DryProvac
Vacuum Pump-sets

Convince yourself of the benefits:
- Dry vacuum generation
- Reliable
- Air cooled
- Low maintenance
- Economical

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Convince yourself of the benefits:

- Dry vacuum generation
- Very good fine vacuum, final pressures of $10^{-2}$ to $10^{-3}$ mbar
- Short evacuation times due to very high pumping speeds from atmospheric pressures down to the fine vacuum pressure range
- Air cooled
- Low maintenance
- Economical
- Reliable

Application:
The DryProvac vacuum pump-sets have been designed for generating an oil-free vacuum in the pressures range of $5 \times 10^{-2}$ to $5 \times 10^{-3}$ mbar. Pumping speeds ranging from 30 m$^3$/h to 80,000 m$^3$/h are offered depending on the system. The areas of application cover almost all vacuum processes which require an oil-free vacuum, from semiconductor technology to vacuum chemistry and chemistry involving solvents in the evacuation flow. The possibilities of the DryProvac range from short pump down times for vacuum processes to maintaining of a fine vacuum.

Rotary piston vacuum pump as the first and the second vacuum stage

This series of pumps consists of:

- DryProvac D/2 HV/SR for moist or dry gases down to a final pressure of $5 \times 10^{-2}$ mbar
- DryProvac D/2 VE/SR for wet or dry gases down to a final pressure of $5 \times 10^{-2}$ mbar
- DryProvac C/2 VE/SR for dry gases down to a final pressure of $5 \times 10^{-3}$ mbar and short pump down cycles
- DryProvac C/3 HV/VE/SR for dry gases down to a final pressure of $5 \times 10^{-3}$ mbar and very high pumping speeds of final pressure

Machine with pre-admission cooling, for rough and fine vacuum generation, called VE machine.

In the machine with pre-admission, already compressed gas from the delivery side of the machines is either branched off uncooled as a partial flow and cooled as the pre-admission flow, or directly downstream of the machine the full gas flow is cooled and a cooled partial flow is branched off and passes through the pre-admission channel of the machine into the pump chamber.

Thus the compression process is performed with pre-cooled gas within the machine before the rotary pistons open the pump chamber to the delivery port. Thereby higher pressure differences are possible compared to an uncooled first HV machine stage. In the case of the VE machine the pre-admission channels are cast into the machine housing. The full flow or the pre-admission partial flow is cooled preferably by direct air cooling with a fan.

Description for the vacuum stages HV and VE

Two dual vane pistons arranged in the geometrical shape of a figure-of-eight, rotate in opposing directions and without making contact in a grey cast iron housing. The pistons are synchronised via a gear so that they may revolve about each other without making contact. The slots between the pistons and the housing have been minimised to such an extent that only small amounts of gas are allowed to flow back at the pressure difference maintained during operation, and such that the pistons will not make contact with the housing when thermally expanding.

In the first and the second vacuum stage a difference is made between:

- Machine without cooling, for classic fine vacuum generation, called HV blower.
- Machine with pre-admission cooling, for rough and fine vacuum generation, called VE machine.
DryProvac Vacuum pump-sets
80000 C/3 HV/VE/SR

Design of the vacuum stage HV and VE

Housing sections: Cylinder 1, wheel case 2, cover 3, side panels 4, material grey cast iron GG 20.

Stage VE is equipped with built-in pre-admission channels for cooling the machine. The gas is pumped from top to bottom. The surfaces of the machine are equipped with cooling fins for dissipating the generated heat to the ambient air.

The machine is assembled so that the pump chamber is entirely free of oil and grease.

Housing seal with O-ring seals separating the pump chamber and the bearing or gear chambers as well as the pump chamber against the atmosphere.

Lubrication:

Lubrication is provided by splash lubrication. Right-hand drive end, the oil splasher 7 provides the bearings 8 and 9 with lubricating oil.

Shaft seal:

Between pump chamber 5-6 and neutral space 13, 4-fold rectangular labyrinth seal 14 and for the right-hand drive end bearing chamber 3 and left-hand gear chamber 2 via 2-fold rectangular gaskets and oil splash rings. Sealing of the drive shaft up to size HV, VE 800 with splasher and canned motor, from size 1400 by two shaft minimum eccentricity whilst maintaining perfect grip.

Drive:

Up to size HV, VE 800 via canned motor, and from size 1400 direct coupling with motor, in part also driven using frequency converters or a spur wheel back-gear or narrow V-belts.

Toothed wheels:

The helical gearing is hardened, ground and manufactured with highest precision. The toothed wheels are adjusted by a driving fit which ensures minimum eccentricity whilst maintaining perfect grip.

Sealing of the drive shaft up to size HV, VE 800 with splasher and canned motor, from size 1400 by two shaft sealing rings 15 with oil stop.

Left-hand side, gear, splasher 10 and toothed wheels 11 provide the bearings 12 with lubricating oil. At higher speeds oil guiding facilities are provided.
Vacuum screw as the second or third stage to the atmosphere

Description of the SR screw stage

Operation of the vacuum screw SR is based on the screw principle: two screw type rotors arranged in parallel turn in opposing directions within the cylinder. Here the medium which is to be pumped is trapped in the volume between the screw type rotors and the housing, and is moved by the rotary motion towards the delivery side where the medium is ejected. Owing to the non-contact suspension of the screw rotors, no lubrication is required in the pump chamber and the screw can be operated with absolutely no oil in the pump chamber.

The screw is so designed that there is no oil on the vacuum side which otherwise would have to lubricate any bearings or the synchronisation gear. The bearings on the vacuum side are encapsulated and greased for life. Located on the delivery side is the gear box for the bearings, for the synchronising gear and the drive unit, thereby ensuring that the vacuum will be absolutely free of any oil.

The screw is cooled with cooling water in a closed circuit which is in turn air-cooled. The screw does not require any additional intermediate cooler. This prevents potential process deposits from forming in the pump and the formation of condensate even under the most difficult operating conditions.

The screw consists of the horizontally arranged cylinder 1 with screw rotors 2 and the enclosed pump and compression chamber, the left-hand and right-hand cylinder covers 3, centering flanges 4. The screw rotors have on the shaft ahead of the left and right shaft centering components and bearing arrangements for sealing off the pump chamber against the neutral spaces 6.

The screw may be provided with a direct purge gas connection. All components in contact with the gas are anti-corrosion treated.

Design of the vacuum screw SR

Housing components GG 25, cylinder grey cast iron GG 25 with anti-corrosion coating, screw rotors made of C 45 with anti-corrosion coating, shaft C 45 N.

The gas is pumped from the top to the side. The screw is assembled so that the pump chamber is entirely free of oil and grease.

Lubrication:

The lubrication is provided by splash lubrication. The splashes supply the oil to the gears and the bearings.

Sealing of the cylinder:

Sealing of the cylinder against the left-hand and right-hand cylinder cover / centering flange via O-rings 10.

Sealing of the right-hand cylinder cover / centering flange to the gear chamber drive shaft and drive shaft via two O-rings 11.

Right-hand pump chamber seal on the delivery side, to the neutral space through labyrinths, centering rings and piston rings as well splashes 12 for the synchronising gear 16.

Left-hand pump chamber seal gas inlet side 8, for neutral space 6 by labyrinths 5, centering rings and shaft sealing rings 13 for pedestal bearing 9.

Seal for the right-hand synchronisation gear, drive shaft / drive shaft via shaft sealing rings with splashes 14.

The screw is cooled via the surfaces with water 15.

The screw consists of the horizontally arranged cylinder 1 with screw rotors 2 and the enclosed pump and compression chamber, the left-hand and right-hand cylinder covers 3, centering flanges 4. The screw rotors have on the shaft ahead of the left and right shaft centering components and bearing arrangements for sealing off the pump chamber against the neutral spaces 6.

Flanged to the cylinder cover/gas inlet side 8 is the encapsulated pedestal bearing cover 9 with the life-long lubrication.

Toothed wheels:

The helical gearing is hardened, ground and manufactured with high precision. The toothed wheels are adjusted by a driving fit which ensures minimum eccentricity whilst maintaining perfect grip.

Drive:

Depending on the size of the screw via direct coupling to the motor, in part also driven using frequency converters or a spur wheel back-gear or narrow V-belts.

DryProvac Vacuum pump-sets

35000 - 40000 C/3 HV/VE/SR

Figure No.: 16a

Figure No.: 16b
**Series**

**D/2 HV/SR**

two-stage, final pressure of 5 x 10^{-2} mbar, suited for pumping of humid or dry gases and for maintaining a fine vacuum.

**Properties and operation**

High pumping speed at final pressure. Without intermediate cooling between the stages. In order to protect the first stage HV against being overloaded when pumping down from atmospheric pressure, the first stage HV from atmospheric pressure cuts in power limited via the frequency converter drive or it cuts in at about 20 mbar via a pressure switch.

Pumping down from atmospheric pressure until starting of the first stage HV is restricted in this system thus to the pumping speed of the second stage SR.

**Area of application**

Fine vacuum systems in which a vacuum needs to be maintained without having to continuously pump larger quantities of gas at high pressures or high pressure differentials.

The DryProvac D/2 HV/SR can be supplied as one of 10 standard types with pumping speeds ranging from 30 m³/h to 7,000 m³/h. Higher pumping speeds are available through custom units.

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**Figure No.: 15a**

DryProvac Vacuum pump-sets

**27000 C/3 HV/VE/SR**

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**Figure No.: 15b**

DryProvac Vacuum pump-sets

**D/2 HV/SR**
DryProvac Vacuum pump-sets
12000 - 20000 C/3 HV/VE/SR

Technical Data

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<td>4 x 10⁻³</td>
<td>4 x 10⁻³</td>
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Dimensions

| Width B (mm) | 475 | 485 | 515 | 800 | 800 | 800 | 900 | 900 | 1900 | 1900 |
| Length L (mm) | 790 | 790 | 790 | 1350 | 1350 | 1430 | 1520 | 1520 | 2700 | 2700 |
| Height H (mm) | 610 | 610 | 610 | 990 | 990 | 990 | 1700 | 1700 | 2310 | 2310 |
| Weight (kg) | 110 | 145 | 195 | 390 | 390 | 590 | 895 | 1420 | 1820 | 3550 |
| Oil filling in ltr. | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 |
| Suction line DN/PN | KF 40 | KF 40 | KF 40 | 100/10 | 100/10 | 100/10 | 100/10 | 100/10 | 100/10 | 100/10 |
| Outlet line DN/PN | KF 10 | KF 10 | KF 25 | 100/10 | 100/10 | 100/10 | 100/10 | 100/10 | 100/10 | 100/10 |
| Frequency converter needed | 1 |

1. Frequency converter needed

Gas outlet
DN 500

Figure No.: 14a

suction line
DN 500

Figure No.: 14b

DryProvac System D/2 HV/SR

1. Stage rotary piston blower HV
2. Stage vacuum screw SR to atmosphere
3. Check valve
4. Silencer
5. Purging gas line
DryProvac Vacuum pump-sets
400 - 500 - 600 D/2 HV/SR

Figure No.: 2a

R & I - Scheme System C/3 HV/VE/SR air cooled

Figure No.: 2b

DryProvac System C/3 HV/VE/SR

Technical Data

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<th>2000 C/3</th>
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Dimensions

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Legend:

- Frequency converter needed
- with gear
- with belt drive
- short pumping time
DryProvac Vacuum pump-sets
1400 - 1700 D/2 HV/SR

Figure No.: 3a

Figure showed without silencer

Figure No.: 3b

Gas outlet
Suction line

Figure No.: 3b

Gas outlet
Suction line

1. Stage rotary piston blower HV
2. Stage rotary piston blower VE
3. Stage vacuum screw to atmosphere
4. Intercooler
5. Inlet line

6. Bypass line
7. Check valve
8. Check valve
9. Silencer
10. Purging gas line

DryProvac Vacuum pump-sets
1400 - 1700 D/2 HV/SR
DryProvac Vacuum pump-sets
6000 - 7000 D/2 HV/SR

Series
C/3 HV/VE/SR
three-stage, final pressure of 5 x 10⁻³ mbar, suited for pumping of dry gases or gases with little humidity and for maintaining a good fine vacuum.

Properties and operation
Very high pumping speed after switching on the first stage HV and at final pressure. Still relatively high pumping speed with second stage VE and third stage SR when pumping down from atmospheric pressure to the cut-in pressure for the first stage HV without the risk of thermally overloading these stages VE/SR.

The second stage VE is cooled via pre-admission cooling just like in the DryProvac D/2 VE/SR only with the difference that the entire compressed gas from the delivery side of the second stage VE is cooled by an air cooler and that a partial flow of the cooled gas is branched off and supplied via the pre-admission channel of the stage VE into the pump chamber. Pumping down from atmospheric pressure is effected with second stage VE and third stage SR whereby the second stage VE pumps directly to the atmosphere until attaining the pressure conditions of the third stage SR. In order to protect the first stage HV against being overloaded when pumping down from atmospheric pressure, the first stage cuts-in via a pressure switch at about 20 mbar.

Area of application
Fine vacuum systems in which a vacuum needs to be maintained at a very high pumping speed and a high base pressure without having to continuously pump very large quantities of gas at high pressures or high pressure differentials.

The DryProvac C/3 HV/VE/SR can be supplied as one of 9 standard types with pumping speeds ranging from 2000 m³/h to 80000 m³/h.
DryProvac Vacuum pump-sets
8500 C/2 VE/SR

**Series**

D/2 VE/SR

two-stage, final pressure
5 \times 10^{-2} \text{ mbar}, suited for
pumping of humid or dry
gases.

**Properties and**

operation

High pumping speed from
atmospheric pressure down
to final pressure without the
risk of thermally overloading
the stages. Without direct
intermediate cooling
between the stages. The first
stage VE is cooled via
pre-admission. Here the
pre-admission gas flow is
branched off as an
uncooled partial flow from
the delivery side of the first
stage VE, cooled by an air
cooler and supplied via the
pre-admission channel of the
stage VE into the pump
chamber. Pumping from
atmospheric pressure is
affected with both stages
VE/SR whereby the first stage
VE pumps directly to the
atmosphere until the
pressure conditions of the
second stage are reached
for the first stage to cut-in.

**Area of application**

Rough and fine vacuum
applications where on the
one hand large quantities of
gas and vapour need to be
pumped or rapidly changing
operating modes with short
pump down times are requi-
red, and where on the other
hand a vacuum down in to
the fine vacuum range
needs to be maintained
rapidly after starting to pump
down.

The DryProvac D/2 VE/SR can
be supplied as one of
6 standard types with
pumping speeds ranging
from 500 m$^3$/h to 5500 m$^3$/h.
Higher pumping speeds are
available through custom
units.
### Technical Data

#### Data

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<td>1450</td>
<td>1750</td>
<td>1600</td>
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<td>Dimensions L in mm</td>
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<td>2650</td>
<td>2850</td>
<td>3100</td>
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<td>4500</td>
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<tr>
<td>Dimensions H in mm</td>
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<td>1800</td>
<td>2770</td>
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<td>1500</td>
<td>2010</td>
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<td>6.0</td>
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<td>150/10</td>
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<td>250/10</td>
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#### Notes

- Frequency converter needed
- The table includes all necessary data for the DryProvac vacuum pump-sets.
DryProvac Vacuum pump-sets
800 - 1400 D/2 VE/SR

Figure No.: 6a

Figure No.: 6b

DryProvac Vacuum pump-sets
600 - 1300 C/2 VE/SR

Figure No.: 9a

Figure No.: 9b
DryProvac Vacuum pump-sets
1800 D/2 VE/SR

Suction line DN 250
Gas outlet DN 150

DryProvac System C/2 VE/SR

Technical Data

<table>
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<tr>
<th>Technical Data</th>
<th>600 C/2 VE</th>
<th>800 C/2 VE</th>
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<th>2600 C/2 VE</th>
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<tr>
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<td>577</td>
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<td>11.6</td>
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<td>Max. pressure mbar</td>
<td>1.3 x 10⁸</td>
<td>1 x 10⁸</td>
<td>3 x 10⁸</td>
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<td>Energy consumption kW</td>
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Dimensions

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<tr>
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<tr>
<td>H in mm</td>
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<td>2570</td>
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<td>300/10</td>
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</table>

Figure No.: 7a
Figure No.: 7b

1. Stage rotary piston blower HV
2. Stage vacuum screw SR to atmosphere
3. Intercooler
4. Inlet line
5. Bypass line
6. Check valve
7. Check valve
8. Silencer
9. Purging gas line
DryProvac Vacuum pump-sets
5500 D/2 VE/SR

Series C/2 VE/SR
Two-stage, final pressure 5 x 10⁻² mbar, suited for pumping of dry gases or low humidity gases and for maintaining a fine vacuum.

Properties and operation
High pumping speed from atmospheric pressure down to final pressure without the risk of thermally overloading the first stage VE. With direct intermediate cooling between the stages. The first stage is cooled via pre-admission VE just as for the series DryProvac D/2 VE/SR only with the difference that the entire compressed gas from the delivery side of the first stage VE is cooled by an air cooler and that a partial flow of the cooled gas is branched off and supplied via the pre-admission channel of the stage VE into the pump chamber. With the DryProvac C/2 VE/SR a higher pumping speed is attained with the same vacuum pumping stages as for the DryProvac D/2 VE/SR. Pumping from atmospheric pressure is performed with both stages VE/SR as for the DryProvac VE/SR.

Area of application
Rough and fine vacuum applications where on the one hand large quantities of gas with a low water vapour content need to be pumped or rapidly changing operating modes with short pump down times are required, and where on the other hand a vacuum down in to the fine vacuum range needs to be maintained rapidly after starting to pump down.

The DryProvac C/2 VE/SR can be supplied as one of 9 standard types with pumping speeds ranging from 600 m³/h bis 8500 m³/h. Higher pumping speeds are available through custom units.