**6.3 A / 18** 6.3 A / 18	

A supply cable sized to correspond to the amount of power drawn or the connected load is to be used when making the connection. The parameters which affect dimensioning include current load, ambient temperature, how the cable is laid and type of cable and conductors. Local codes shall be observed when sizing the connection cable.

Leybold recommends to connect an existing neutral conductor. If the neutral conductor is not connected, there will be no symmetry in case of a heating rod malfunction or failure. This may lead to an untimely destruction of the other heating rods.

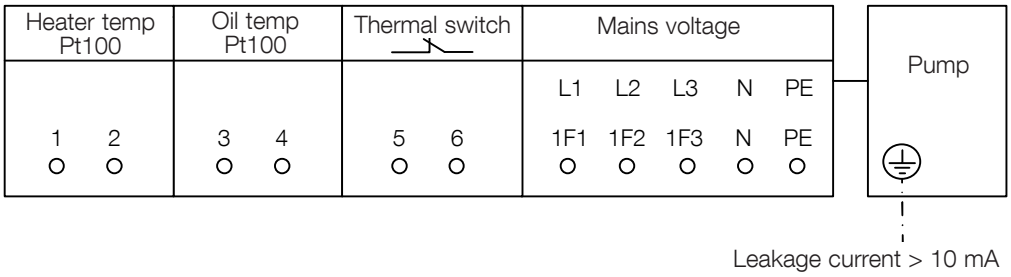
NOTICE

The operator must check the impedance of the fault loop, and verify the suitability of the corresponding overcurrent protection device.
After the installation, the required safety tests (e.g., PE conductor test, among others) have to be carried out.
The PE conductor test must include its connection and any accessible part requiring a protective connection. Use a test current of 10 A (effective value; AC or DC) with a resulting impedance of < 0.1 Ω.

With DIJ-EEC variants an overcurrent protection device must be provided by the system operator, for detecting an insulation error and safely shutting-down the supply automatically.
The supply voltage must correspond to the limits specified.

The insulation for the lines from the junction boxes to the fuse boxes shall be resistant to temperatures of up to 200 °C.

Electrical junction box DIJ



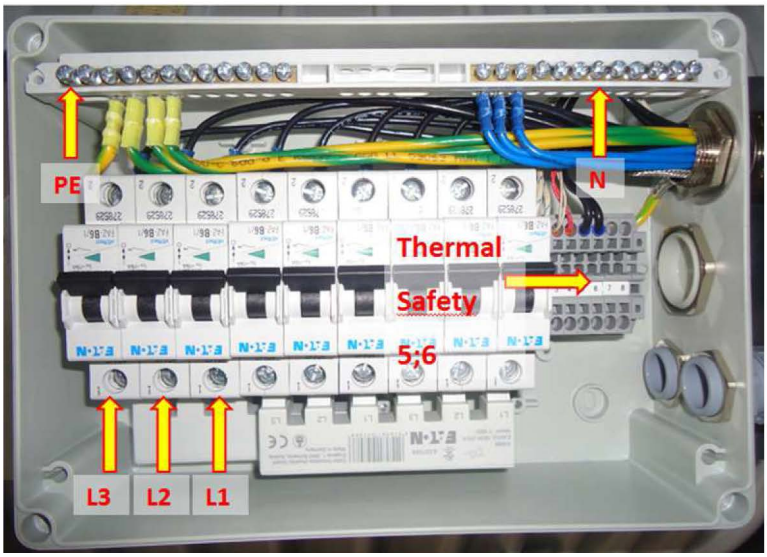
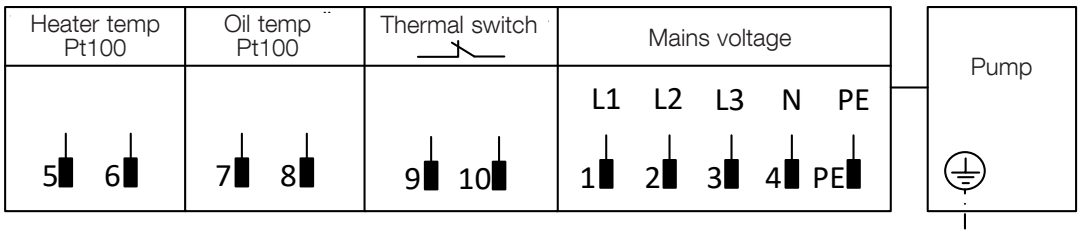


Fig. 8a Versions of electrical connections

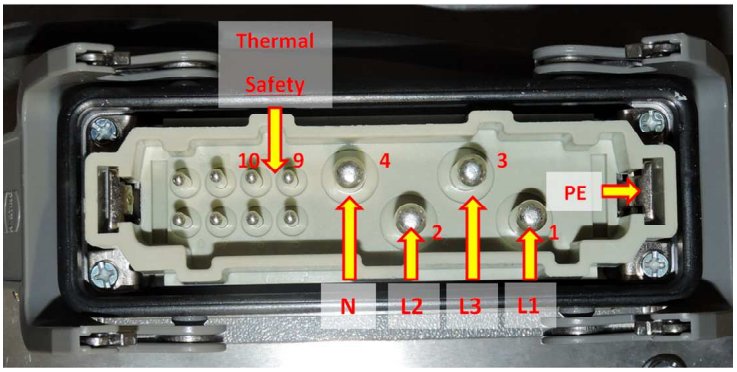
Installation

DIJ with plug – 222xxV000, 222xxV001

Harting 1 – XH1 (plug RHS)



Leakage current > 10 mA



DIJ with EEC – 222xxV009, 222xxV010

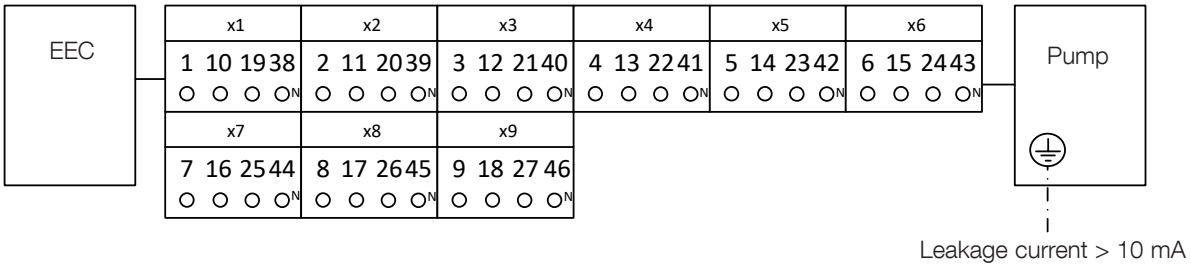
Oil temp Pt100	Heater temp Pt100	Oil temp Pt100	Therm. switch	C. water temp. Pt100	X1 Mains voltage	Pump
1 2	3 4	5 6	7 8	11 12	L1 L2 L3 N PE 1/L1 3/L2 5/L3 N PE	
Switch-off temp. 100° C	Warning oil vapour	Oil temp. >220° C	Standby	Cooling water valve	X2 Controller voltage	
13 14	15 16	17 18	19 20	9 10	L+ M-	

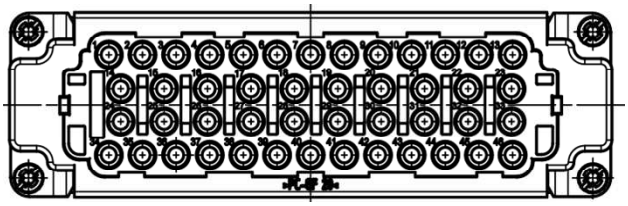
Leakage current > 10 mA

Fig. 8b Versions of electrical connections

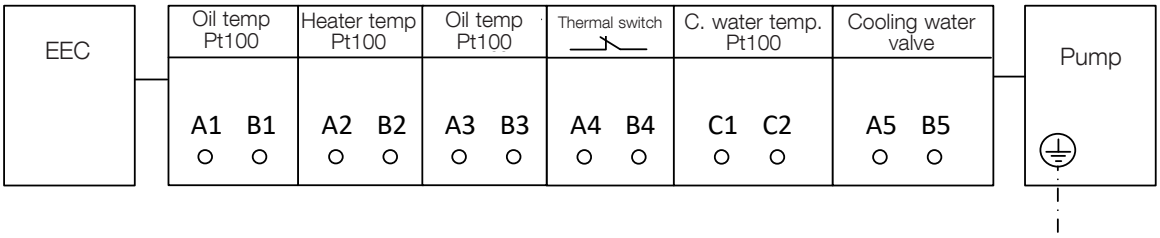
DIJ w/ plug & EEC (connection cable) – 222xxV002, 222xxV003

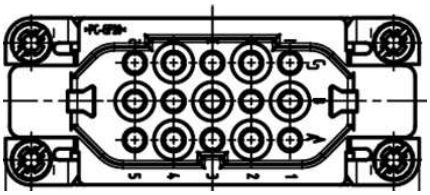
Harting- Typ HAN46 24B





Harting- Typ HAN15D 10A





DIJ w/ plug & EEC (separate EEC)

X3

Oil temp Pt100	Heater temp Pt100	Oil temp Pt100	Thermal switch	C. water temp. Pt100	X1 Mains voltage
1 2	3 4	5 6	7 8	11 12	L1 L2 L3 N PE 1/L1 3/L2 5/L3 N PE
Switch-off temp. <100° C	Warning oil vapour	Oil temp. >220° C	Standby	Cooling water valve	X2 Controller voltage 24V
13 14	15 16	17 18	19 20	9 10	L+ M-

Note: The customer is recommended to integrate Output 7/8 into the system control.

Fig. 8c Versions of electrical connections

Installation

Annotation

Technical Data	DIJ 10 / DIJ 320		DIJ 16 / DIJ 500		DIJ 20 / DIJ 630		DIJ 32 / DIJ 800 DIJ 35 / DIJ 1000	
Mains supply	3 ~ 400 /N/PE / 3 ~ 460 /N/PE							
Mains supply tolerance	±10 %							
Frequency	50/60 Hz							
Rated output power	3.6 kVA		7.2 kVA		10.8 kVA		21.5 kVA	
Rated current	5.2 A	4.4 A	8.7 A	7.4 A	15.6 A	13.6 A	23.3 A	28.5 A
Control voltage	24 VDC				24 VDC			
Wire colors marking								
Main circuit 400 VAC	Black							
Main circuit neutral	Azure RAL 5015							
Control circuit 230 VAC	Red							
Control circuit 230 VAC neutral	Red / White							
Control circuit 24 VDC	Gentian blue RAL 5010							
Control circuit 24 VDC neutral	Gentian blue RAL 5010 / White							
Analog circuits 0...10 V	White							
Analog circuits 4...20 mA	Brown							
Data lines	Violet							
External volt. / potential-free contacts	Orange							
Protective earth	Green / Yellow							
All wires not signed in the: Main circuit Control circuit	 1.5 mm² / AWG 16 1.0 mm² / AWG 18							
Core type to be used:	Standard							

Thermal safety switch

DIJ pumps are generally equipped with a thermal safety switch that is triggered at a temperature of 330 °C. The operator of the plant must ensure that the DIJ pump will be switched off automatically when reaching this treshold.

The DIJ pump must therefore be routed via a power relay of appropriate capacity (not included as standard equipment).

The control circuit for the relay coil is to interface with the switching contact for the thermal safety switch in such a way that the relay will separate the pump from the power supply if unacceptably high temperatures are detected. Use terminals 1 and 2 at the switch for this purpose.

NOTICE

Connect the thermal safety switch in such a way that, after triggering, the pump cannot start again spontaneously once the system has cooled down again.
As an additional system monitoring the DIJ pumps are equipped with Pt 100 thermo sensors, to control the temperatures of oil and cartridges.

Electrical connection of the thermo switch

To set up the protective interlock system connect the switching contact for the thermal safety switch with the appropriate power circuit to control the relay coil.

For fuse box pump variants carry out the following steps: Remove the cover at the electrical junction box. Pass the end of the supply line through the type PG threaded fitting and connect the conductors with the connector contacts at the thermal safety switch (see the schematic for the wiring scheme). Attach the ground conductor in the supply lead to the central grounding point on the backing plate (PE bus). Then connect the supply line with the system control unit in order to ensure that this protective interlock is set up properly.

NOTICE

Missing or wrong connections for the thermal safety switch can cause the pump to overheat or untimely destroy the heating cartridges.

Connect the supply line with the electrical junction box
Pass the end of the supply lead through the type PG threaded fitting.

Attach the ground and neutral conductors at the appropriate PE and N buses inside the fuse box. Connect the neutral conductor only after determining that it can carry a load.

We recommend to provide the pump's connection with a neutral conductor, as with the default delivery a Y wiring is used. If during operation a heater cartridge failure occurs, there will be phase shifting, possibly leading to accelerated failure rates of the other heater cartridges (leakage current).

Then connect the hot conductor(s) (L1, L2 and L3) at the appropriate connection strips for the fuse groups. Tighten down the PG threaded fitting to activate the strain relief feature and then reinstall the cover on the electrical junction box.

Carry out the corresponding electrical safety tests.

3.5.2 Connecting Monitoring Components (optional)

Overheating switch
We recommend installing a special thermostatic safety switch (P/N 12284 for monitoring the coolant temperature). It should be located in the immediate vicinity of the coolant pipe. The contacts are closed at temperatures below 50 °C during normal operations. If the temperature at the sensor rises above 50 °C (in case the coolant circulation should fail, for example), then the contacts will open and shut down the DIJ pump heating by way of a relay (to be provided by owner).

Route one phase of the relay in the power supply through the overheating protection switch.

NOTICE

Connect the pump in such a way that it will not start again spontaneously once a monitoring component (overheating protection switch, coolant flow monitor) has been tripped and the operating parameters have returned from the unacceptable to the normal status.

Use four cap screws, M 3 x 6 to mount the thermal protection switch.

Coolant flow monitor
The optional coolant flow monitor should be installed in the outlet port of the coolant circuit for the series DIJ pump.

If coolant circulation fails the flow monitor can, for example, be used to drive a relay which will switch off the pump heating, activate an alarm system or carry out another suitable switching function. The minimum coolant volumes are given in Section 1.3, "Technical Data".

3.6 Pump Fluid

CAUTION

Hazard of slipping, tripping or falling due to oil leakage from the pump

Depending on the work process, oil may escape from the pump.

Check the pump for any oil that has run out. Take appropriate security measures.

The series DIJ pumps are shipped without pump fluid installed.

We recommend using either LEYBONOL LVO 500, or silicone oil (LEYBONOL LVO 521). These compounds are particularly suitable because of their high thermal and chemical stability.

Silicone oils are distinguished by their very low vapor pressure and great resistance to oxidation and decomposition. We recommend using type LEYBONOL LVO 521 silicone oil.

NOTICE

Mineral oils, synthetic oils and PFPE do not mix.
All the pump's interior surfaces must be carefully cleaned before filling the pump with a different oil compound (e.g. from mineral oil to silicone oil).

Install the pump fluid through the pump fluid filler port; cf. Fig. 12.

The quantities of fluid required will be found in Section 1.3, "Technical Data", but may vary slightly due to the pump's design. Always fill in oil up to the max. mark of the oil level eye.

Use a litre gauge to measure the quantity of pump fluid and fill the pump fluid into the pump. When filling the pump for the first time or when filling it after cleaning, we recommend to fill the pump up to its maximum.

After having filled in the pump fluid, wait a few minutes for the pump fluid to spread and then read off the oil level at the oil level sight glass. In order to correctly determine the oil level, read off the filling level at eye level (cf. the figure in Section 5.2, "Checking the Pump Fluid Level").

During operation always ensure that the oil level is at the max. mark of the level indicator.

Operating the pump for long periods with an oil level too low (at or below the min. mark) will lead to problems with replacing the heater cartridges and may damage the pump.

NOTICE

There is the risk of slipping if due to a leak amounts of oil escaped the pump. Fully remove and properly dispose escaped oil!

DIJ	Oil diffusion pump with cold cap baffle
P1	Rotary vane vacuum pump
P2	Roots vacuum pump
P3	Rotary vane vacuum pump (optional as support pump)
V1	High-vacuum valve
V2	Forevacuum valve
V3	Bypass valve
V4	DIJ forevacuum valve (optional for support vacuum)
Baffle	Vapor baffle
BV	Airing valve
HM	High-vacuum measurement point
VM1	Forevacuum measurement point (DIJ)
VM2	Forevacuum measurement point (vacuum chamber customer)

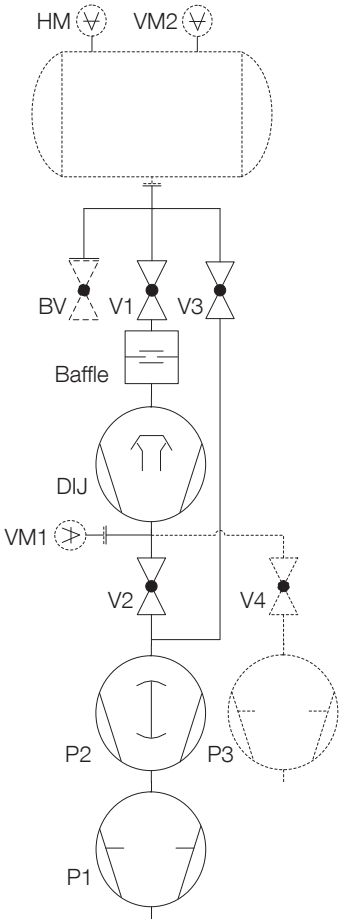


Fig. 9 Schematic for a diffusion-type vacuum pump system

4 Operation

4.1 Media Compatibility

The pump is not suitable for handling oxygen above normal atmospheric concentration.

Kindly contact the manufacturer whenever gases with high hydrogen content are to be pumped (cf. Section 3.1, Conforming Utilization).

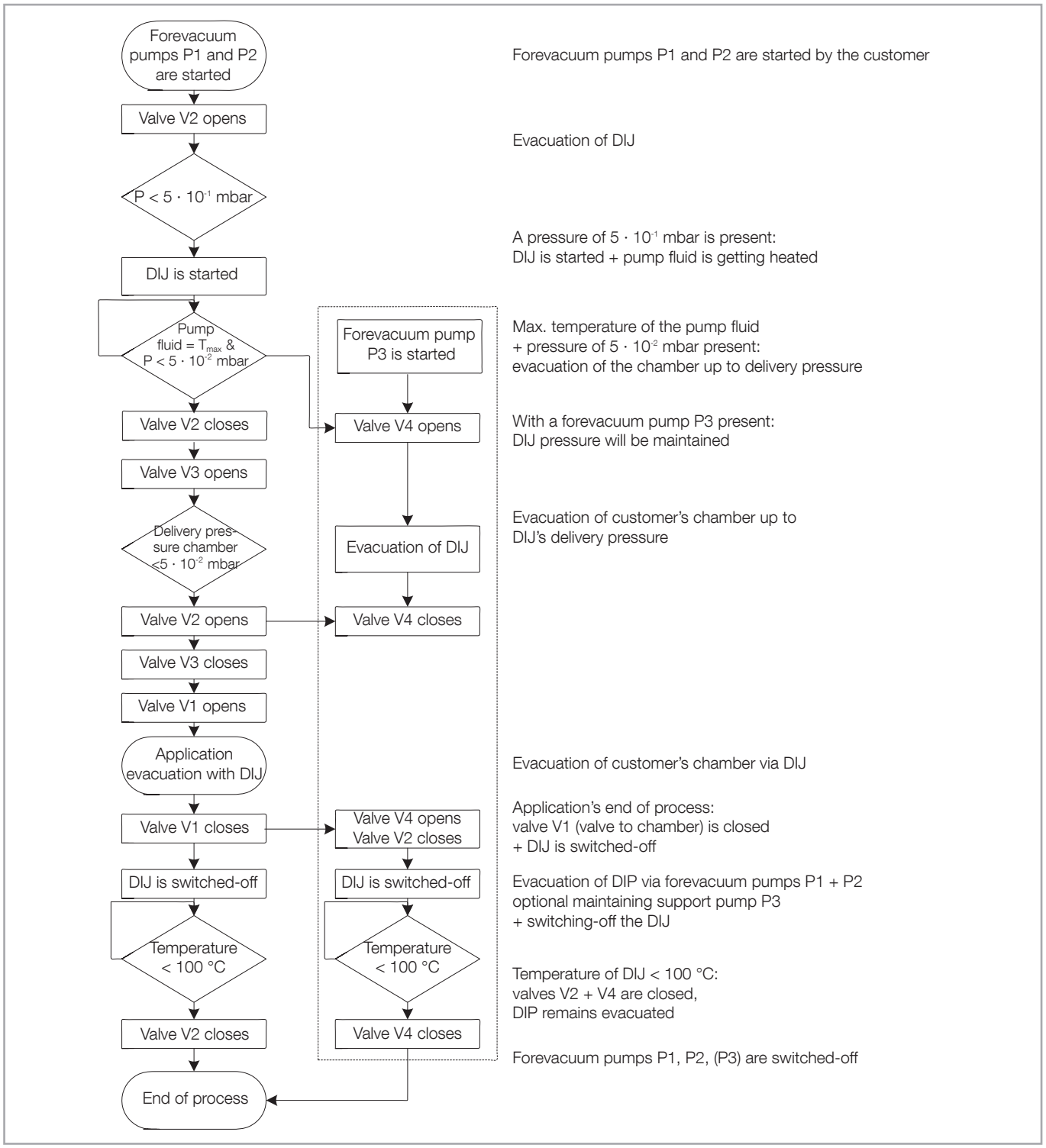


Fig. 9a Schematic for commissioning and operational sequences of a DIJ pump system

4.2 Start-up

DANGER

Danger through expulsion of transported toxic gases/vapours. Fire or explosion in case of transport or ejection of flammable gases/ vapours, oxidizing agents or pyrophoric gases

Transported process gases can escape out of the exhaust pipe and from leaking areas of the vacuum system.

Transport of toxic gases/vapours, flammable gases/vapours, oxidizing agents or pyrophoric gases is generally excluded.

In its standard version, the pump system is not suitable for operation in ex-zones.

The operator is responsible for the assessment of the hazard potential of the process media and/or mixtures. For this purpose, the operator must perform a risk or hazard assessment. The operator must take appropriate measures to ensure that there is no danger to man and the environment.

Do not use any easily flammable materials near the hot pump area.

Hazards through emission of harmful gases/vapours

During the start-up and the new installation of the heater cartridge, smoke and an unpleasant smell may develop. Therefore, turn on new pumps and pumps after successful servicing of the heater cartridges only in well-ventilated areas. Avoid direct contact with the smoke or gases that can develop during start-up.

The pumping speed attained by diffusion pumps is constant between 10^{-3} mbar and $5*10^{-7}$ mbar.

Forevacuum line

We recommend joining the vacuum chamber direct to the backing pump via a valve V3 and a roughing line. A high-vacuum valve V1 and a forevacuum valve V2 are required for proper functioning of the roughing line.

The vacuum chamber is evacuated down to the transfer pressure via the roughing line. The diffusion pump and pump fluid will operate normally when the high-vacuum valve V1 is opened. Close the forevacuum valve V2 and the high-vacuum valve V1 prior to venting the vacuum chamber; the diffusion pump will remain in a state of operational readiness.

High-vacuum valve

The high-vacuum valve must in its closed state provide a reliable seal. If it is leaky then large quantities of gas will be pumped through the DIJ. This will then result in premature ageing of the oil and a significantly increased oil loss.

Ensure to open the valve slowly to reduce flow disturbances within the pump as well as oil losses.

Check the heater cartridges after longer periods of system downtimes (after one year at the latest). This is specially true for pumps in stock.

NOTICE

4.3 Operation

DANGER

Ejection of parts through bursting of the vacuum system due to excessive pressure, caused by malfunction at the gas inlet into the vacuum system

When venting the DIJ pump at > 100 °C danger of explosion!

The pump must be securely locked during operation.

The DIJ pump may be vented only if the pump fluid temperature is < 100 °C.

Any rearward venting must be ruled out. The cooled pump should be vented from the high vacuum side.

Turn off the cooling water supply only once the DIJ pump has cooled down to < 100 °C.

DIJ pump operation with closed high vacuum and fore-vacuum side and simultaneously switched off cooling water supply is a dangerous condition and must be reliably ruled out (e.g. by locking circuit).

CAUTION

Getting dragged into the vacuum system

Do not operate the pump system with opened intake and outlet port.

During installation the system, first connect the system mechanically via the inlets and outlets and only then make the electrical connections.

Ejection of parts through implosion of a part of the pump or the pump system

If the boiler overheats due to too little or no oil or too little cooling water flow, the boiler can implode.

The water cooling system may not be interrupted in the case of a malfunction.

Observe the installation regulations.

CAUTION

Burns from touching hot surfaces

Burning of fingers, hands, arms on hot surfaces up to +140 °C. Hazard of burns with open covers.

Handle the pump only in ventilated and cooled down condition. Wear suitable protective equipment. Take note of the cooling time after switching off.

All the connections and preparations for operation have been made properly.

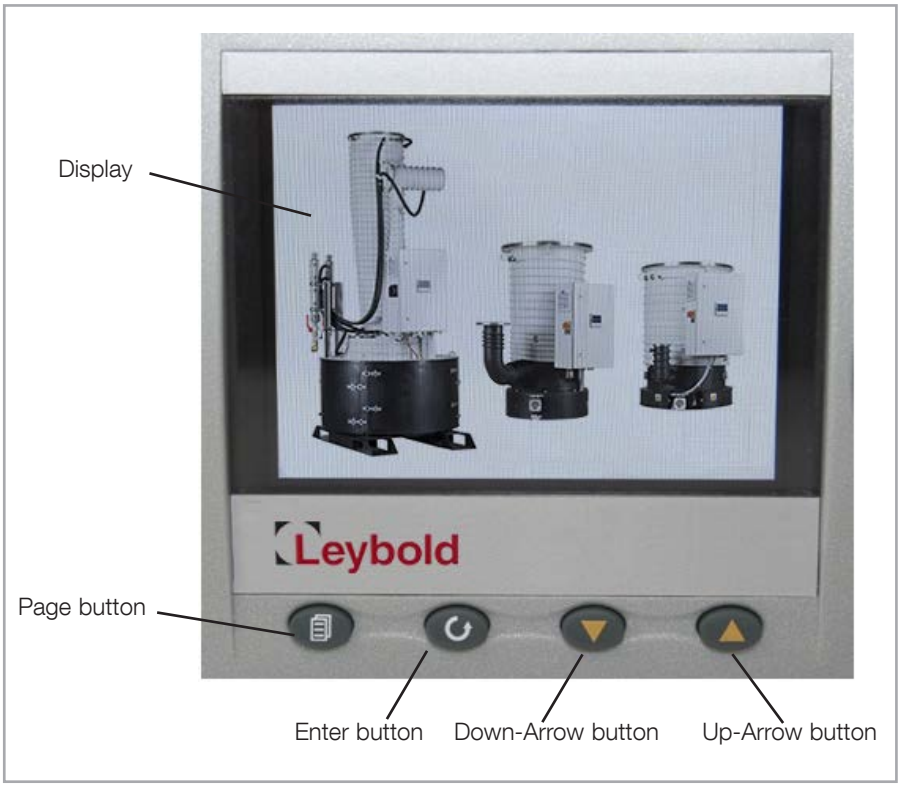


Fig. 10a Screen during boot-up

NOTICE

Operating the pump is permitted only in the installed condition. During operation pumps must not be opened nor vented.
The operator must conduct process-dependent considerations regarding risks with the general starting and stopping, with the operation, and with automatic restarts after power failures of the system.

Switch on the fore vacuum pump and evacuate the DIJ pump down to forevacuum pressure < $5 \cdot 10^{-2}$ mbar; open the coolant supply valve.

4.3.1 DIJ without Energy Efficiency Control (EEC)

Switch on the pump heaters. The DIJ pump will begin functioning after a certain period of time.

4.3.2 DIJ with EEC

Switch on the pump Energy Efficiency Control.

With the main switch in pos. I, the start screen (depicted above) will be displayed for approx. 20 s during the control unit's boot-up.

The following screen will appear (Fig. 10b).

NOTICE

The EEC is equipped with a buffer battery to prevent data losses in case of a power failure. Ensure to replace this battery every 3 years.

Fig. 10b Operational mode's screen

4.3.2a Adjusting the Oil temperature

The oil temp's set-point is preset to 230 °C. Follow the instructions hereinafter, to change this default value. Observe the notes in Section 4.3.2e.

Pressing the Enter button selects the mode to change the set-point. This will be indicated by the background display colour change to yellow. For changing the value press the Enter button again. Use the Up-/Down-Arrow buttons repeatedly, to change the value of the set-point. To set the new value, press the Enter button again.

The pump is now controlled by the control unit and sets the new WSP value for the oil temp. During operation the control unit additionally serves as a monitor for the heater temp, the heater power, and the oil temp.

Fig. 10c Service Monitor

Fig. 10d Bar Diagram

Fig. 10e Graphic Diagram

Fig. 10f Numeric Diagram

4.3.2b Changing the Control Unit's Display

Pressing the Up-Arrow or Down-Arrow buttons repeatedly toggles between the four different diagrams shown below. Independent of the displayed diagram all the relevant process values for oil temp, heater temp, and heater power are shown.

4.3.2c Safety System

NOTICE

If the oil reaches a temperature of 330 °C, an error warning is shown on the display, indicated by a yellow flashing. The heaters then will be turned off by the thermal circuit breaker.

A yellow flashing error warning will also be shown, if the heater reaches a temperature of 400 °C.

Fig. 10g Configuration Menu

4.3.2d Changing the Language Settings

To change the displayed language version you have to log-in to the Configuration menu first.

NOTICE

The USB interface is on the control unit's rear side (inside the switching cabinet).

Changes of parameters and values in configuration mode not described in these Operating Instructions are not recommended and will void the warranty.

1 Press the Page button after the boot-up, to invoke the following screen.

2 Use the Up-Arrow and Down-Arrow buttons to scroll to “Log in”. Then press the Enter button.

3 When “Logged Out” is displayed, press the Down-Arrow button.

4 When “Engineer” is displayed, press the Enter button.

5 On the displayed keyboard use the Arrow buttons, to navigate to “Numeric” for entering the access code.

6 Press the Enter button, to invoke a decimal keyboard.

7 Successively enter the access code digits “1611”: Navigate to “1”, and then press the Enter button. An asterisk replaces the digit in the text box below “Password”.

8 Repeat entering the other digits, and press the Enter button each time. After all numbers have been keyed in, press the Page button.

9 When “Accept” is displayed, use the Arrow buttons to navigate to “Yes”. Press the Enter button, to invoke the configuration menu.

10 Navigate to and select “Instrument”, then press the Enter button.

11 Use the Arrow buttons to navigate to “Save and Restore” and press the Enter button.

12 Press the Enter button again, navigate to and select “Restore”, and press the Enter button once more.

13 On the USB media select the UIC File (with the desired language version) and push the Enter button. The file selected will be loaded (can take a few seconds).

14 A message is displayed that the language version has been updated.

15 Repeatedly press the Page button, to return to the initial screen and to log out.

Logging out correctly via „Logged out“ matters, as otherwise the control unit will not function properly.

NOTICE

After having logged out, the control unit’s display will show the selected language.

4.3.2e Notes

Pump fluid

Oil Name	Part No. (for 1L)	Oil Type	Oil Temp (default setting)	Oil Temp (fine-tuning; quality- and process-dependent)
Leybonol 400	L 400 01	PFPE oil	220 °C	200 °C – 230 °C
Leybonol 410	L 410 01	PFPE oil	220 °C	200 °C – 230 °C
Leybonol 500	L 500 01	Mineral oil	250 °C	240 °C – 270 °C
Leybonol 521	L 521 01	Silicone oil	250 °C	220 °C – 260 °C

NOTICE

When using PFPE as pump fluid ensure to reduce the switch-off temperature to 290 °C.
This can be done by integrating a bimetallic switch.
With EEC or fuse box type DIJ pumps this can be accomplished via the thermal circuit breaker or the EEC setting.

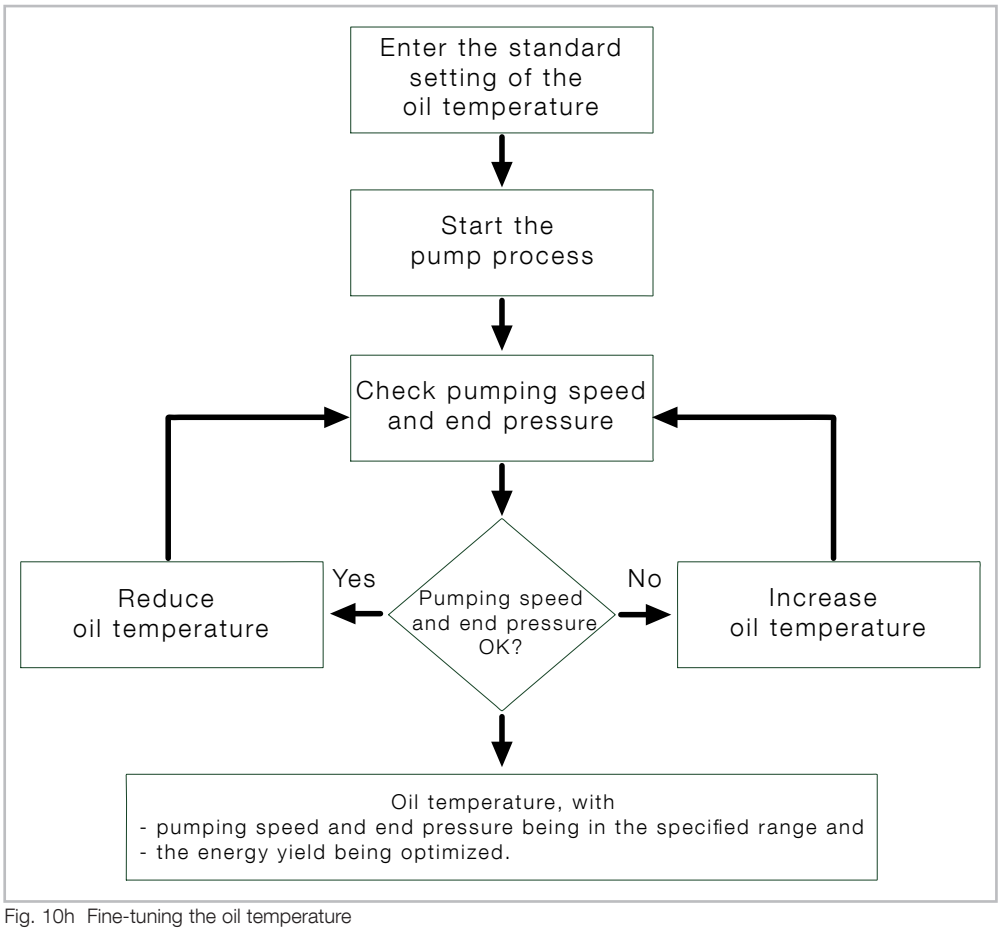


Fig. 10h Fine-tuning the oil temperature

4.3.2f Modbus

The controller supports Modbus and uses TCP port 502 by default. For this, on the EEC‘s rear panel connect the RJ45 socket with a standard ethernet cable.

Modbus Configuration

You can configure the controller so that it can communicate via the Modbus Transmission Control Protocol.

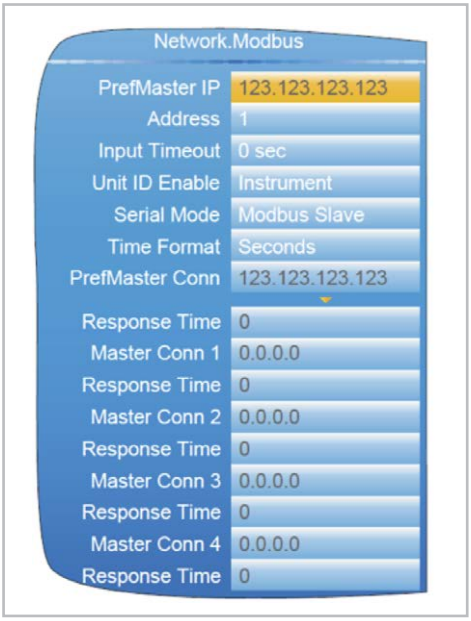


Fig. 10i Modbus TCP Configuration

PrefMaster IP The IP address of the relevant Modbus master. You can establish a connection anytime via the preferred master switch, even if all slave connections (max. 4 for TCP) are engaged.

Address The Modbus address. This address must be unique within the relevant network. The controller responds to this address, and to address 255.

Input Timeout You can enter a value between 0 and 3,600 to set the timeout (in seconds) for the Modbus input channels. If no value is written within the specified period, the value of this channel is set to -9999.0 with a „No Data“ status. Entering „0“ turns off the timeout function when there is no communication / transmission.

Unit ID Enable Activates/deactivates the Modbus TCP Unit Identity Field.

Strict The Modbus TCP Unit Identity Field (UIF) does not have to match the device‘s address. The device only responds to hex value „FF“ entered in the UIF. iTools will be looking for this device only at position 255 and then terminates the search.

Loose The Modbus TCP Unit Identity Field does not have to match the device‘s address. The device will respond to all values entered in the UIF.

Device The Modbus TCP Unit Identity Field must match the device‘s address; otherwise there will be no answers to messages / requests.

Serial Mode Slave communication via the lateral attached CPI (Configuration Port Interface).

Time Format Selects the time format, ranging from milliseconds and seconds to minutes or hours. Sets the r/w-resolution for time format parameters.

PrefMaster Conn Shows the IP address of the preferred master when connected.

Response Time Shows the response time for a single communication request addressed to the relevant master.

Master Conn 1-4 Shows the IP addresses of other masters connected to the Nanodac.

Modbus Addresses

You can configure the controller so that it can communicate via the Modbus Transmission Control Protocol.

Function	Channel name	Value	Address (decimal)	Data type
Oil temperature	Channel 1 Main PV	actual value (°C)	256	float32
Oil temperature	Loop 1 SP SP1	setpoint (0 – 400 °C)	5724	float32
Heater temperature	Channel 2 Main PV	actual value (°C)	260	float32
Heater power	Loop 1 OP Ch1 Out	actual value (%)	523	float32
Oil temp <100 °C	Channel 1 Alarm 1 Status	alarm status	258	uInt8
Oil temp >200 °C	Channel 1 Alarm 2 Status	alarm status	259	uInt8
Heater temperature	Channel 2 Alarm 2 Status	alarm status	263	uInt8

4.3.2g Web Server

- PC, tablet, and client support for mobiles (using the corresponding browsers)
- supporting Safari, IE9 or higher, and Google Chrome
- the web server is for visualization only

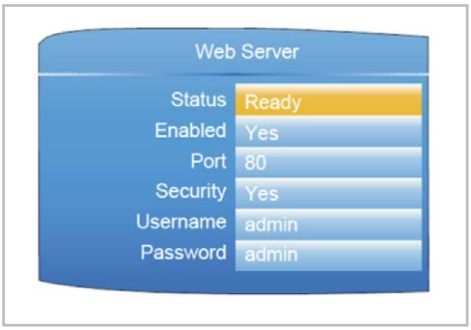


Fig. 10j Web Server Configuration

Status Ready: the Web Server is running.
Inactive: the Web Server is not running.
Connected: a client is connected to the Web Server.
During operation the status may toggle between Ready and Connected.

Enabled Yes/No

Port 80 or 8080

Security Yes/No. Default = „Yes“.

Username Enter your own username. This username is required for logging onto the Web Server. Default = „admin“. The username will only be displayed when „Security“ is set to „Yes“.

Password Enter your own password. This password is required for logging onto the Web Server. Default = „admin“. The username will only be displayed when „Security“ is set to „Yes“.

Operation (continuation)

If a high-vacuum valve has been installed between the diffusion pump and the vacuum chamber, then this should be opened when the DIJ pump is hot only if the pressure in the vacuum chamber is below $5 \cdot 10^{-2}$ mbar.

When inlet and forevacuum temperatures are above the maximum permissible levels it is possible for pump fluid to pass into other parts of the vacuum system.
We strongly recommend to monitor the pressures of the HV and FV areas.

Unrestricted coolant flow and satisfactory temperature and the quantity and temperature of the pump fluid have to be monitored while the DIJ pump is in operation.

Where there is an unacceptable rise in temperature caused, for instance, by failure of the coolant circuit, the built-in thermo switch will switch off the heating cartridges at the DIJ pump; cf. Section 3.5.1. If you have optionally installed a thermal safety switch for monitoring the coolant temp and/or a coolant flow monitor unit these will also switch off.

Air inrush

DANGER

Loss of power supply

The pump fluid is no longer heated in case of failure of the power supply. There is no risk from the DIJ. The pump fluid cools down. The risk of the entire system cannot be assessed. In the worst case, the system will be vented rearward and can explode.

The valves must be closed in the event of a power failure.

Air infiltration in an operation-ready, warm diffusion pump are a dangerous condition and must be reliably ruled out.

If electro-pneumatically propelled high- and fore-vacuum valves are used, these must be used shut in the specification “de-energised” and “unpressurised”. Also for these valves, the ventilation of a ready-to-operate, hot diffusion pump must be ruled out through appropriate latch circuits.

The components must be connected correctly and properly. Electrical safety examinations, in particular the insulation and protective grounding conductor examination, must be carried out.

We recommend to interlock the high-vacuum valve V1 and the forevacuum valve V2 in a way that prevents venting the hot diffusion pump ready for operation.

Regular checks

In order to ensure trouble-free operation of the DIJ pump we recommend in the case of normal operation the following regular checks:

Check	Interval	Action	Section
Filling level of the pump fluid	1 week	If required top up oil, be sure to use the same grade of oil	5.2, 5.3
Condition of the pump fluid	1 month	If required change the oil	5.4
Cleaning of the nozzle assembly	1 year	Use suitable solvents, for example, soap-impregnated stainless-steel wool, petroleum ether or acetone; final cleaining with alcohol.	5.5
Cleaning the heat conducting plates of the heater cartridges	1 year	Use a commercial high-pressure cleaner, 4 bar overpressure max.	5.5
Cooling water flow	1 year	If required clean the cooling coils	5.5.5

4.4 Switching Off/Shutting Down

DANGER

Ejection of parts through bursting of the vacuum system due to excessive pressure, caused by malfunction at the gas inlet into the vacuum system

When venting the DIJ pump at > 100 °C danger of explosion!

The pump must be securely locked during operation.

The DIJ pump may be vented only if the pump fluid temperature is < 100 °C.

Any rearward venting must be ruled out. The cooled pump should be vented from the high vacuum side.

Turn off the cooling water supply only once the DIJ pump has cooled down to < 100 °C.

DIJ pump operation with closed high vacuum and fore-vacuum side and simultaneously switched off cooling water supply is a dangerous condition and must be reliably ruled out (e.g. by locking circuit).

CAUTION

Scalding by touching hot equipment or lubricants

Risk of scalding when opening the hot pump through pump fluid steam

Only open fluid drain port or inlet port if the pump is vented and is cooled down to room temperature.

Let cooling water pipes cool down before removing and then shut off the feed line.

Wear suitable protective equipment.

Close the high-vacuum valve V1.

Switch off the pump heating and wait until the DIJ pump has cooled down sufficiently (<100 °C).

Close the forevacuum valve V2.

Shut off the coolant supply.

Switch off and vent the forevacuum pump.

For systems without EEC additionally carry out a temperature measurement. Contact Leybold for an optional dial-type thermometer.

Detaching the pump from the system

DANGER

Danger as a result of contact with toxic decay/reaction products of lubricants, equipment or pumped substances during the maintenance of the pump

In the event of servicing, there may be deposits in the pump.

The pumping of toxic gases and vapours is basically excluded.

The operator is responsible for the assessment of the hazard potential of the process media and/or mixtures. For this purpose, the operator must perform a risk or hazard assessment. The operator must take appropriate measures to ensure that there is no danger to man and the environment.

For this purpose, we recommend that the pump is flushed for a longer time with inert gas before opening. Wear appropriate protective clothing (gloves, goggles, respiratory protection, personal protective equipment).

Avoid body contact with plant oil, process residues and contaminated surfaces. Perform maintenance in preferably clean, dry and well-ventilated rooms.

Switch off and vent the DIJ pump in a planned fashion and as described in Section 4.4.

Isolate the DIJ pump from the power supply and detach at the electrical connection terminals.

Disconnect the coolant system and use compressed air to blow out the piping network.

Separate the pump's forevacuum and high-vacuum flanges from the system and remove the DIJ pump.

For lifting the DIJ pump use all lifting eyes.

Open the pump fluid outlet ports (12/5) and drain the pump fluid (oil or PFPE) into a suitable container.

NOTICE

Dispose of the pump fluid properly (may possibly have to be handled as toxic waste).

Separate the pump's forevacuum and high-vacuum flanges from the system and remove the DIJ pump.

Pack the pump so that it cannot be damaged during shipment.

Protect the flanges and the coolant connections in particular.

Please observe the precautions set forth in Section 5.1 if you send a pump to Leybold.

An electrical safety test IAW DIN EN 60204 must be carried out, if the pump or electrical parts were replaced. The compliance with the corresponding technical documents (PE conductor continuity, functional tests) must be checked.

Maintaining in stock

Maintain the pump in stock so that it is dry and not exposed to frost. The cooling coils need to be blown out and must be dry. **Beforehand** blow out the cooling lines with compressed air.

Keep the pump in stock standing upright. When storing the pump for longer periods or in environments with high humidity conditions foil the pump and use bags with desiccant, to protect it against corrosion and ageing of the heater cartridges!

Pumps having a filling of PFPE should be sealed off in a gas-tight manner and vented with nitrogen.

5 Maintenance

DANGER

Danger as a result of contact with toxic decay/reaction products of lubricants, equipment or pumped substances during the maintenance of the pump

In the event of servicing, there may be deposits in the pump.

The pumping of toxic gases and vapours is basically excluded.

The operator is responsible for the assessment of the hazard potential of the process media and/or mixtures. For this purpose, the operator must perform a risk or hazard assessment. The operator must take appropriate measures to ensure that there is no danger to man and the environment.

For this purpose, we recommend that the pump is flushed for a longer time with inert gas before opening. Wear appropriate protective clothing (gloves, goggles, respiratory protection, personal protective equipment).

Avoid body contact with plant oil, process residues and contaminated surfaces. Perform maintenance in preferably clean, dry and well-ventilated rooms.

Vacuum pumps which are operated with the lubricant Perfluorinated Polyether (PFPE) may in the case of thermal decomposition release toxic and corrosive gases.

Wear appropriate protective clothing (gloves, goggles, respiratory protection, personal protective equipment).

Avoid body contact with plant oil, process residues and contaminated surfaces. Perform maintenance in preferably clean, dry and well-ventilated rooms.

Do not smoke with PFPE on your fingers.

DANGER

Electric shock through direct or indirect contact of live parts

There are hazardous voltages present on the mains cables (danger to life).

Before carrying out maintenance or service work on the product, take it off the mains supply. After mains power off, wait for 5 minutes!

Maintenance

5.1 Leybold Service

Contamination

Whenever you send us in equipment, indicate whether the equipment is contaminated or is free of substances which could pose a health hazard. If it is contaminated, specify exactly which substances are involved. You must use the form we have prepared for this purpose.

Form

This form is available from
www.leybold.com/ -> Downloads -> Download Documents.

Attach the form to the equipment or enclose it with the equipment.

This statement detailing the type of contamination is required to satisfy legal requirements and for the protection of our employees.

We must return to the sender any equipment which is not accompanied by a contamination statement.

5.2 Checking the Pump Fluid Level

The fluid fill level can be read at the sight glass on the DIJ pump. There are markings for the minimum and maximum levels at the sight glass. When the DIJ pump is running the fill level should be at the max. mark of the sight glass (slightly oscillating). Operating the pump for longer periods with lower oil levels (at or below the min. mark) will lead to overheating resulting in premature failures of and problems with replacing heater cartridges.

Cold and vented pump

The oil fill level can be checked exactly only when the pump is cold and vented. In order to correctly determine the oil level, read off the filling level at eye level.

The fill level will fluctuate hardly at all during normal operation. As the O-ring groove gases out with the first commissioning there will be bubbles visible in the sight glass. This process can take several hours. There may be differences, depending on the oil used. If the DIJ pump has to be aired frequently or is operated with a vacuum chamber that is vented regularly (batch operation), then we recommend keeping the fluid level at the maximum level.

Loss of pump fluid

If the heated pump fluid falls rapidly and below the expected fill level (cf. sight glass), the oil return line is blocked and the pump must be cleaned. If during operation the pump loses oil too fast, check the valve velocity of the high-vacuum valve. A gas throughput being too high or gas inrushes may be possible other causes (leakages).

5.3 Topping up Pump Fluid

The level of the pump fluid must not be allowed to drop below the minimum mark. Top up as required.

DANGER

Ejection of parts through bursting of the vacuum system due to excessive pressure, caused by malfunction at the gas inlet into the vacuum system

When venting the DIJ pump at > 100 °C danger of explosion!

The pump must be securely locked during operation.

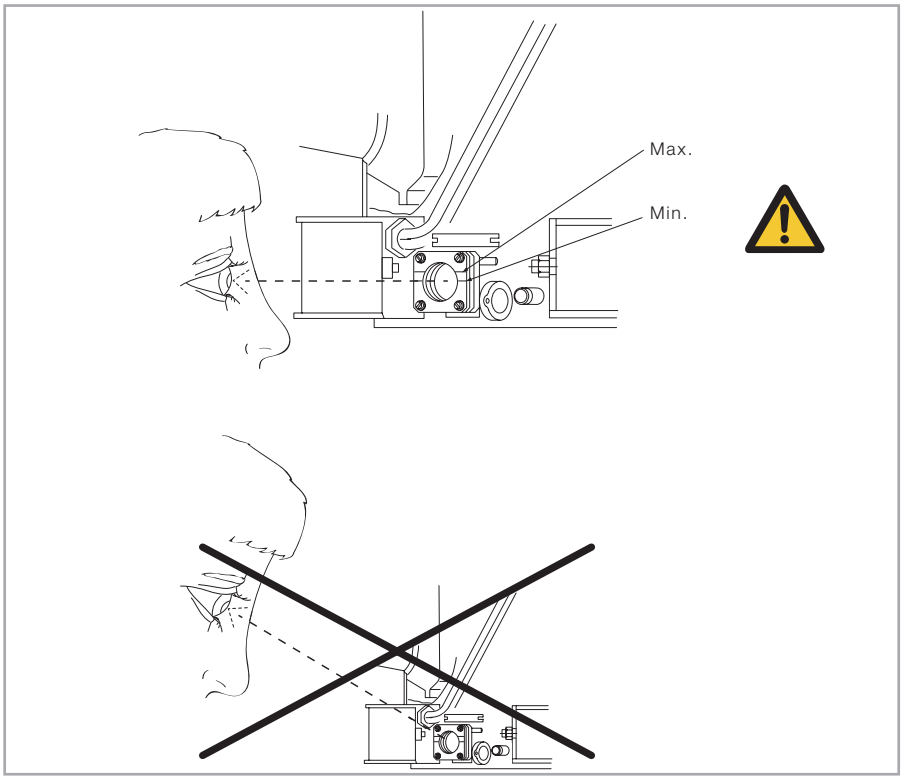


Fig. 11 Checking the level of the pump fluid

The DIJ pump may be vented only if the pump fluid temperature is < 100 °C.

Any rearward venting must be ruled out. The cooled pump should be vented from the high vacuum side.

Turn off the cooling water supply only once the DIJ pump has cooled down to < 100 °C.

DIJ pump operation with closed high vacuum and fore-vacuum side and simultaneously switched off cooling water supply is a dangerous condition and must be reliably ruled out (e.g. by locking circuit).

Scalding by touching hot equipment or lubricants

CAUTION

Risk of scalding when opening the hot pump through pump fluid steam

Only open fluid drain port or inlet port if the pump is vented and is cooled down to room temperature.

Let cooling water pipes cool down before removing and then shut off the feed line.

Wear suitable protective equipment.

Maintenance

1 Pump fluid inlet port
2 Oil fill level sight glass
3 “Maximum” mark
4 “Minimum” mark
5 Pump fluid outlet port

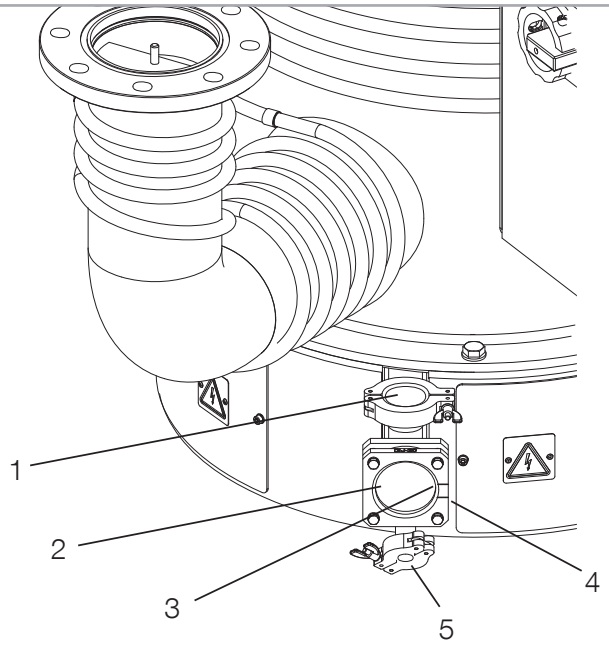


Fig. 12 Oil level sight glass with pump fluid inlet and outlet ports

CAUTION

Hazard of slipping, tripping or falling due to oil leakage from the pump

Depending on the work process, oil may escape from the pump.

Check the pump for any oil that has run out. Take appropriate security measures.

- Switch the pump off, wait for it to cool down and vent it (cf. Section 4.4).
- Read off the filling level at eye level. Be sure to use the same grade of pump fluid.
- Open the inlet port (12/1) and fill in the pump fluid ensuring that the maximum mark is not exceeded.
- We recommend that you replace the gasket at the inlet port (15/43).
- Close the inlet port.

5.4 Exchanging the Pump Fluid

Unused pump fluid (mineral oil and silicone oil) is as translucent and clear as water. When it changes its colour to “honey yellow” it will have to be exchanged.

When using PFPE as intended, PFPE is not subject to ageing. It must only be changed if it is contaminated by the process gas. It can only be determined for each individual case when the PFPE is so contaminated that it must be changed.

NOTICE

Prior to using PFPE (Leybonol LVO 400 or LVO 410) consult with Leybold.

- Switch the pump off, wait for it to cool down and vent.
- Open the drain port and drain the pump fluid into a suitable vessel. Leave the drain port open for at least 30 minutes so that as much pump fluid as possible can drain out.
- With exchanging the pump fluid it is mandatory to replace the two gaskets at the filling port and the drain port (cf. Fig. 15)!
- Close the drain port.
- Open the inlet port and fill in the pump fluid.
- The quantities of fluid required will be found in Section 1.3, “Technical Data”.
- Use a litre gauge to measure the quantity of pump fluid and fill the pump fluid into the pump. When filling the pump for the first time or when filling it after cleaning, we recommend always to fill the pump up to its maximum.
- After having filled in the pump fluid, wait a few minutes for the pump fluid to spread and then read off the oil level at the oil level sight glass. In order to correctly determine the oil level, read off the filling level at eye level (cf. Fig. 11).
- Close the inlet port.
- There exists the risk of slipping when spilling oil during topping-up. Clean-up the affected areas and properly dispose the oil!

For disposing of waste oil refer to Section 8.

5.5 Cleaning the Pump

The inner surfaces of the pump should be cleaned at least once a year. Moreover, they must be cleaned when filling in a different grade of pump fluid.

The pump will have to be dismantled to do so.

5.5.1 Dismantle Pump

Disconnect the power supply and coolant circuit (see Section 4.4, “Switching off”).
Open the pump fluid outlet port and allow the pump fluid to drain.
Separate the pump’s forevacuum and high-vacuum flanges from the system.

Remove the cold cap baffle.

Unscrew the nut and remove the washer. Unscrew the mounting bolt.

Carefully lift the cold cap baffle and pull it out of the pump housing.

Loosen the connection ports with by tapping lightly with a rubber hammer or wooden mallet if necessary.

When removing the baffle carefully remove the two insulating washers and the spacer.

Unscrew the cap, loosen the nut of the main axis, and lift out the nozzle assembly.

DIJ 10 – DIJ 20: Grasp the nozzle assembly at the first stage and lift it out of the pump housing.

DIJ 35: By means of the crane eyes lift the nozzle assembly out of the housing.

5.5.2 Cleaning the Pump

The nozzle assembly and the inner parts of the pump may be cleaned with a commercial steam cleaner.

NOTICE

The pressure of the steam cleaner may

- only **amount to 4 bar** when cleaning the heat conducting panels of the heater inserts (risk of breaking the copper lamellae).
- only **amount to 10 bar** for the remainder of the pump.

Stubborn dirt (burnt-in residues of the pump fluid) may be removed with a suitable solvent or with fine grain detergents or fine emery paper.

Place the pump at a slight angle (ensure that it can not topple over) so that the cleaning fluid can run out. At the end of the cleaning process clean all inner surfaces with a commercial hot air fan.

5.5.3 Oil Level Sight Glass

Remove the screws at the flange mount to clean the oil level sight glass in the assembly.

We recommend replacing the two O-rings in front of and behind the sight glass during assembly.

Pay attention to correct positioning of the marking at the sight glass cover. The marking line indicating the upper level for the pump fluid must be located above the middle of the oil level sight glass. The marking lines are always placed on the oil glass frame‘s right side. Additionally, the frame is marked with a number that has to be readable above the oil glass.

NOTICE

Oil glass frames of different pumps must not be swapped, as pumps may be configured for individual filling levels.
If arrows are present on the cover frame, these must point downwards.

5.5.4 Assembling the Pump

When assembling the pump ensure that the individual components are again mounted in the correct order (see Fig. 15).

NOTICE

The nozzle assembly may not be dismantled. Please contact our service, if you notice defects at the nozzle assembly. Deformations at the nozzle assembly are an indicator for serious air ingress during pump operation.

Install the nozzle assembly centered in the pump housing. Check to ensure that it is seated in the center of the high-vacuum flange. Ensure that the nozzle assembly locks into the centering position! This centering position is located exactly along the axis of the forevaccum port.

Mount the cold cap baffle, paying particular attention to correct seating of the gasket rings for the coolant liquid port.

Pay attention to correct positioning of the two insulating washers and the spacer between the cold cap baffle and the nozzle assembly.

Close the pump fluid outlet port and reinstall the DIJ pump in the system, being sure that it is vacuum-tight.

NOTICE

Pay attention to correct positioning, properties and cleanliness for all gaskets. Only use new heat resistant gaskets (FKM, Silicone).

Install new pump fluid at the pump fluid filling port. See Section 1.3, “Technical Data”, for specifications on the amount of pump fluid required.

5.5.5 Cleaning the Cooling Coils

Clean the cooling coils with a commercial decalcifier based on formic acid or ethanoic acid.

NOTICE

Do not use any chlorine based decalcifier since this will damage the cooling coils due to crevice corrosion.

5.6 Replacing the Heating Cartridges

CAUTION

High electrical fault currents due to moisture absorption by mineral insulating material of the heating elements

The hygroscopic insulation of the heating element could lead to a burn-out of the heater cartridge. Risk occurs through longer shut-off cycles and humid ambient conditions.

Take note of the installation instructions for the replacement and connection of the heater cartridge.

Check stock before changing/inserting (measured value: 49 to 55 ohms) and degas if necessary.

In case of standstill, check heater cartridge after one year.

The heating cartridges contain magnesium oxide (MgO) and thus attract humidity. For this reason keep the replacement heater cartridges in dry rooms only or in plastic bags which are sealed air-tight. If the heater cartridges have attracted humidity, they may be dried in a drying oven for 8 hours at 180 °C.

NOTICE

Only install heater cartridges which are dry.
Annually check the heater cartridges (metered resistance: 49 – 55 ohm). Depending on the load we recommend to de-install the heater cartridges and apply never-seize spray on an annual basis. This prevention measure facilitates exchanging cartridges in the event of replacement.

Switch off the DIJ pump in preparation for replacing the heating cartridge. Prevent reconnection (lockout / tagout). Drain out the oil. Remove the sheet metal cladding at the base of the pump by loosening the screws. Disconnect the leads for the defective heating cartridge, remove the fixing flange by loosening the screws (4*M6*16) of the cartridge, and pull out the heating cartridge.

Check the sealing surfaces for damage and dirt or contaminations and replace the gasket. erneuern. Before inserting the heater cartridge with its new gasket use high temperature graphite grease (PN 6471174). Align the gasket with the flange, insert the cartridge, and tighten the fixing flange (12 Nm).

Finally provide the electrical connections.

Fill in the pump fluid according to the quantity given in Table 1.3!

Before re-commissioning the pump carry out an electrical safety check!

DANGER

Hazards through emission of harmful gases/vapours

During the start-up and the new installation of the heater cartridge, smoke and an unpleasant smell may develop. Therefore, turn on new pumps and pumps after successful servicing of the heater cartridges only in well-ventilated areas. Avoid direct contact with the smoke or gases that can develop during start-up.

6 Troubleshooting

The ultimate total pressure specified in Section 1.3, “Technical Data”, will be attained under the following conditions:

- The chamber must be leak-tight and bake-out procedures should be possible, if this is at all feasible. The interior surfaces must be clean.
- The gases liberated by the sealing elements used in the unit are to be kept to a minimum, which means that FPM gaskets are to be used instead of NBR or silicone sealing rings. If very low working pressures are required, then metal seals will preferably be installed.
- If the ultimate pressure is obviously not attained although the conditions given here are all satisfied, then the following defects may be present:

Malfunction	Possible cause	Remedy	Responsibility
Insufficient pump fluid	Heating units switch off and on at insufficient pump fluid level.	Top up with pump fluid.	Operator/ Maint. personnel
Pump fluid contaminated	Pump fluid has decomposed as a result of frequent air ingress or there are contaminants originating from the apparatus.	Clean the DIJ pump; replace the pump fluid.	Maint. personnel
Pump fluid crystallises (siliconr oil)	Cleaning agents unsuitable!	Do **not** use acetone, benzole or acetic acid as cleaning agents! If there‘s no other option, wash with alcohol and clean pump afterwards.	Maint. personnel
	Process- or product waste (PVC plasticisers) or high oxygen environment	Clean the DIJ pump; replace the pump fluid.	
Pump fluid „vanishes“ after heating up	Return line blocked	Clean the return line	Maint. personnel
Insufficient heater output	Line voltage too low; heating cartridge defective.	Replace the defective heating cartridge.	Maint. personnel/ Leybold Service
Insufficient cooling; pump runs too hot	Coolant circuits connected incorrectly	Connect the coolant circuits as described in Section 3.4.	Maint. personnel
	Insufficient coolant pressure	Raise the coolant pressure to a maximum of 6 bar	Operator/ Maint. personnel
	Clogged lines, scale deposits	Clean the lines, run water through the system in the reverse direction.	Maint. personnel
		Do not use any de-scaling products containing chlorine compounds; use commercially available products based on formic or acetic acid.	
Pump achieves neither full pumping speed nor satisfactory ultimate pressure.	Nozzle assembly assembly improperly mounted.	Remove and clean the nozzle assembly and then carefully reinstall (see Section 5.5). Ensure that the nozzle assembly is centered in the DIJ pump. Check ejector aligning w/ forevacuum port.	Maint. personnel/ Leybold Service
	Insufficient forevacuum.	Examine the forevacuum line for potential leaks and seal where needed. The required forevacuum pressure upline from the diffusion pump must be ensured.	Maint. personnel
	Oil level too high.	Oil level should be between min/max markings.	Maint. personnel
	Device leaking or soiled.	Use a leak tester to examine the apparatus; clean thoroughly, dry and bake out if indicated.	Maint. personnel
	Oil contaminated or aged.	Change the oil.	Maint. personnel
	Pump is not suspended vertically / standing flat and level.	Connect the pump correctly.	Maint. personnel
	Oil temperature too low.	At EEC adjust / increase temperature.	cf. Section 4.3.2e
High pump fluid loss	Gas throughput too high.	Check the process.	Operator/ Maint. personnel
	High-vacuum valve leaky.	Clean or repair the valve.	Maint. personnel

Wearing Parts

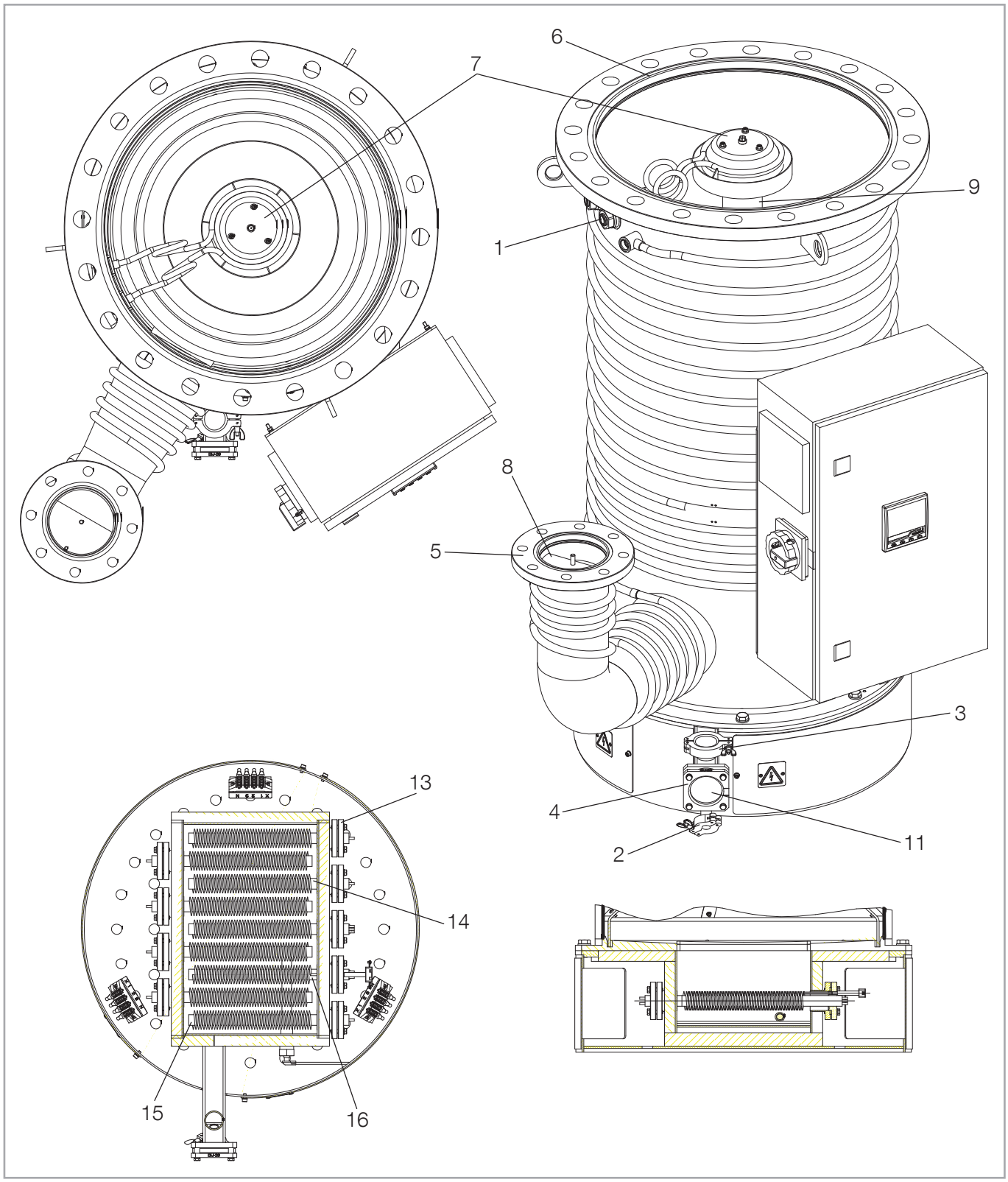


Fig. 15 Overall view of the DIJ 20; other models are similar

7 Wearing Parts and Original Spare Parts

Item in Fig. 15	DIJ 10	DIJ 320	DIJ 16	DIJ 500	Opt. extras	Designation, Dimension, Material	Part No.	Comments
1	2	2	2	2		O-ring 25 x 2.5; NBR	ES23950105	Pump body doolant port, cold cap baffle
2	1	1	1	1		O-ring 18 x 5; FPM	ES210605	DN16 KF fluid outlet port
3	1	1	1	1		O-ring 42 x 5; FPM	ES210625	DN40 KF fluid inlet port
4	2	2	2	2		O-ring 65 x 5; FPM	ES23970129	Fill level sight glass
5		1				O-ring 75 x 5; FPM	ES210635	DN 63 ISO-K, 5 pcs.
6		1				O-ring 315 x 5; FPM	ES210660	DN 320 ISO-K, 5 pcs.
5				1		O-ring 100 x 5; FPM	ES210645	DN 100 ISO-K
6				1		O-ring 506 x 7; FPM	E210675	DN 500 ISO-K
5		1				O-ring 150 x 5; FPM	ES210650	DN 160 ISO-K
6		1				O-ring 640 x 8; FPM	E210741	DN 630 ISO-F
5				1		O-ring 195 x 5; FPM	ES210655	DN 200 ISO-K, 5 pcs.
6				1		O-ring 1023 x 8; FPM	E210751	DN 1000 ISO-F
5	1					O-ring 75 x 5; FPM	E6531917	2" ASA
6	1					O-ring 315 x 5; FPM	E400000104	10" ASA
5			1			O-ring 135 x 5; FPM	ES23950214	3“ ASA
6			1			O-ring 475 x 8; NBR	E6530298	16" ASA
6					Z	Vac. sealing disk, complete DIJ320	26846	DN 320 ISO-K
6					Z	Vac. sealing disk, complete DIJ500	26848	DN 500 ISO-K
2,3,4					Z	Silicone O-ring pack	EK6526563	Silicone O-rings / sight glass kit
7						Cold cap baffle 10 / 320	E6529962	
7						Cold cap baffle 16 / 500	E6530632	
7					Z	Extended cold cap baffle 16 / 500	6531108	Baffle for oil backflow reduction
7					Z	Integrated baffle 16 / 500	6531109	large baffle for oil backflow reduction
7	1	1				Insulating washers, set PTFE	E20005471	Thermal insulation,cold cap baffle 10/320
7			1	1		Insulating washers, set PTFE	E20005425	Thermal insulation,cold cap baffle 16/500 20/630
8	1	1				Forevacuum baffle 10 / 320	E6521085	
8			1	1		Forevacuum baffle 16 / 500	E6521088	
9	1	1				Nozzle assembly, complete 10 / 320	E6521084	
9			1	1		Nozzle assembly, complete 16 / 500	E6521087	
11					Z	Fill level sight glass, mounting set	20005470	incl. spacer sleeves; O-rings and looking glass
12	1	1	1	1		Overtemperature switching device 330 °C	ES6519795	Bimetallic switch

Wearing Parts

Item in Fig. 15	DIJ 10	DIJ 320	DIJ 16	DIJ 500	Opt. extras	Designation, Dimension, Material	Part No.	Comments
					Z	Double Pt100 for DIJ with 3m cable	E6433374	Oil temperature sensor
					Z	Pt100 with 5 m cable	E6433373	Oil temperature sensor
					Z	Overtemperature switching device	12284	Cooling water monitoring >50 °C
					Z	Flow control sensor with display	500006623	Water flow-monitor Set 1-40 l/min (w/ display)
					Z	Flow control sensor	6507100	Flowmetering
13	3	3	6	6		Gasket 50x36x3 Klingersil® C - 4509	ES6523372	
14	1	1	4	4		Heating cartridge w/ fins ø32x300	EK6523371	230V / 1200W
15	1	1	1	1		Heating cartridge w/ fins ø32x300 & Pt 100	EK6523373	230V / 1200W
16	1	1	1	1		Heating cartridge ø32x300 & bimetallic connection	EK6523358	230V / 1200W
14	1	1	4	4		Heating cartridge ø32x300	EK6523359	270V / 1200W
15	1	1	1	1		Heating cartridge ø32x300 & Pt 100	EK6523390	270V / 1200W
16	1	1	1	1		Heating cartridge ø32x300 & bimetallic connection	EK6523391	270V / 1200W
					Z	Graphite grease	ES6471174	
	1	1	1	1		Elec. junction box, cplt. 10/320 / 16/500	E6531021	
					Z	EEC (plug & EEC w/ 10m cable)	503646V001	
						Filter fan 230V/50-60Hz/55/66m³/h	E6515261	
						Filter fan 115V/50-60Hz/55/66m³/h	E6519134	
	1	1	2	2		Terminal 4-pin	EK57020313	Terminal block w/ insulation

Item in Fig. 15	DIJ 20	DIJ 630	DIJ 32	DIJ 800	Opt. extras	Designation, Dimension, Material	Part No.	Comments
1	2	2	2	2		O-ring 25 x 2.5; NBR	ES23950105	Pump body doolant port, cold cap baffle
2	1	1	1	1		O-ring 18 x 5; FPM	ES210605	DN16 KF fluid outlet port
3	1	1	1	1		O-ring 42 x 5; FPM	ES210625	DN40 KF fluid inlet port
4	2	2	2	2		O-ring 65 x 5; FPM	ES23970129	Fill level sight glass
5		1				O-ring 150 x 5; FPM	ES210650	DN 160 ISO-K
6		1				O-ring 640 x 8; FPM	E210741	DN 630 ISO-F
5				1		O-ring 195 x 5; FPM	ES210655	DN 200 ISO-K
6				1		O-ring 820 x 8; FPM	E210746	DN 800 ISO-F
5	1					O-ring 135 x 5; FPM	ES23950214	4" ASA
6	1					O-ring 560 x 8; FPM	E6525202	20" ASA
5			1			O-ring 200 x 5; FPM	ES6527631	6" ASA
6			1			O-ring 820 x 8; FPM	E210746	32" ASA
6					(1)	Vac. sealing disk, complete DIJ630	17116	DN 630 ISO-F
6					(1)	Vac. sealing disk, complete DIJ1000	17118	DN 1000 ISO-F
2,3,4					Z	Silicone O-ring pack	EK6526563	Silicone O-rings / sight glass kit
7	1	1				Cold cap baffle 20 / 630	E6523852	
7	1	1				Extended cold cap baffle 20 / 630	6526358	Baffle for oil backflow reduction
7	1	1				Integrated baffle 20 / 630	6526359	large baffle for oil backflow reduction
7			1	1		Cold cap baffle 32 / 800	E6533789	
7					Z	Extended cold cap baffle 32 / 800	6533820	Baffle for oil backflow reduction
7					Z	Integrated baffle 32 / 800	6533821	large baffle for oil backflow reduction
7	1	1				Insulating washers, set PTFE	E20005425	Thermal insulation,cold cap baffle 20 / 630
7			1	1		Insulating washers, set PTFE	E20005472	Thermal insulation,cold cap baffle 32 / 800
8	1	1				Forevacuum baffle 20 / 630	E6521082	
8			1	1		Forevacuum baffle 32 / 800	E6521101	
9	1	1				Nozzle assembly, complete 20 / 630	E6521081	
9			1	1		Nozzle assembly, complete 32 / 800	E6533788	
11					(1)	Fill level sight glass, mounting set	20005470	incl. spacer sleeves; O-rings and looking glass
12	1	1	1	1		Overtemperature switching device 330 °C	ES6519795	Bimetallic switch

Wearing Parts

Item in Fig. 15	DIJ 20	DIJ 630	DIJ 32	DIJ 800	Opt. extras	Designation, Dimension, Material	Part No.	Comments
					Z	Double Pt100 for DIJ with 3m cable	E6433374	Oil temperature sensor
					Z	Pt100 with 5 m cable	E6433373	Oil temperature sensor
					Z	Overtemperature switching device	12284	Cooling water monitoring >50 °C
					Z	Flow control sensor with display	500006623	Water flow-monitor Set 1-40 l/min (w/ display)
					Z	Flow control sensor	6507100	Flowmetering
13	9	9	18	18		Gasket 50x36x3 Klingersil® C - 4509	ES6523372	
14	7	7	16	16		Heating cartridge w/ fins ø32x300	EK6523371	230V / 1200W
15	1	1	1	1		Heating cartridge w/ fins ø32x300 & Pt 100	EK6523373	230V / 1200W
16	1	1	1	1		Heating cartridge w/ fins ø32x300 & bimetallic connection	EK6523358	230V / 1200W
14	7	7	16	16		Heating cartridge w/ fins ø32x300	EK6523359	270V / 1200W
15	1	1	1	1		Heating cartridge w/ fins ø32x300 & Pt 100	EK6523390	270V / 1200W
16	1	1	1	1		Heating cartridge w/ fins ø32x300 & bimetallic connection	EK6523391	270V / 1200W
					Z	Graphite grease	ES6471174	
	1	1				Electrical junction box, cplt. 20 / 630	E6526418	
			1	1		Electrical junction box, cplt. 32 / 800	E6534780	
					Z	EEC (plug & EEC w/ 10m cable)	503646V001	
	1	1	1	1		Filter fan 230V/50-60Hz/55/66m³/h	E6515261	
	1	1	1	1		Filter fan 115V/50-60Hz/55/66m³/h	E6519134	
	1	1	1	1		Filter fan 24V/55/66m³/h	E6533050	
	3	3	6	6		Terminal 4-pin	EK57020313	Terminal block w/ insulation
	1	1				Set electr. cover 20 / 630	E6527427	
			1	1		Set electr. cover 32 / 800	E6527428	

Item in Fig. 15	DIJ 35	DIJ 1000	Opt. extras	Designation, Dimension, Material	Part No.	Comments
1	2	2		O-ring 25 x 2.5; NBR	ES23950105	Pump body doolant port, cold cap baffle
2	1	1		O-ring 18 x 5; FPM	ES210605	DN16 KF fluid outlet port
3	1	1		O-ring 42 x 5; FPM	ES210625	DN40 KF fluid inlet port
4	2	2		O-ring 65 x 5; FPM	ES23970129	Fill level sight glass
5				O-ring 150 x 5; FPM	ES210650	DN 160 ISO-K
6				O-ring 640 x 8; FPM	E210741	DN 630 ISO-F
5		1		O-ring 195 x 5; FPM	ES210655	DN 200 ISO-K
6		1		O-ring 1023x 8; FPM	E210751	DN 1000 ISO-F
5				O-ring 135 x 5; FPM	ES23950214	4" ASA
6				O-ring 560 x 8; FPM	E6525202	20" ASA
5	1			O-ring 200 x 5; FPM	ES6527631	6" ASA
6	1			O-ring 910 x 8; FPM	E20002521	35" ASA
6			(1)	Vac. sealing disk, complete DIJ1000	17118	DN 1000 ISO-F
2,3,4			Z	Silicone O-ring pack	EK6526563	Silicone O-rings / sight glass kit
7	1	1		Cold cap baffle 35 / 1000	E6526372	
7	1	1		Extended cold cap baffle 35 / 1000	6526373	Baffle for oil backflow reduction
7	1	1		Integrated baffle 35 / 1000	6526374	large baffle for oil backflow reduction
7	1	1		Insulating washers, set PTFE	E20005472	Thermal insulation,cold cap baffle 35 / 1000
8	1	1		Forevacuum baffle 35 / 1000	E6521101	
9	1	1		Nozzle assembly, complete 35 / 1000	E6521100	
11			(1)	Fill level sight glass, mounting set	20005470	incl. spacer sleeves; O-rings and looking glass
12	1	1		Overtemperature switching device 330 °C	ES6519795	Bimetallic switch

Wearing Parts

Item in Fig. 15	DIJ 35	DIJ 1000	Opt. extras	Designation, Dimension, Material	Part No.	Comments
			Z	Double Pt100 for DIJ with 3m cable	E6433374	Oil temperature sensor
			Z	Pt100 with 5 m cable	E6433373	Oil temperature sensor
			Z	Overtemperature switching device	12284	Cooling water monitoring >50 °C
			Z	Flow control sensor with display	500006623	Water flow-monitor Set 1-40 l/min (w/ display)
			Z	Flow control sensor	6507100	Flowmetering
13	18	18		Gasket 50x36x3 Klingersil® C - 4509	ES6523372	
14	16	16		Heating cartridge w/ fins ø32x300	EK6523371	230V / 1200W
15	1	1		Heating cartridge w/ fins ø32x300 & Pt 100	EK6523373	230V / 1200W
16	1	1		Heating cartridge w/ fins ø32x300 & bimetallic connection	EK6523358	230V / 1200W
14	16	16		Heating cartridge w/ fins ø32x300	EK6523359	270V / 1200W
15	1	1		Heating cartridge w/ fins ø32x300 & Pt 100	EK6523390	270V / 1200W
16	1	1		Heating cartridge w/ fins ø32x300 & bimetallic connection	EK6523391	270V / 1200W
			Z	Graphite grease	ES6471174	
	1	1		Electrical junction box, cplt. 35 / 1000	E6528313	
			Z	EEC (plug & EEC w/ 10m cable)	503646V001	
	1	1		Filter fan 230V/50-60Hz/55/66m³/h	E6515261	
	1	1		Filter fan 115V/50-60Hz/55/66m³/h	E6519134	
	1	1		Filter fan 24V/55/66m³/h	E6533050	
	6	6		Terminal 4-pin	EK57020313	Terminal block w/ insulation
	1	1		Set electr. cover 35 / 1000	E6527428	

Item	Part No.	Designation	DIJ 20 / 630 Qty.	DIJ 32 / 800 Qty.	DIJ 35 / 1000 Qty.
1	E6533049	3phased Solid state relay with cooling body	1	1	1
2	E6509414	Fuse 5 x 20mm slow acting 6.3A	9	18	18
2	ES6509414	Fuse 5 x 20mm slow acting 6.3A (20 pcs.)	9	18	18
3	E6532118	Eurotherm Nanodac control unit / 24VDC	1	1	1

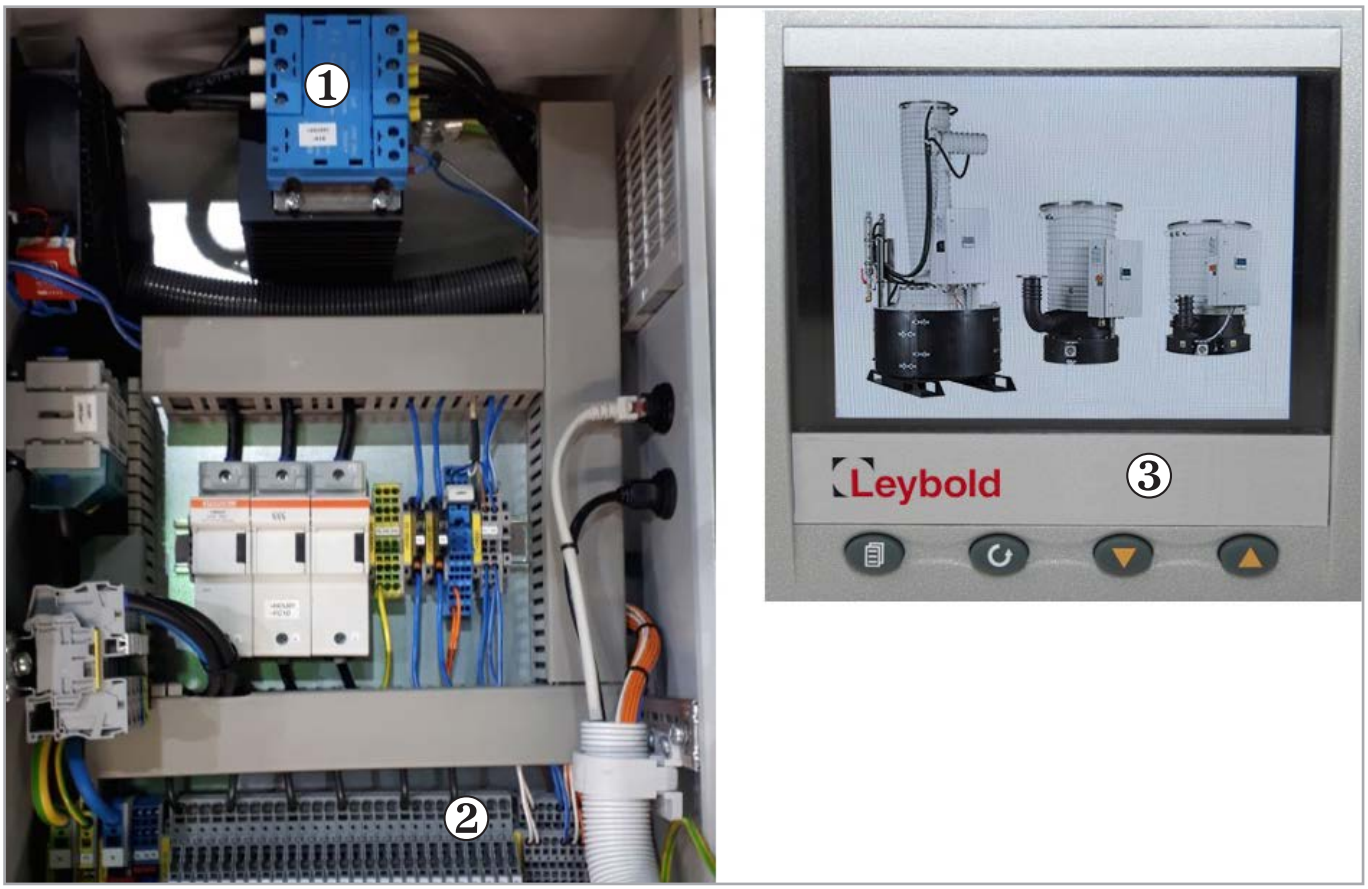


Fig. 16 Location of wearing parts

8 Waste Disposal

Contamination

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. Leybold offers this service at fixed prices. Further details are available on request.

DANGER

Danger as a result of contact with toxic decay/reaction products of lubricants, equipment or pumped substances during the maintenance of the pump

In the event of servicing, there may be deposits in the pump.

The pumping of toxic gases and vapours is basically excluded.

The operator is responsible for the assessment of the hazard potential of the process media and/or mixtures. For this purpose, the operator must perform a risk or hazard assessment. The operator must take appropriate measures to ensure that there is no danger to man and the environment.

Vacuum pumps which are operated with the lubricant Perfluorinated Polyether (PFPE) may in the case of thermal decomposition release toxic and corrosive gases.

For this purpose, we recommend that the pump is flushed for a longer time with inert gas before opening. Wear appropriate protective clothing (gloves, goggles, respiratory protection, personal protective equipment).

Avoid body contact with plant oil, process residues and contaminated surfaces. Perform maintenance in preferably clean, dry and well-ventilated rooms.

Do not smoke with PFPE on your fingers.

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

When sending any equipment to Leybold, observe the regulations given in Section “5.1 Leybold Service”.

Disposing of spent fluid
The owners of used fluid are responsible for its proper disposal.

Spent fluid from vacuum pumps may not be mixed with other substances.

Spent fluids from vacuum pumps (Leybold's petroleum-based oils) which are contaminated only as a result of normal wear and tear due to the effects of atmospheric oxygen, elevated temperature and mechanical strain can be disposed of in the same way as used motor oils.

Spent oils from vacuum pumps which were contaminated with other substances will have to be marked to identify the contaminant and stored and disposed of as toxic wastes.

European, national and local regulations concerning the disposal of waste need to be observed. The waste must only be handled and disposed of through an approved waste disposal vendor.

PFPE from vacuum pumps may be regenerated, if required, and provided the quantities are large enough. For this, please contact us for assistance.

EU Declaration of Conformity

(Translation of original Declaration of Conformity)

The manufacturer: Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

herewith declares that the products specified and listed below which we have placed on the market, comply with the applicable EU Directives. This declaration becomes invalid if modifications are made to the product without agreement of Leybold GmbH.

Product designation: Oil Diffusion Pumps

Type designation:	**Part numbers:**	"x" can be "0" to "9"
DIJ 10 / 320	22213Vxxx / 22214Vxxx	
DIJ 16 / 500	22223Vxxx / 22224Vxxx	
DIJ 20 / 630	22227Vxxx / 22228Vxxx	
DIJ 32 / 800	22237Vxxx / 22238Vxxx	
DIJ 35 / 1000	22243Vxxx / 22244Vxxx	

The products comply with the following Directives:

Electromagnetic Compatibility (2014/30/EU)

The following harmonized standards have been applied:

EN 61000-6-2:2005/AC:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4:2007/A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

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Cologne, May 11, 2018

Andries Desiron
VP Engineering
Industrial Vacuum

Cologne, May 11, 2018

i.V. Martin Laerbusch
Head of Production Systems
Cologne Product Company

Document No.: 300665206-002-A1

EC Declaration of Incorporation

(Translation of original Declaration of Incorporation)

The manufacturer:

Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

herewith declares that the following product:

Product designation: Oil Diffusion Pumps

Type designation:	**Part numbers:**	"x" can be "0" to "9"
DIJ 10 / 320	22213Vxxx / 22214Vxxx	
DIJ 16 / 500	22223Vxxx / 22224Vxxx	
DIJ 20 / 630	22227Vxxx / 22228Vxxx	
DIJ 32 / 800	22237Vxxx / 22238Vxxx	
DIJ 35 / 1000	22243Vxxx / 22244Vxxx	

complies with the following fundamental requirements of the **Machinery Directive (2006/42/EC)**:
Annex I, Paragraph 1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.3, 1.2.4.1, 1.2.4.2, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.13, 1.6.1 and 1.7.1

The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Appendix 1 No. 1.5.1 of Machinery Directive 2006/42/EC.

The following harmonised standards have been applied:

EN 1012-2:1996+A1:2009	Compressors and vacuum pumps - Safety requirements Part 2: Vacuum pumps
EN 60204-1:2006	Safety of machinery - Electrial equipment of machines Part1: General requirements

The incomplete machine may only be put into operation after it has been determined that the machine into which the incomplete machine shall be installed complies with the regulations laid down in the EC Machinery Directive (2006/42/EC).
The manufacturer commits himself to make the special documentation on the incomplete machine electronically available to national authorities upon request.
The special engineering documentation belonging to the machine was compiled in accordance with Annex VII Part B.

Documentation officer:

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Cologne, May 11, 2018

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VP Engineering
Industrial Vacuum

Cologne, May 11, 2018

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