Donaldson
Filtration Solutions

Refrigeration Compressed Air Dryer Boreas Variopulse

The intelligent refrigeration compressed air

Why is compressed air processed?

Compressed air is an essential form of driving and process energy in all fields of industrial and production manufacturing. Compressed air must be dry, free of oil and clean to avoid expensive production breakdowns. Compressed air is produced by compressing air which is sucked into the compressor. This usually contains pollutants, dirt particles and always moisture in the form of water vapour, which condenses spontaneously in the compressed air and can then lead to disruptions in operations and thereby to substantial but avoidable costs.

DV 1800 AP

How does a Boreas work?

To process the compressed air, it is fed into the refrigeration compressed air dryer and is pre-cooled in an air/air heat exchanger. This pre-cooling is conducted in counter-flow with the expelled, cooled compressed air and therefore operates completely without additional energy. Further cooling to the pressure dewpoint is conducted in a refrigerant/air heat exchanger cooled by a refrigerant cycle. Throughout the entire cooling process, moisture is precipitated from the compressed air as condensate and is automatically drained. Before being expelled the processed compressed air is re-heated in the air/air heat exchanger by means of the entering compressed air.

Variopulse: A technical leader in dryer control systems

This microprocessor-based controller constantly processes data such as the cooling temperature, the pressure in the refrigeration cycle, the ambient temperature and dryer-specific parameters and thereby calculates the current operating status. Depending on the demand on the refrigeration compressed air dryer, the Variopulse controller regulates the performance of the condenser and the compressor via a frequency converter or the suction pressure control. At a very low demand, the refrigerant compressor is even switched off intermittently. With its function as a thermal accumulator, the heat exchanger permits a rapid response to changing demands and prevents dewpoint peaks.

dryer: Boreas Variopulse

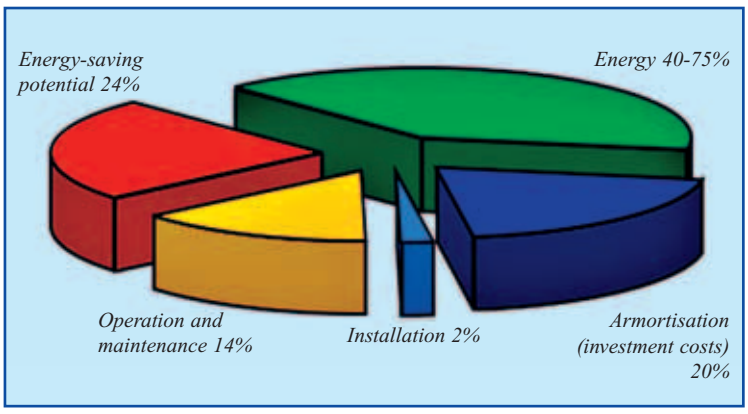
Frequency converter or suction pressure control – two ways to one objective: Energy-saving

With the Boreas Variopulse DV 1800 AP to DV 2800 AP, the performance of the refrigerant circulation system is controlled in the partial load range by a suction pressure control. This closes the suction pipe of the refrigerant compressor so that only a small proportion of the refrigerant flows through a bypass to the compressor. This then compresses less refrigerant than at peak load and therefore consumes substantially less energy.

The Boreas Variopulse dryers sizes DV 3500 AP to DV 28500 WP employ a frequency converter to control the performance. With this system, a frequency converter continuously controls the speed of one of the refrigerant compressor.

With these two control concepts and the Variopulse controller, the energy consumption falls in linear proportion to the dryer load by up to 90% at zero load. This leads to an extremely low energy consumption in the zero, partial and peak load ranges.

The energy costs exceed the investment costs within a very short time.



The multifunction display

- Current pressure dewpoint
- Operating mode normal/summer/automatic
- Energy consumption in relation to the overall service life
- Error messages
- Malfunction history
- Expired maintenance intervals
- Condensate drain operating status
- Operating hours
- Refrigerant compressor on/off
- Current energy consumption

Features and advantages

- Variopulse controller as standard
- Permanently illuminated multifunction display
- Constant pressure dewpoint without dewpoint peaks
- Load-dependant energy consumption, reduction by up to 90% in proportion to the rated energy consumption
- Aluminium heat exchanger
- Level-controlled condensate drain Ultramat UFM-T100
- CAN-BUS interface for remote monitoring or to read data using a laptop computer as standard
- Display adjustable for °C or °F
- No energy-wasting hot gas bypass
- High overload capacity due to use of environmentally friendly refrigerant R-134a

The intelligent refrigeration compressed air

Aluminium heat exchanger

- Generously proportioned high performance air/air and refrigerant/air heat exchangers
- Integrated condensate separation system
- Insensitive to dirt due to generously proportioned flow ducts
- Low air pressure difference
- Insensitive to corrosion due to the use of aluminium in special production processes which have been tried and tested for decades

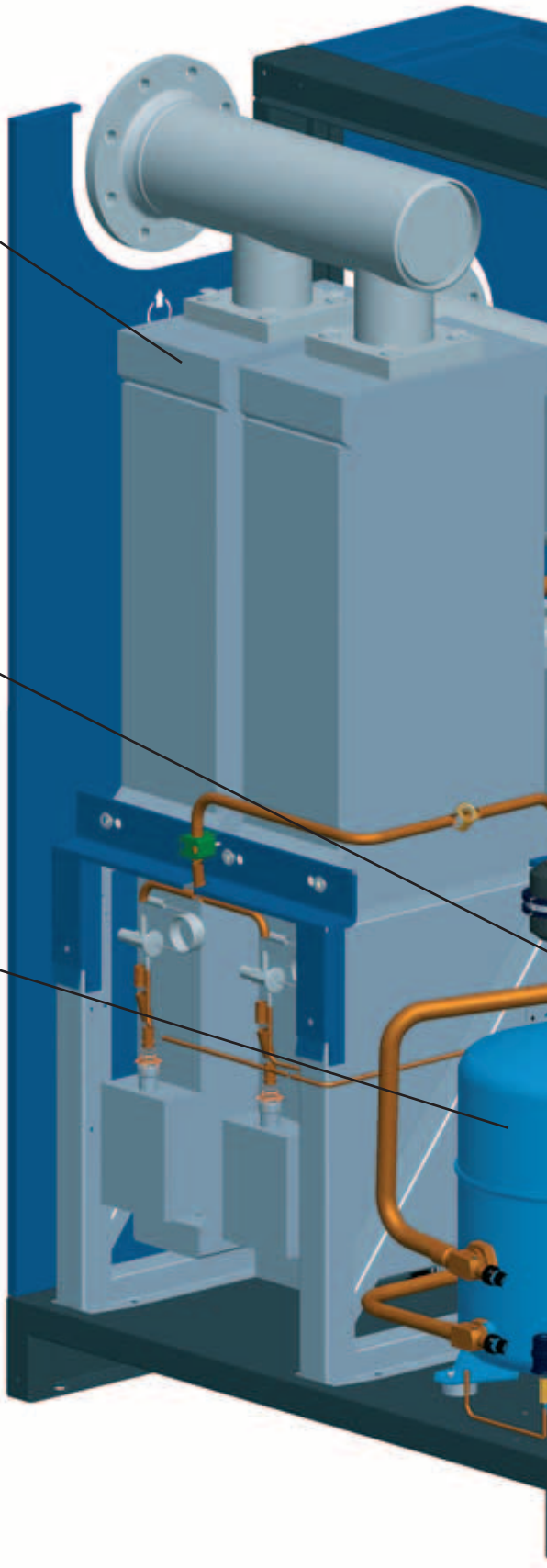
R-134a as refrigerant

- As all other refrigeration compressed air dryers from Donaldson, the Boreas Variopulse types use as standard the refrigerant R-134a. With an ozone depletion factor of 0, this refrigerant for example loses less of its efficiency at high ambient temperatures than other common refrigerants. This leads to a substantial reduction in the susceptability to failure of the machine.

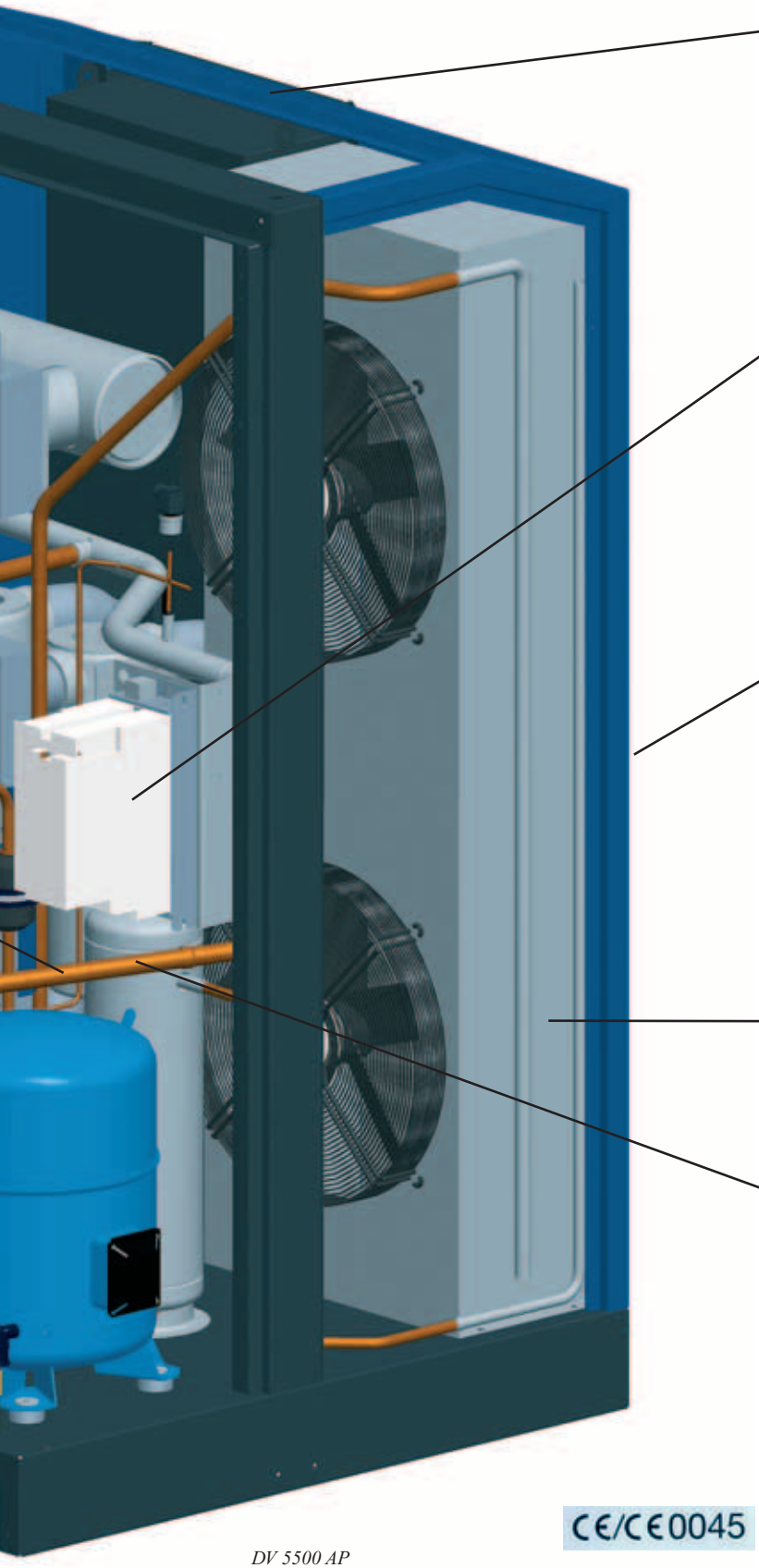
Piston refrigerant compressor

- With permissible coolant temperatures of +2 to +50°C (atmospheric air or cooling water), the piston compressors used in the Boreas Variopulse provide benefits over the frequently used scroll compressors.

  Due to their design, scroll compressors work with optimum effectiveness in only a narrow range of operation. In contrast, piston compressors achieve very good efficiency over a substantially wider range. This leads to a low dewpoint at overload or a lower energy consumption under partial loads in comparison with scroll compressors.



dryer: Boreas Variopulse



DV 5500 AP

CE/CE0045

Electrical cabinet with integrated display

- Compact electrical cabinet with all operating units at the front.
- Permanently illuminated display indicating all relevant information.

Frequency converters

- The frequency converter used to control the performance regulates the speed of the refrigerant compressor (DV 3500 AP to 28500 WP).
- In the smaller refrigeration compressed air dryers, the performance is controlled by a solenoid valve in a suction pressure control system instead of a frequency converter (DV 1800 to 2800 AP).

Level-controlled condensate drain Ultramat UFM-T 100

- All Boreas Variopulse refrigeration compressed air dryers are equipped with the level-controlled condensate drain UFM-T100. This fully prevents compressed air losses.

High-performance condensers

- The entire Boreas Variopulse series is available with both water-cooled plate condensers and air-cooled condensers.

Refrigerant cycle

- Mainly in high-quality copper pipe. At places subject to vibrations, stainless steel pipes are used to attain long product life cycles.

Boreas Variopulse DV 1800 AP to DV 28500

Technical Data										
Case	Type	Flow rate	Flow rate	Pressure drop	Electrical connection	Power Consumption kW			Cooling air consumption	Cooling water consumption
		m^3/h	m^3/min	bar	3~/50Hz	100% Peak load	50% Partial load	0% Zero load	m^3/h	m^3/h
0	DV 1800 AP	1800	30,0	0,12	400 V	3,1	1,7	0,4	4800	1,0
	DV 2000 AP	2000	33,3	0,14	400 V	3,2	1,9	0,4	4800	1,1
	DV 2300 AP	2300	38,3	0,19	400 V	3,4	2,0	0,4	4800	1,3
	DV 2800 AP	2800	46,6	0,24	400 V	4,3	2,5	0,6	5200	1,6
1	DV 3500 AP	3500	58,3	0,11	400 V	6,9	4,0	0,8	9600	2,0
	DV 4300 AP	4300	71,6	0,16	400 V	7,1	4,1	0,9	9600	2,5
	DV 5500 AP	5500	91,6	0,24	400 V	10,8	6,2	1,4	10400	2,9
2	DV 7000 WP	7000	116,6	0,19	400 V	12,6	7,1	1,5	19200	4,0
	DV 8750 WP	8750	145,8	0,17	400 V	15,3	8,6	2,0	19200	5,2
	DV 10500 WP	10500	175,0	0,22	400 V	17,3	9,7	2,1	20800	6,4
3	DV 12500 WP	12500	208,3	0,22	400 V	21,9	12,1	2,7	23000	7,5
	DV 14250 WP	14250	237,5	0,20	400 V	23,9	13,3	3,0	23000	8,5
Twin	DV 17500 WP	17500	291,6	0,17	400 V	30,6	17,3	3,8	38400	10,4
	DV 21000 WP	21000	350,0	0,22	400 V	34,6	19,6	4,4	41600	12,8
	DV 25000 WP	25000	416,6	0,22	400 V	43,8	24,3	5,5	46000	15,0
	DV 28500 WP	28500	475,0	0,20	400 V	47,8	26,6	6,0	46000	17,0

Design
Flow rate in relation to the suction status of the air compressor (+20°C, 1 bar) at compressed air inlet +35°C, operating pressure 7 bar, ambient temperature + 25°C, dewpoint +3°C, measured at the dryer outlet according to DIN ISO 7183, power consumption at +25°C ambient temperature/cooling water temperature.

Operating pressure	min. 2 bar max. 16 bar	Inlet temperature	max. +70 °C
Ambient temperature	min. +2 °C max. +50 °C	Noise level	dB (A) < 80

Operating pressure	bar g	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Factor	f_p	0,60	0,70	0,80	0,88	0,94	1,00	1,04	1,06	1,09	1,10	1,12	1,14	1,15	1,16	1,17

Compressed air inlet temperature	°C	30	35	40	45	50	55	60	65	70
Factor	f_{ti}	1,20	1,00	0,82	0,67	0,55	0,45	0,38	0,34	0,30

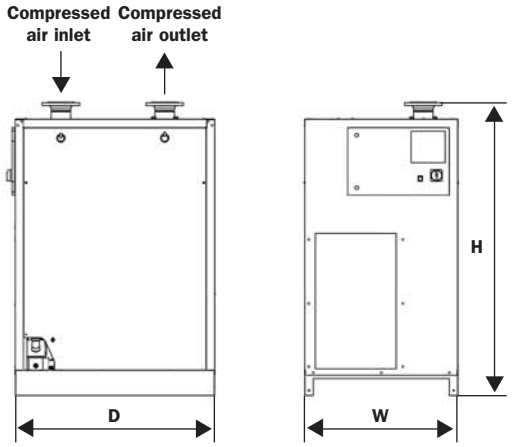
Ambient temperature / cooling water temperature	°C	25	30	35	40	45	50
Factor	f_{tc}	1,00	0,98	0,93	0,84	0,72	0,56

Pressure dewpoint	°C	3	5	7	10	15
Factor	f_{ta}	1,00	1,10	1,21	1,35	1,58

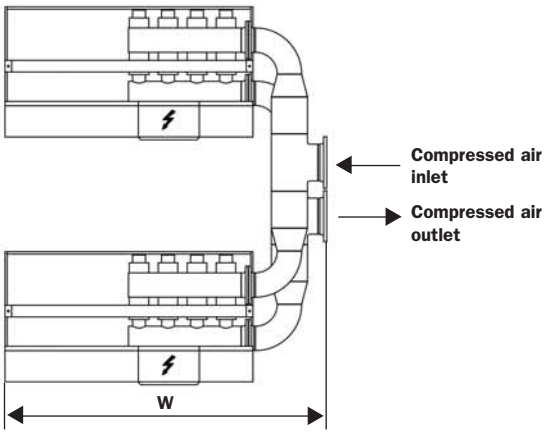
Corrected dryer performance =
standard dryer performance x f_p x f_{ta} x f_{tc} x f_{ti}

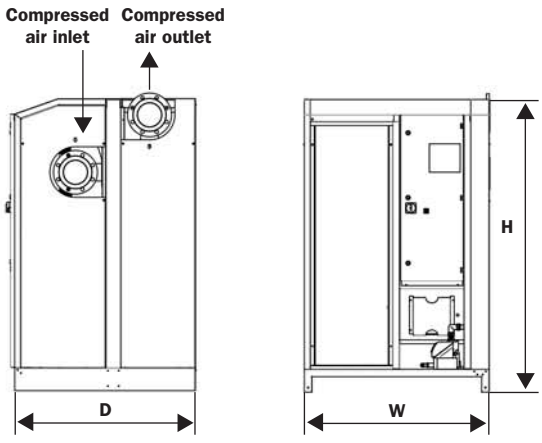
WP Twin: Technical data

Dimensions							
Case	Type	Air connections	Condensate drain	Weight	Dimensions		
		DN	DN	kg	Width	Height	Depth
0	DV 1800 AP	100	14	412	900	1725	1175
	DV 2000 AP	100	14	420	900	1725	1175
	DV 2300 AP	100	14	425	900	1725	1175
	DV 2800 AP	100	14	435	900	1725	1175
1	DV 3500 AP	150	14	610	1200	1940	1200
	DV 4300 AP	150	14	630	1200	1940	1200
	DV 5500 AP	150	14	670	1200	1940	1200
2	DV 7000 WP	200	14	995	2225	1970	1200
	DV 8750 WP	200	14	1165	2225	1970	1200
	DV 10500 WP	200	14	1225	2225	1970	1200
3	DV 12500 WP	250	14	1710	3345	2030	1200
	DV 14250 WP	250	14	1940	3345	2030	1200
Twin	DV 17500 WP	250	14	2730	2885	1970	3400
	DV 21000 WP	300	14	2890	2885	1970	3400
	DV 25000 WP	350	14	3860	4145	2080	3400
	DV 28500 WP	350	14	4320	4145	2080	3400

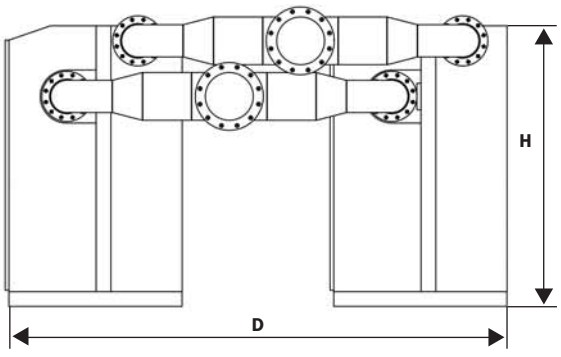


DV 1800 AP-2800 AP





DV 3500 AP-14250 WP



DV 17500 WP-28500 WP

Annual energy savings with the microprocessor-based Variopulse controller as a unit with suction pressure control or speed control with a frequency converter.

Annual energy savings of 35 % or more

Comparison of the energy consumption of different systems				
	Boreas Variopulse DV 7000 WP	**Standard refrigeration compressed air dryer with hot gas controller**	**Standard refrigeration compressed air dryer with accumulator**	**Standard speed-controlled refrigeration compressed air dryer**
Flow rate	7000 m^3/h	7000 m^3/h	7000 m^3/h	7000 m^3/h
Pressure dewpoint	3 °C	3 °C	3 °C	3 °C
Annual energy consumption	32003 kWh	60574 kWh	49260 kWh	42965Wh
Annual energy costs in Euros	**2.560,-**	**4.846,-**	**3.941,-**	**3.437,-**

This example of energy saving is based on the following principles: Industrial production in one shift, 5 working days per week, standby mode on days off work and an electricity price of 8 Eurocents per kilowatt hour. The pressure loss is not taken into account in the calculation, but leads to additional energy costs of 40-80%.

Technical alterations reserved (6/2005)

GB – 2009/1