oerlikon
leybold vacuum

DIP

Oil Diffusion Pumps
3 000 - 50 000 l x s^{-1}

Oils, Baffles, Accessories, Adsorption Traps

174.01.02
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Contents

Operating Principle of Fluid Entrainment Vacuum Pumps

The main components of diffusion pumps, the operation of which relies on vapor-phase pump fluids are:

- Cooled pump body with intake and exhaust ports
- System of nozzles
- Pump boiler

In the case of diffusion pumps a pump fluid contained in a boiler is heated to such an extent that it is vaporized. The vapor is then forced through nozzles within the pump. The nozzles are generally designed in such a way, that they accelerate the vapor to a speed exceeding the speed of sound (Laval nozzles), thus creating a high speed vapor jet. The vapor is then deflected by the nozzles at a specific angle onto the pump body. The pump body is cooled, so that the vaporized pump fluid condenses and is returned back to the boiler as a liquid. The pumping action of diffusion pumps and fluid entrainment pumps in general is based on the transporting capacity of the vapor jet.

The gas which is to be pumped is compressed sufficiently at the fore-vacuum port so that it can be pumped out by a backing pump.

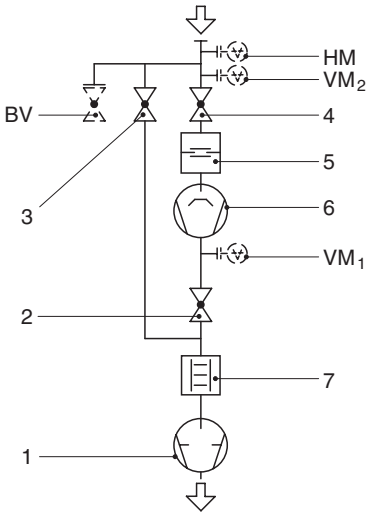
Applications and Accessories

Pumps		DIP 3 000	DIP 8 000	DIP 12 000	DIP 20 000	DIP 30 000	DIP 50 000
Application							
Vacuum coating		■	■	■	■	■	■
Research and development		■	■	■	■	■	■
Metallurgy/furnaces		■	■	■	■	■	■
Mechanical engineering		■	■	■	■	■	■
Accessories	Page						
Pump fluids	C11.07	■	■	■	■	■	■
Astrotorus baffle	C11.12	■	■	■	■	■	■
Water flow monitor	C11.14	■	■	■	■	■	■
Over-temperature protection switch	C11.15	■	■	■	■	■	■
Contact thermometer	C11.15	■	■	■	■	■	■
Resistance thermometer Pt 100	C11.15	■	■	■	■	■	■
Adsorption trap	C11.16	For generating an oil-free vacuum with oil-sealed backing pumps					

Diffusion Pumps

Compared to other fluid entrainment pumps the density of the vapor in the boiler and in the vapor jet is fairly low so that the gas molecules may almost completely diffuse into the vapor jet. Thus most of the molecules which enter the vapor jet are also pumped out.

For this reason, the pumping speed of diffusion pumps is extremely high with respect to the in-take area and constant – starting at an inlet pressure of approximately 10^{-3} mbar (0.75 x 10^{-3} Torr) down to very low pressures – as within the pressure range the vapor jet is not influenced in any way by the pressure within the vacuum vessel.



1	Two-stage rotary vane vacuum pump
2	Forevacuum valve
3	Rough vacuum valve
4	High vacuum valve
5	Baffle
6	Oil diffusion pump
7	Adsorption trap
HM	High vacuum gauge
VM_1	Forevacuum gauge/diffusion pump
VM_2	Forevacuum gauge/roughing line
BV	Venting valve

Diagram of a pump system with diffusion pump

Operating Oil Diffusion Pumps

Forevacuum

In all cases diffusion pumps require a sufficiently sized backing pump (see Technical Data). The size and type of forevacuum pump depends on the operating conditions and the quantities of gas which are to be pumped.

1. Continuous operation at operating pressures above 10^{-4} mbar (0.75 x 10^{-4} Torr) – large quantities of gas.
2. Continuous operation at operating pressures below 10^{-4} mbar (0.75 x 10^{-4} Torr) – smaller quantities of gas.

In applications which rely on diffusion pumps, the vacuum chamber must be connected via a valve **(3)** and a roughing line directly to the backing pump. This is done so that the vacuum chamber may be pre-evacuated by the backing pump down to a pressure where the diffusion pump can take over. Until the high vacuum valve **(4)** opens, both diffusion pump and pump fluid are preserved. Before venting the vacuum chamber the forevacuum valve **(2)** and the high vacuum valve **(4)** must be closed, whereby the diffusion pump remains in the ready status.

Pumping Speed

The pumping speed of any pump is equivalent to the volume throughput through the intake opening of a pump. In the case of diffusion pumps the pumping speed for lighter gases is higher compared to heavier gases.

Backstreaming of the Pump Fluid

Undesirable backstreaming of molecules from the pump fluid is caused by the effect that some molecules are able to leave the vapor jet and thus do not arrive at the cooled pump body. Because of collisions between each other and due to reflection at the pump body, these molecules are then able to move in the direction of the vacuum chamber.

For DIP pumps the backstreaming effect amounts only to a few µg per cm^2 of intake area per minute. Backstreaming may be almost completely suppressed by including a cold cap baffle or an additional Astrotorus baffle.

Backstreaming of Oil in the Case of Diffusion Pumps

- Pump without baffle
  approx. 1 x 10^{-2} mg x cm^{-2} x min^{-1}
- Pump with cold cap baffle
  approx. 1 x 10^{-3} mg x cm^{-2} x min^{-1}
- Pump with Astrotorus baffle
  (T = 10 °C (50 °F))
  approx. 1 x 10^{-5} mg x cm^{-2} x min^{-1}

The values stated have been measured at an intake pressure of < 1 x 10^{-4} mbar and apply to DIFFELEN normal. When using DC 705 the values may improve on average by one order of magnitude.

Attainable Ultimate Pressure

The attainable ultimate pressure for a particular vacuum system depends not only on the type and pumping speed rating of the diffusion pump, but also on the vapor pressure of the pump fluid, shape and temperature of the baffle, leaks at connecting flanges or welded joints and the condition of the surfaces within the vacuum chamber. When excluding all effects which contribute to an increase in pressure within the vacuum chamber due to leaks and contamination of the vacuum chamber walls, it will be possible to attain the ultimate pressures stated in the table "Attainable Ultimate Pressures with Oil Diffusion Pumps (DIP)" given in section "General".

In practice the following combination has been found to work very well when needing a low vacuum free of oil vapors.

- Water-cooled cold cap baffle as a integral part of the diffusion pump together with a water-cooled Astrotorus baffle which may be installed as an additional component on the high vacuum flange of the diffusion pump.

Sealing Methods

For ultimate pressures down to 10^{-8} mbar (0.75×10^{-8} Torr) bakeout temperatures of up to 150 °C (302 °F) are sufficient. FPM (FPM = Fluor caoutchouc, temperature resistant up to 150 °C (302 °F)) sealing rings or ultra sealing rings made of aluminum must be used.

In order to prevent pressure variations, ultra sealing rings must be used in the connections, between diffusion pump and baffle.

Ultimate pressures below 10^{-8} mbar (0.75×10^{-8} Torr) require bakeout temperatures up to 400 °C (752 °F). However, it is only necessary to bake out the vacuum chamber to 400 °C (752 °F) and to maintain a temperature gradient across the baffle or the cold trap so that a temperature of 150 °C (302 °F) is not exceeded at the intake flange of the pump.

In this way, it is still acceptable to use FPM sealing rings or ultra sealing rings made of aluminium.

Cooling

The cooling water temperature should not exceed 25 °C (77 °F) at the intake and 30 °C (86 °F) at the discharge, otherwise sufficient condensation of the pump fluid cannot be ensured. When connecting the cooling system of the pump and the baffle in series, the cooling water must always be made to flow through the baffle first and then through the diffusion pump, because the attainable ultimate pressure in the vacuum chamber depends strongly on the condensation temperature of the pump fluid in the baffle.

Attainable Ultimate Pressures with Oil Diffusion Pumps (DIP)

Attainable Ultimate Pressure [1]		DIFFELEN normal (or DC 704)	DIFFELEN ultra	DC 705	Polyphenylether ULTRALEN
Without baffle	mbar (Torr)	1.5×10^{-6} (1.1×10^{-6})	6.0×10^{-7} (4.5×10^{-7})	4.0×10^{-7} (3.0×10^{-7})	4.0×10^{-7} (3.0×10^{-7})
With cold cap baffle	mbar (Torr)	5.0×10^{-7} (3.8×10^{-7})	3.0×10^{-7} (2.3×10^{-7})	1.5×10^{-7} (1.1×10^{-7})	1.0×10^{-7} (0.75×10^{-7})
With Astrotorus baffle	mbar (Torr)	1.5×10^{-7} (1.1×10^{-7})	3.0×10^{-8} (2.3×10^{-8})	1.5×10^{-8} (1.1×10^{-8})	1.5×10^{-8} (1.1×10^{-8})

[1] Attained in consideration of the notes given under para. "Sealing Methods" in the section "General" and after degassing the connected vacuum chamber for several hours at 200 °C (392 °F)

Pump Fluids for Diffusion Pumps

Pump fluids for oil diffusion pumps must exhibit a low vapor pressure at room temperature and must be able to resist thermal decomposition and oxidization to a large extent. Surface tension of the pump fluids must be high to reduce creep of oil films. They must be chemically inert, exhibit high flash point and evaporation heat must be low. Moreover, the pump fluids should permit high pumping speeds over a wide range of pressures and be cost-effective.

One type of pump fluid alone cannot meet these comprehensive requirements. It is therefore required to select a pump fluid according to the operating pressure and the requirements of the application in each case.

The pump fluids given below are subjected to an extensive series of tests in our factory laboratories under conditions commonly encountered in practice by diffusion pumps.

We recommend the use of the pump fluids specifically qualified by Oerlikon Leybold Vacuum, since only this will ensure that the specifications will be met by our diffusion pumps in practice. Equally we recommend the use of qualified pump fluids to attain the optimum oil change intervals and prevent the accumulation of unwanted deposits.

Mineral Oil Pump Fluid DIFFELEN

The various types of this kind of pump fluid are closely toleranced fractions of a high quality base product distilled with particular care. During the distillation process the pressure and temperature conditions are maintained continuously within close limits, so that individual fractions are obtained which are of consistent quality.

- **DIFFELEN normal** is the most frequently used pump fluid. It is the ideal pump fluid for high vacuum applications. The attainable ultimate pressure is below 10^{-7} mbar (0.75×10^{-7} Torr).
- **DIFFELEN ultra** is used in connection with ultra-high vacuum pump systems. With a water-cooled baffle the attainable ultimate pressure is about 10^{-8} mbar (0.75×10^{-8} Torr).

Polyphenylether

ULTRALEN is a high-quality pump fluid based on a polyphenylether for operation in the high vacuum range.
It excels through its very high resistance against oxidation, thermal decomposition and chemical attack, and exhibits an exceptionally low vapor pressure.

Silicone Oil

Silicone oil differs from DIFFELEN oil in that silicone oil is a defined chemical compound which is extremely resistant to decomposition. Because of the extremely low vapor pressure, silicone oil is especially well suited as a pump fluid in diffusion pumps. Even after a great number of air inrushes, silicone oil will remain unaffected by aging even when subjected to mass spectrometric analysis.

DC 704 is a pump fluid for high vacuum and ultra-high vacuum applications with stringent requirements concerning resistance against oxidization and de-composition.

DC 705 is a special pump fluid (an organic silicon compound) for ultra-high vacuum applications which require an extremely low vapor pressure together with stringent requirements concerning resistance against oxidization and decomposition.

Safety data sheets are available to professional users from:
e-mail “documentation.vacuum@oerlikon.com” or Internet “www.oerlikon.com”.

Overview Pump Fluids

Technical Data		Mineral Oil/DIFFELEN	
		normal	ultra
Vapor pressure at 20 °C (68 °F)	mbar (Torr)	4×10^{-9} (3×10^{-9})	4×10^{-11} (3×10^{-11})
Middle molecular weight	g/mol	510	600
Flash point	°C (°F)	> 258 (> 496)	> 270 (> 518)
Dyn. viscosity at 25 °C (77 °F)	mPas	200	220
Kin. viscosity at 40 °C (104 °F)	mm^2/s	100	110
Density at 20 °C (68 °F)	g/ml	0.87	0.87

Ordering Information	Mineral Oil/DIFFELEN	
	normal	ultra
0.5 l (0.47 qts)	**Part No. 176 73**	**Part No. 176 71**
5.0 l (4.7 qts)	**Part No. 176 72**	–

Technical Data		Silicone Oil		Polyphenylether
		DC 704	DC 705	ULTRALEN
Vapor pressure at 20 °C (68 °F)	mbar (Torr)	3.0×10^{-8} (2.8×10^{-8})	4.0×10^{-10} (3×10^{-10})	3.0×10^{-10} (2.3×10^{-10})
Middle molecular weight	g/mol	485	545	450
Flash point	°C (°F)	221 (430)	243 (469)	288 (611)
Dyn. viscosity at 25 °C (77 °F)	mPas	47	190	2900
Kin. viscosity at 40 °C (104 °F)	mm^2/s	24	66	370
Density at 20 °C (68 °F)	g/ml	1.07 [1]	1.09 [1]	1.20

Ordering Information	Silicone Oil		Polyphenylether
	DC 704	DC 705	ULTRALEN
0.05 l (0.047 qts)	–	–	**Part No. 155 72**
0.5 l (0.47 qts)	**Part No. 176 94**	**Part No. 176 96**	–
5.0 l (4.7 qts)	**Part No. 500 600** [2]	–	–
1.0 gal (DC 704 CA)	**Part No. 981 98 069**	–	–
5.0 gal (DC 704 CP)	**Part No. 981 98 070**	–	–

[1] At 25 °C (77 °F)

[2] 5 kg (11.4 lbs)

Please note that the technical data stated are only typical data. Slight variations from batch to batch must be expected.
The technical data given here can not be taken as assured data

Products

DIP Pumps Water-Cooled

DIP 12 000

The DIP range of pumps was developed for operation in industrial systems. Excellent vacuum performance data combined with the inherent ruggedness of this kind of pump, make our diffusion pumps pumps a reliable component in high and medium vacuum applications.

Advantages to the User

- High pumping speeds in the fine and high vacuum ranges
- Low attainable ultimate pressure
- Integrated, water-cooled cold cap baffle guarantees low oil backstreaming rates into the vacuum chamber
- Low oil losses (even at high gas throughputs) by integrated water-cooled forevacuum baffle
- High forevacuum resistance even at reduced heating power
- The heating cartridges are accessible from the outside via heating inserts which are built into the boiler. This ensures a quick exchange of single heating cartridges (even when the pump is hot)
- A separate automatic circuit breaker for each heating cartridge ensures a high level of electrical safety
- A standard built-in thermostat acts as an thermal overload switch and ensures that the heating cartridges can not overheat
- All pumps are prepared for installation with an over-temperature switch (optional) for checking the cooling water circuit, and a contact thermometer (optional) to monitor the operating temperature of the diffusion pump
- Indication of the oil level by sight-glass permits simple checking of the current oil level
- All DIP pumps are delivered with their inside chamber cleaned in such a manner that it is free of oil. The inside is evacuated. In the condition as delivered, the pumps may be also operated with silicone oil

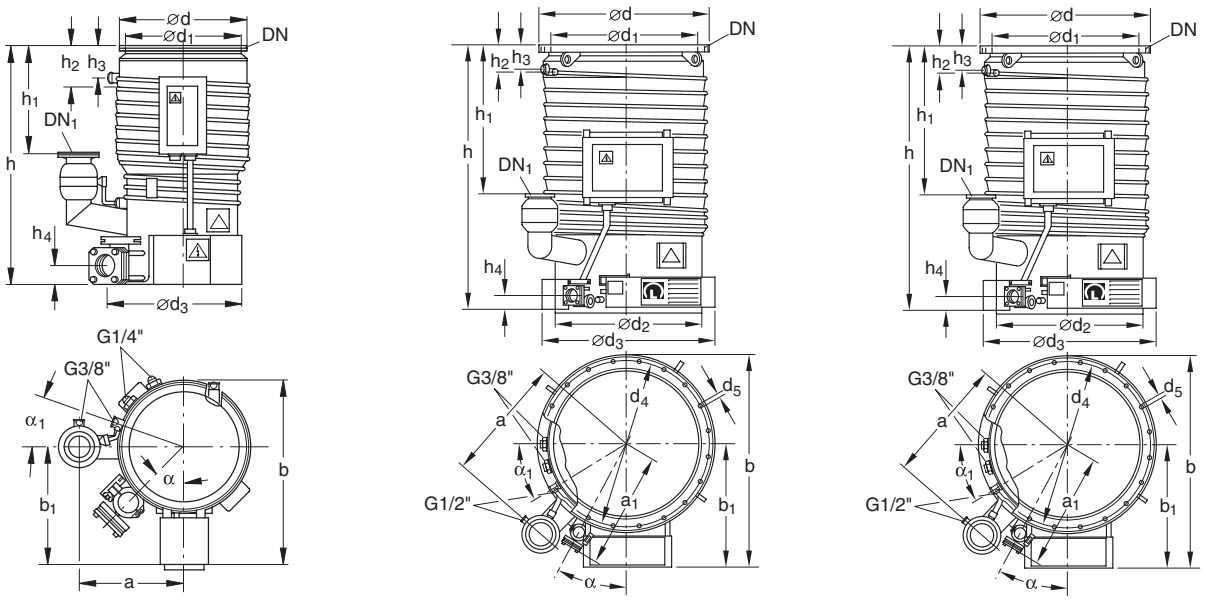
Typical Applications

The diffusion pumps from the DIP range are used in coating systems, vacuum melting and drying systems as well as in vacuum furnaces in the area of metallurgy.

Supplied Equipment

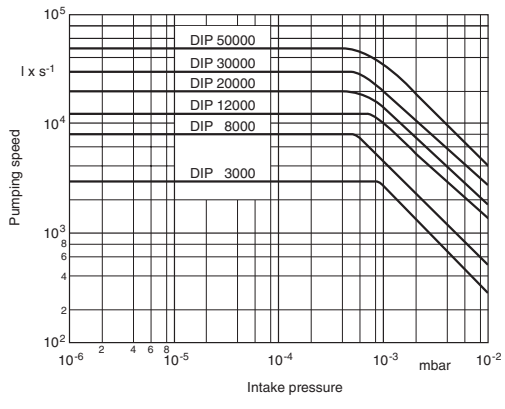
The DIP pumps are supplied ready for connection but without the filling of pump fluid.

The inside of the pump is cleaned before delivery to such an extent that it is free of oil. The inside is evacuated. High and forevacuum flanges are equipped with gaskets and centering rings having shipping flanges and complete with clamping components.



DIP	3 000	8 000	12 000	20 000	30 000	50 000
DN	250 ISO-K	400 ISO-K	500 ISO-K	630 ISO-F	800 ISO-F	1000 ISO-F
DN_1	63 ISO-K	63 ISO-K	100 ISO-K	100 ISO-K	160 ISO-K	160 ISO-K
a	240 (9.45)	350 (13.78)	420 (16.54)	540 (21.26)	600 (23.62)	800 (31.5)
a_1	250.5 (9.86)	375.5 (14.78)	432 (17)	496 (19.53)	536 (21.10)	636 (25.04)
b	443 (17.44)	643 (25.31)	775 (30.51)	920 (36.22)	1090 (42.91)	1290 (50.79)
b_1	276 (10.87)	373 (14.69)	460 (18.11)	540 (21.26)	630 (24.8)	730 (28.74)
d	290 (11.42)	450 (17.72)	550 (21.65)	750 (29.53)	920 (36.22)	1120 (44.09)
d_1	261 (10.28)	400 (15.75)	50119.72)	651 (25.63)	800 (31.5)	1000 (39.37)
d_2	–	405 (15.94)	506 (19.92)	636 (25.04)	716 (28.19)	916 (36.06)
d_3	278 (10.94)	530 (20.87)	630 (24.80)	760 (29.92)	840 (33.07)	1040 (40.94)
d_4	–	–	–	720 (28.35)	890 (35.04)	1090 (42.91)
d_5	–	–	–	14 (0.55)	14 (0.55)	14 (0.55)
Quantity of holes	–	–	–	20	24	32
h	560 (22.05)	785 (30.91)	940 (37)	1130 (44.49)	1450 (57.09)	1880 (74.02)
h_1	250 (9.84)	400 (15.75)	470 18.5)	620 (24.41)	870 (34.25)	1275 (50.2)
h_2	68 (2.68)	88 (3.46)	92 (3.62)	97 (3.82)	102 (4.02)	102 (4.02)
h_3	75 (2.95)	102 (4.02)	106 (4.17)	110 (4.33)	116 (4.57)	116 (4.57)
h_4	45 (1.77)	68 (2.68)	68 (2.68)	74 (2.91)	70 (2.76)	70 (2.76)
α	45 °	30 °	30 °	30 °	20 °	25 °
α_1	20 °	30 °	30 °	30 °	30 °	45 °
α_2	–	–	–	–	–	25 °
α_3	–	–	–	–	–	15 °

Dimensional drawing for the DIP 3000 [top left], DIP 8000 to DIP 20 000 [top middle], DIP 30 000 [top right] and DIP 50 000 [bottom right];
Dimensions in brackets ( ) are in inch



Pumping speed characteristics of the DIP pumps as a function of intake pressure

Technical Data		DIP 3 000	DIP 8 000	DIP 12 000
High vacuum / forevacuum connection	DN	250 ISO-K / 63 ISO-K	400 ISO-K / 63 ISO-K	500 ISO-K / 100 ISO-K
Pumping speed for air [1] below 1 x 10^{-4} mbar	l x s^{-1}	3 000	8 000	12 000
Operating range	mbar (Torr)	< 10^{-2} to 10^{-7} (0.75 x 10^{-2} to 0.75 x 10^{-7})	< 10^{-2} to 10^{-7} (0.75 x 10^{-2} to 0.75 x 10^{-7})	< 10^{-2} to 10^{-7} (0.75 x 10^{-2} to 0.75 x 10^{-7})
Ultimate total pressure [2]	mbar (Torr)	< 5.0 x 10^{-7} (3.75 x 10^{-7})	< 5.0 x 10^{-7} (3.75 x 10^{-7})	< 5.0 x 10^{-7} (3.75 x 10^{-7})
Max. permissible forevacuum pressure	mbar (Torr)	6.0 x 10^{-1} (4.5 x 10^{-1})	6.0 x 10^{-1} (4.5 x 10^{-1})	6.0 x 10^{-1} (4.5 x 10^{-1})
Pump fluid filling, min. / max.	l (qts)	1.0 / 1.4 (1.1 / 1.5)	1.7 / 3.4 (1.8 / 3.6)	2.4 / 5.3 (2.5 / 5.6)
Mains connection				
Standard EURO, 50/60 Hz	V	230 ~ 1 Ph	400 ~ 3 Ph Y	400 ~ 3 Ph Y
Standard Americas, 50/60 Hz	V	230 ~ 1 Ph	460 ~ 3 Ph Y	460 ~ 3 Ph Y
Special, 50/60 Hz	V	–	230 ~ 3 Ph Δ	230 ~ 3 Ph Δ
Heating power	kW	2.4	4.8	7.2
Number of heating cartridges		2	6	9
Heating up time	min	< 25	< 25	< 25
Cooling water (minimum)				
for pump [3]	l x h^{-1} (gal/min)	160 (0.7)	290 (1.28)	500 (2.2)
for cold cap baffle	l x h^{-1} (gal/min)	20 (0.09)	30 (0.13)	50 (0.22)
Max. supply pressure	bar (psig)	6 (87)	6 (87)	6 (87)
Number of cooling circuits (including cold cap baffle)		2	2	2
Cooling water connection				
for pump	G (BPS)	3/8"	1/2"	1/2"
for cold cap baffle	G (BPS)	1/4"	3/8"	3/8"
Weight, approx.	kg (lbs)	29 (64)	70 (154)	102 (225)
Recommended backing pump [4]				
at operating pressures > 10^{-4} mbar (> 0.75 x 10^{-4} Torr)		TRIVAC D 65 B + W 251	DK 200 + W 251	DK 200 + W 501
at operating pressures < 10^{-4} mbar (< 0.75 x 10^{-4} Torr)		TRIVAC D 25 B	TRIVAC D 65 B + W 251	TRIVAC D 65 B + W 251

Ordering Information	DIP 3 000	DIP 8 000	DIP 12 000
Oil diffusion pump			
Standard EURO	**Part No. 222 10**	**Part No. 222 20**	**Part No. 222 25**
Standard Americas	**Part No. 222 10**	**Part No. 500 670**	**Part No. 500 591**
Special	**–**	**Part No. 500 649**	**Part No. 500 651**
Astrotorus baffle	**Part No. 227 50**	**Part No. 227 60**	**Part No. 227 65**
Water flow monitor			
LR 10	**Part No. 122 82**	**Part No. 122 82**	**–**
LR 20	**–**	**–**	**Part No. 122 83**
Over-temperature protection switch	**Part No. 122 84**	**Part No. 122 84**	**Part No. 122 84**
Contact thermometer	**Part No. 218 81**	**Part No. 218 81**	**Part No. 218 81**
Resistance thermometer Pt 100 sensor	**Part No. 200 02 958**	**Part No. 200 02 958**	**Part No. 200 02 958**
Pump fluid [5]	see “Pump Fluids for Diffusion Pumps” in section “General”		

1) Measured to DIN 28 427 with **DIFFELEN normal** as the pump fluid

2) Measured to DIN 28 427 with **DIFFELEN normal** as the pump fluid. With pump fluids DC 705 and FPM gaskets the DIP pumps - when equipped with water-cooled baffles and after running a suitable degassing processes - are capable of attaining pressures below 1 x 10^{-8} mbar (0.75 x 10^{-8} Torr)

3) The required quantity of cooling water refers to DT = 10 °C (50 °F). The discharge temperature should not exceed 30 °C (86 °F)

4) Single- or two-stage rotary vane vacuum pump (TRIVAC; SOGEVAC) or rotary piston vacuum pumps (E/DK) from our range of forevacuum pumps jointly with Roots vacuum pumps (RUVAC) in pump systems

5) Oil must be puchased separately

Technical Data		DIP 20 000	DIP 30 000	DIP 50 000
High vacuum / forevacuum connection	DN	630 ISO-F / 100 ISO-K	800 ISO-F / 160 ISO-K	1000 ISO-F / 160 ISO-K
Pumping speed for air [1] below 1 x 10^{-4} mbar	l x s^{-1}	20 000	30 000	50 000
Operating range	mbar (Torr)	< 10^{-2} to 10^{-7} (0.75 x 10^{-2} to 0.75 x 10^{-7})	< 10^{-2} to 10^{-7} (0.75 x 10^{-2} to 0.75 x 10^{-7})	< 10^{-2} to 10^{-7} (0.75 x 10^{-2} to 0.75 x 10^{-7})
Ultimate total pressure [2]	mbar (Torr)	< 5.0 x 10^{-7} (3.75 x 10^{-7})	< 5.0 x 10^{-7} (3.75 x 10^{-7})	< 5.0 x 10^{-7} (3.75 x 10^{-7})
Max. permissible forevacuum pressure	mbar (Torr)	6.0 x 10^{-1} (4.5 x 10^{-1})	6.0 x 10^{-1} (4.5 x 10^{-1})	6.0 x 10^{-1} (4.5 x 10^{-1})
Pump fluid filling, min. / max.	l (qts)	5.0 / 9.0 (5.3 / 9.5)	7.0 / 15.0 (7.4 / 15.9)	12.0 / 25.0 (12.7 / 26.4)
Mains connection				
Standard EURO, 50/60 Hz	V	400 ~ 3 Ph Y	400 ~ 3 Ph Y	400 ~ 3 Ph Y
Standard Americas, 50/60 Hz	V	460 ~ 3 Ph Y	460 ~ 3 Ph Y	460 ~ 3 Ph Y
Special, 50/60 Hz	V	230 ~ 3 Ph Δ	230 ~ 3 Ph Δ	230 ~ 3 Ph Δ
Heating power	kW	12	18	24
Number of heating cartridges		12	18	24
Heating up time	min	< 25	< 30	< 30
Cooling water (minimum)				
for pump [3]	l x h^{-1} (gal/min)	600 (2.6)	900 (4.0)	1500 (6.6)
for cold cap baffle	l x h^{-1} (gal/min)	60 (0.26)	80 (0.35)	150 (0.66)
Max. supply pressure	bar (psig)	6 (87)	6 (87)	6 (87)
Number of cooling circuits (including cold cap baffle)		2	3	3
Cooling water connection				
for pump	G (BPS)	1/2"	1/2"	1/2"
for cold cap baffle	G (BPS)	3/8"	3/8"	3/8"
Weight, approx.	kg (lbs)	172 (379)	296 (653)	560 (1235)
Recommended backing pump [4]				
at operating pressures > 10^{-4} mbar (> 0.75 x 10^{-4} Torr)		SV 200 + W 501	SV 300 + W 1001	SV 630 + W 2001
at operating pressures < 10^{-4} mbar (< 0.75 x 10^{-4} Torr)		TRIVAC D 65 B + W 251	DK 200 + W 251	DK 200 + W 501

Ordering Information	DIP 20 000	DIP 30 000	DIP 50 000
Oil diffusion pump			
Standard EURO	**Part No. 222 30**	**Part No. 222 35**	**Part No. 222 40**
Standard Americas	**Part No. 500 882**	**Part No. 500 665**	**Part No. 500 728**
Special	**Part No. 500 652**	**Part No. 500 653**	**Part No. 500 654**
Astrotorus baffle	**Part No. 227 70**	**Part No. 227 75**	**Part No. 227 80**
Water flow monitor LR 20	**Part No. 122 83**	**Part No. 122 83**	**Part No. 122 83**
Over-temperature protection switch	**Part No. 122 84**	**Part No. 122 84**	**Part No. 122 84**
Contact thermometer	**Part No. 218 81**	**Part No. 218 81**	**Part No. 218 81**
Resistance thermometer Pt 100 sensor	**Part No. 200 02 958**	**Part No. 200 02 958**	**Part No. 200 02 958**
Pump fluid [5]	see “Pump Fluids for Diffusion Pumps” in section “General”		

[1] Measured to DIN 28 427 with **DIFFELEN normal** as the pump fluid

[2] Measured to DIN 28 427 with **DIFFELEN normal** as the pump fluid. With pump fluids DC 705 and FPM gaskets the DIP pumps - when equipped with water-cooled baffles and after running a suitable degassing processes - are capable of attaining pressures below 1 x 10^{-8} mbar (0.75 x 10^{-8} Torr)

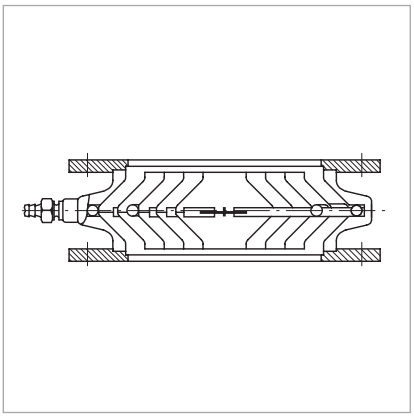
[3] The required quantity of cooling water refers to DT = 10 °C (50 °F). The discharge temperature should not exceed 30 °C (86 °F)

[4] Single- or two-stage rotary vane vacuum pump (TRIVAC; SOGEVAC) or rotary piston vacuum pumps (E/DK) from our range of forevacuum pumps jointly with Roots vacuum pumps (RUVAC) in pump systems

[5] Oil must be puchased separately

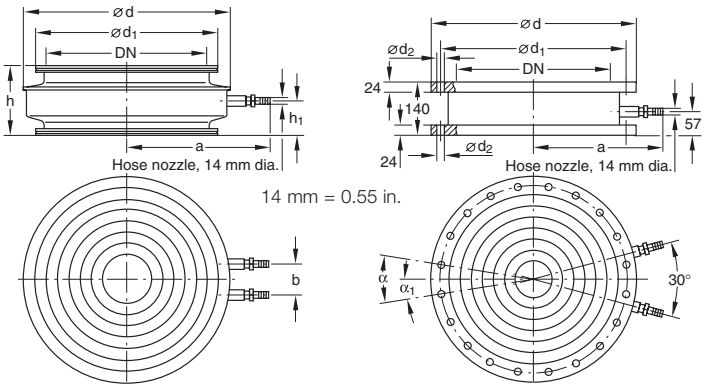
Accessories

Astrotorus Baffles



The cooling inserts of the astrotorus baffles are made of copper, whereas the housing and the connection flange are made of standard steel.

Section through an astrotorus baffle



DN		a	b	ø d	ø d_1	ø d_2
250 ISO-K	mm	265	30	416	290	–
	in.	10.4	0.18	16.4	11.4	–
400 ISO-K	mm	362	120	512	450	–
	in.	14.25	4.72	20.2	17.7	–
500 ISO-K	mm	412	120	612	550	–
	in.	16.22	4.72	24.1	21.7	–
630 ISO-F	mm	440	–	750	720	14
	in.	17.32	–	29.53	28.35	0.55
800 ISO-F	mm	546	–	920	890	14
	in.	21.5	–	36.22	35.04	0.55
1000 ISO-F	mm	599	–	1120	1090	14
	in.	23.58	–	44.09	42.91	0.55

DN		Quantity	h	h_1	α	α_1
250 ISO-K	mm	–	195	97	–	–
	in.		7.68	3.82	–	–
400 ISO-K	mm	–	193	96	–	–
	in.		7.6	3.78	–	–
500 ISO-K	mm	–	193	96	–	–
	in.		7.6	3.78	–	–
630 ISO-F	mm	20	140	–	18 °	9 °
	in.	20	5.5	–	18 °	9 °
800 ISO-F	mm	24	140	–	15 °	7,5 °
	in.	24	5.5	–	15 °	7,5 °
1000 ISO-F	mm	32	140	–	11.25 °	5.625 °
	in.	32	5.5	–	11.25 °	5.625 °

Dimensional drawing for the astrotorus baffle ISO-K (left) and ISO-F (right)

Technical Data

Astrotorus Baffles

Connection to pump	DIP	3 000	8 000	12 000
HV connection flanges	DN	250 ISO-K	400 ISO-K	500 ISO-K
Throttling of the pumping speed, approx.	%	30	30	30
Conductance	l x s^{-1}	3 000	9 000	12 000
Weight	kg (lbs)	25.0 (55.2)	30.0 (66.2)	65.0 (143.5)

Ordering Information

Astrotorus Baffles

Astrotorus baffle			
250 ISO-K	**Part No. 227 50**	–	–
400 ISO-K	–	**Part No. 227 60**	–
500 ISO-K	–	–	**Part No. 227 65**

Technical Data

Astrotorus Baffles

Connection to pump	DIP	20 000	30 000	50 000
HV connection flanges	DN	630 ISO-F	800 ISO-F	1000 ISO-F
Throttling of the pumping speed, approx.	%	30	30	30
Conductance	l x s^{-1}	18 000	28 000	50 000
Weight	kg (lbs)	120.0 (264.9)	170.0 (375.3)	190.0 (419.4)

Ordering Information

Astrotorus Baffles

Astrotorus baffle			
630 ISO-F	**Part No. 227 70**	–	–
800 ISO-F	–	**Part No. 227 75**	–
1000 ISO-F	–	–	**Part No. 227 80**

Monitoring Instruments

Protection against Overheating

Water flow monitors are installed in the cooling water return section of the diffusion pump. When the cooling water throughput drops below a certain level, either the heater in the diffusion pump is switched off or a warning light or signal is triggered, depending of the type of circuit.

Type LR 10 for 60 to 600 l x h^{-1} (3.78 to 37.8 gal/min)
Type LR 20 for 600 to 2400 l x h^{-1} (37.8 to 151.2 gal/min)

The water throughput may be set within the limits stated with a high degree of reproducibility.

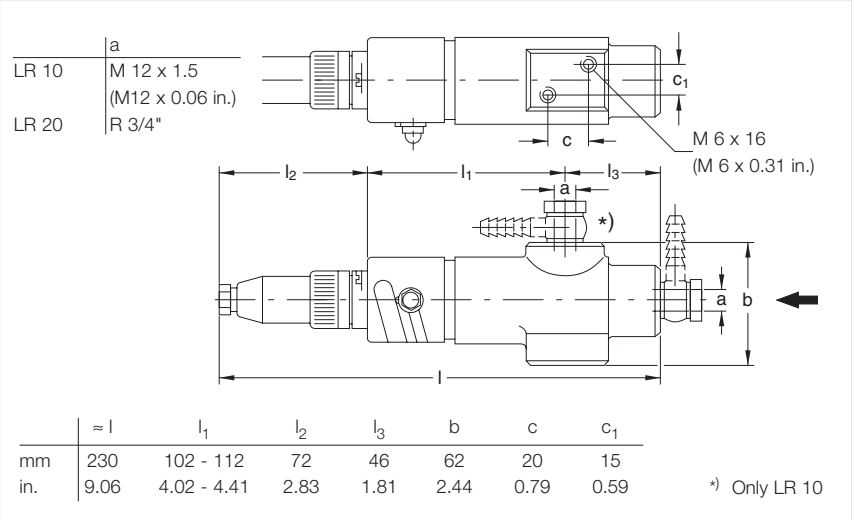
Water flow monitors may be installed in any orientation.
Max. switching capacity:
100 VA (230 V, 50/60 Hz).

Protection against Power Failure

A SECUVAC valve (see Product Section C14 “Vacuum Valves”) must be installed in the forevacuum line in order to prevent damage to the diffusion pump or the pump fluid in the event of a power failure affecting backing pumps which are not equipped with an automatic isolation valve. Rotary vane vacuum pumps from the TRIVAC B series are equipped with an automatic safety valve (intake isolation valve) as standard.

Protection against Pressure Increases in the Forevacuum Line

For protection against a pressure increase in the forevacuum line which is not caused by a power failure you may use our vacuum gauges which offer an adjustable switching threshold (see Product Section C16 “Total Pressure Gauges”).



	≈ l	l_1	l_2	l_3	b	c	c_1
mm	230	102 - 112	72	46	62	20	15
in.	9.06	4.02 - 4.41	2.83	1.81	2.44	0.79	0.59

*) Only LR 10

Dimensional drawing for the water flow monitors LR 10 and LR 20

Ordering Information	Water Flow Monitors
Water flow monitor	
LR 10	**Part No. 122 82**
LR 20	**Part No. 122 83**

Temperature dependant Switching Components for Automatic Pump System Control

The operational status of the diffusion pump depends on the temperature of the pump fluid in the pump boiler. Through temperature dependent switching components which are inserted into the pump boiler it is possible to monitor the operational status of the diffusion pump and signal its status to a process controller.

For this, the diffusion pump requires two thresholds. Depending on the type of pump, the upper threshold should be between 180 and 200 °C (356 and 392 °F) and the lower threshold between 90 and 100 °C (194 and 212 °F).

The upper threshold indicates that the diffusion pump is ready for operation and thus actuates certain devices, for example opening of the high vacuum valve ahead of the diffusion pump.

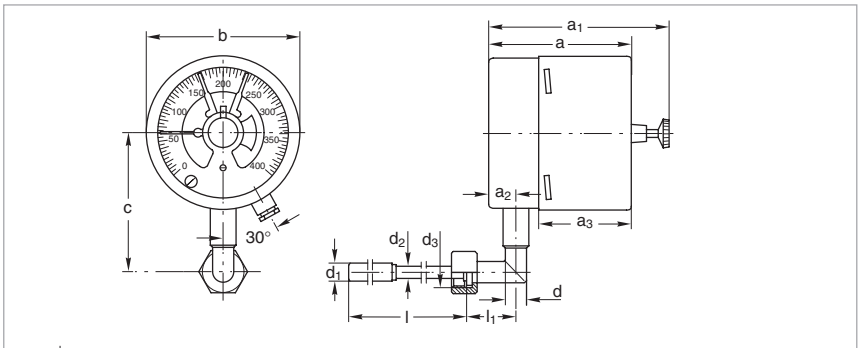
The lower threshold indicates that the diffusion pump has cooled down to such an extent that the backing pump and the cooling water supply may be switched off.

Over-temperature protection switches are used to monitor the temperature of the cooling water in the cooling water circuit of the diffusion pumps. When the temperature rises to unacceptably high levels (for example when the cooling water supply fails) the heater in the diffusion pump is switched off (correct electrical connection to the main supply is required). The use of over-temperature protection switches avoids unnecessary alarms that may be triggered by contaminated water when only a water flow monitor is used. The over-temperature protection switch is screwed on to a contact plate which is soldered to the cooling pipe on the pump's body.

Max. switching current: 5 A (230 V, 50/60 Hz)

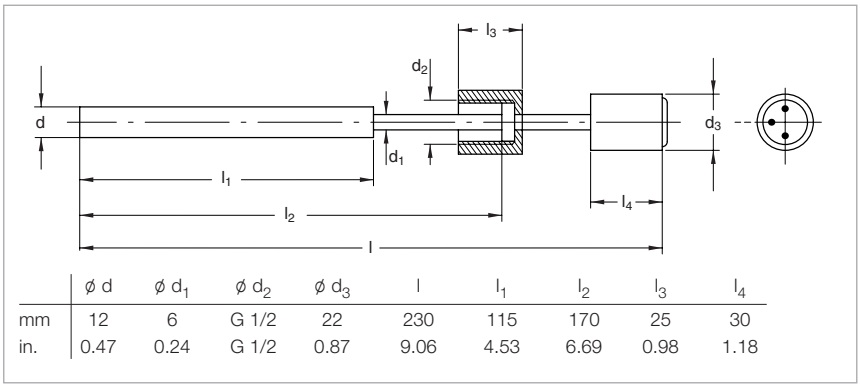
Contact thermometer with a range from 0 to 400 °C (752 °F). Through a trailing pointer two switching thresholds may be set up independently. The current oil temperature and the thresholds which have been set up can be read off at the location of the diffusion pump. The contacting thermometer is not suited for remote signalling of temperatures.

Resistance thermometer Pt 100 sensor. The measurement range of this sensor depends on the temperature display unit used by the customer where also the required thresholds are set up. The Pt 100 sensor is ideal for remote signalling of temperatures.



	a	a_1	a_2	a_3	b	c	ød	ø d_1	ø d_2	ø d_3	l	l_1
mm	95.0	119.5	17.5	62.0	101.5	92.0	14.0	12.0	9.0	G 1/2	170.0	33.0
in.	3.74	4.70	0.69	2.44	4.00	3.62	0.55	0.47	0.35	G 1/2	6.70	1.30

Dimensional drawing for the contact thermometer



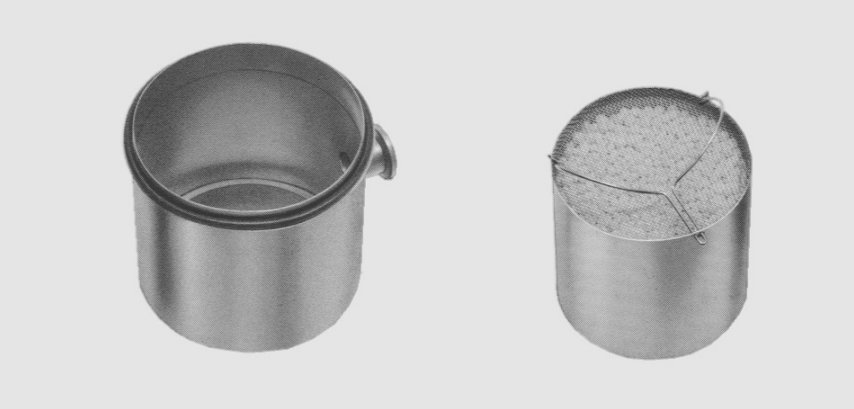
	ø d	ø d_1	ø d_2	ø d_3	l	l_1	l_2	l_3	l_4
mm	12	6	G 1/2	22	230	115	170	25	30
in.	0.47	0.24	G 1/2	0.87	9.06	4.53	6.69	0.98	1.18

Dimensional drawing for the resistance thermometer Pt 100 sensor

Ordering Information — Monitoring Instruments

Over-temperature protection switch	**Part No. 122 84**
Contact thermometer **(Measurement range 0 to 400 °C (32 to 752 °F), Rating at 220 V AC: 250 mA [resistive load], Weight: 1.7 kg (3.7 lbs))**	**Part No. 218 81**
Resistance thermometer Pt 100 sensor	**Part No. 200 02 958**

Adsorption Traps with Aluminum Oxide Insert



Adsorption trap (left) and inserts (right)

Adsorption traps are used in all those cases where a vacuum free of oil is to be produced with the aid of oil-sealed vacuum pumps.

Advantages to the User

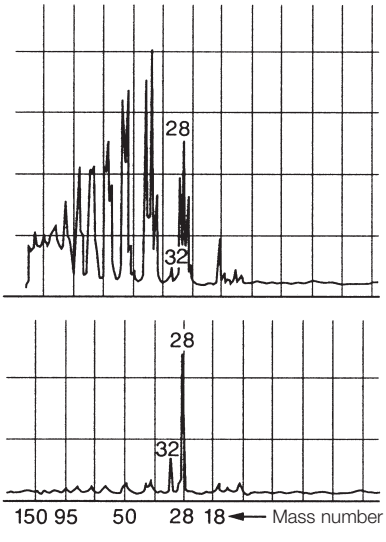
- Backstreaming of oil is reduced by 99%
- Long service life
- High conductance
- Filling can be easily exchanged
- Improvement in the ultimate pressure attained by backing pumps by one order of magnitude
- Stainless steel housing and insert
- NBR gasket

Typical Applications

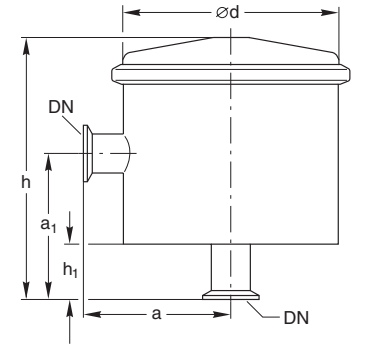
- Product of an oil-free vacuum

Supplied Equipment

- Complete with insert
- Without adsorbent



Residual gas spectrum; top ahead of a rotary vacuum pump, bottom ahead of a rotary vacuum pump with adsorption trap



DN		a	a_1	ø d	h	h_1
16 KF	mm	82	82	135	147	32
	in.	3.23	3.23	5.31	5.79	1.25
25 KF	mm	102	102	175	155	33
	in.	4.02	4.02	6.89	6.10	1.26
40 KF	mm	132	65	235	160	20
	in.	5.19	2.56	9.25	6.3	0.79

Dimensional drawing for the adsorption traps

Technical Data

		Adsorption Traps 16 KF	25 KF	40 KF
Conductance at 10^{-2} mbar (Torr) l x s (l x sec)		4.0 (3.0)	6.0 (4.5)	12.0 (9.0)
Service live with Al oxide	Months	3	3	3
Al oxide filling	l (qts)	0.5 (0.53)	1.0 (1.06)	2.0 (2.1)
Weight, approx.	kg (lbs)	1.3 (2.9)	1.3 (2.9)	4.0 (8.8)

Ordering Information

	Adsorption Traps 16 KF	25 KF	40 KF
Adsorption trap	Part No. 854 14	Part No. 854 15	Part No. 854 16
Activated aluminum oxide in tin 1.6 l (approx. 1.2 kg (2.65 lbs))	Part No. 854 10	Part No. 854 10	Part No. 854 10

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