œrlikon
leybold vacuum

Cryopumps, Cryogenics

182.01.02
Excerpt from the Oerlikon Leybold Vacuum Full Line Catalog
Product Section C12
Edition 2010

Contents

Conversion of Units

Celsius, Fahrenheit, Kelvin

Kelvin (abbreviated as K) is the unit of temperature.

Temperatures on the Kelvin scale are converted into temperatures on the Celsius scale as follows:

n °C = (n + 273.15) K.

Since the following equation applies between Celsius scale and Fahrenheit scale

n °F = 5/9 (n – 32) °C

it follows that

n °F = 5/9 (n + 459.67) K.

The inverse equations are as follows:

m K = (m – 273.15) °C

m °C = (1.8 m + 32) °F

m K = (1.8 m – 459.67) °F.

The following applies in particular to absolute Zero:

0 K = -273.15 °C ; -459.67 °F.

1 bar = 14.5 psi
1 MPa = 10 bar

Applications and Accessories, Cryopumps

Cryo pumps	COOLVAC 800 BL	COOLVAC 800 CL	COOLVAC 1.500 CL	COOLVAC 2.000 CL	COOLVAC 3.000 CL	COOLVAC 5.000 CL	COOLVAC 10.000 CL	COOLVAC 18.000 CL	COOLVAC 30.000	COOLVAC 60.000
Application										
UHV systems	■	■	■	■						
Beam tubes in particle accelerators	■									
Transfer chambers / Loadlock	■	■	■	■	■					
General research	■	■	■	■	■	■	■	■	■	■
Evaporation coating systems		■	■	■	■	■	■	■	■	■
Sputtering systems		■	■	■	■					
Ion implanters		■	■	■	■	■				
Metallization systems	■	■	■	■	■	■	■	■	■	■
Space simulation chambers	■	■	■	■	■	■	■	■	■	■
Electron beam welding systems	■	■	■	■	■	■	■	■	■	

Accessories	Page										
Compressor unit COOLPAK 2000 (A)/2200 (A)	C12.34/36	■	■	■	■	■					
Compressor unit COOLPAK 6000/6200	C12.38	[■]	[■]	[■]	[■]	[■]	■	■	■	■	■
Low temperature controller Modell 9700	C12.52	■									
Temperature sensor	C12.54	■									
Gas manifold GD 2	C12.42	■	■	■	■	■	■				
Gas manifold GD 4	C12.42	■	■	■	■						

[■] = For dual and mutiple operation only

Applications and Accessories, Cryogenics

Cold heads	COOLPOWER 140 T	COOLPOWER 7/25	COOLPOWER 5/100	COOLPOWER 5/100 T	COOLPOWER 10 MD
Application					
Cooling of samples and detectors	■	■	■	■	■
Cooling of superconductors	(■)	■	■	■	■
Cooling of cryopanels	■	■	■	■	■
Cleaning of gases	■	■	■	■	■
Calibration of sensors		■	■	■	■
Optical spectroscopy		■	■	■	■
Infrared spectroscopy		■	■	■	■
Matrix spectroscopy		■	■	■	■
Testing of superconductors		■			
Cooling of superconducting magnets, coils and components HT_C + LT_C	(■)		■	■	■

Accessories	Page					
Compressor unit COOLPAK 2000 (A)/2200 (A)	C12.34/36		■			
Compressor unit COOLPAK 6000/6200	C12.38	■		■	■	
Compressor unit COOLPAK 6000 MD/6200 MD	C12.40					■
Low temperature controller Modell 9700	C12.52		■	■	■	
Low temperature measurement instrument MODEL 211S	C12.53	■	■	■	■	
Temperature sensor	C12.54	■	■	■	■	

(■) = Only high T_c superconductors

Cryopumps

Cryopumps are gas entrapment vacuum pumps for the pressure range from 10^{-3} to $< 10^{-11}$ mbar (0.75×10^{-3} to $\leq 0.75 \times 10^{-11}$ Torr). The principle of operation is that gaseous substances are bound to the cold surfaces within the pump by means of cryocondensation, cryosorption or cryotrapping.

In order to be able to produce a high or ultra-high vacuum the cold surfaces (cryopanels) must be cooled to a sufficiently low temperature. Depending on the type of cooling system used a difference is made between refrigerator cryopumps, bath cryopumps and evaporator cryopumps.

Oerlikon Leybold Vacuum manufactures only cryopumps which are cooled by means of a refrigerator.

Advantages to the User

Advantages offered by the Pumping Principle

- High effective pumping speed for all gases
- Extremely high pumping speed for water vapor

For a given diameter of the high vacuum flange, the cryopump offers the highest pumping speed of all high vacuum pumps.

Advantages offered by Design

In contrast to gas transfer high vacuum pumps (mechanically suspended turbomolecular pumps, for example), cryopumps do not have any mechanically moving, oil, or grease lubricated parts on the vacuum side.

The following advantages are a direct result of this design characteristic:

- Hydrocarbon-free vacuum in the pressure range from 10^{-3} to $< 10^{-11}$ mbar (0.75×10^{-3} to $\leq 0.75 \times 10^{-11}$ Torr).
- Insensitivity to mechanical disturbances from particles coming from the process or external vibrations.

Further Advantages

- Much more compact than comparable pump systems offering a pumping speed of over 1500 l x s^{-1}
- Backing pump is only required during start-up and during regeneration
- Easy process control and pump control via computer
- Favorable price-to-performance ratio and low running costs especially at higher pumping speeds

The cryopumps are cooled by the well-proven two-stage cold heads from Oerlikon Leybold Vacuum's COOLPOWER line (Gifford/McMahon principle).

The design of a refrigerator cryopump from the COOLVAC range is shown schematically in the figure below.

The first stage of the cold head **(9)** cools the thermal radiation shield **(5)** and the baffle **(6)** of the pump.

Depending on the type of pump and the operating conditions operating temperatures of 45 to 80 K are attained. Correspondingly water vapor condenses at this temperature.

The thermal shield and baffle are made of copper which conducts heat very well so as to optimally utilize the refrigerating capacity which is available.

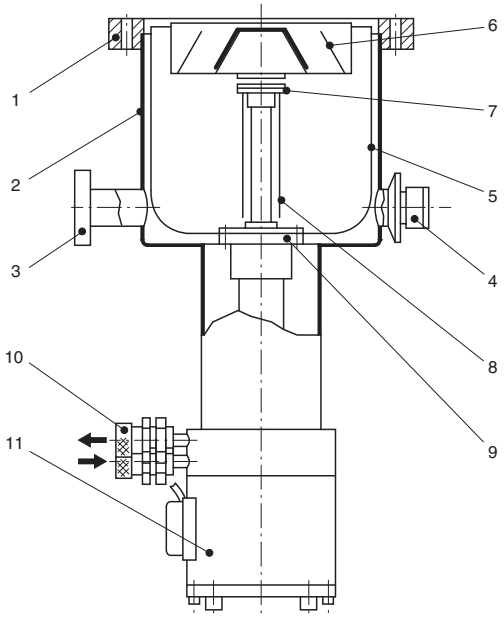
Moreover, the thermal shield is metallized so that reflective losses will be minimal.

The second stage of the cold head **(7)** is used to cool the cryopanels **(8)**. Depending on the operating conditions, operating temperatures of 10 to 20 K are attained.

Here the process of cryocondensation of N_2, O_2 and argon will take place.

The active pumping surfaces are made of copper of high thermal conductivity and they are tightly linked thermally to the second stage of the cold head. H_2, Ne and He are also adsorbed on to these surfaces which are partly covered with activated charcoal.

1 High vacuum flange
2 Pump body
3 Foreline flange
4 Safety valve with flange connection for connection of an exhaust line
5 Thermal radiation shield
6 Baffle
7 Second stage of the cold head
8 Cryopanels
9 First stage of the cold head
10 Helium gas connections
11 Cold head motor with housing and electrical connections



COOLVAC refrigerator cryopump

All cryopumps from the COOLVAC range are equipped with a safety valve (respectively with a bursting disk in the case of the UHV variants) which is set in the factory so that it will open at an overpressure of 150 mbar (113 Torr).

In order to be able to safely remove any gases which may present a health hazard when the safety valve responds, the valve is equipped with an additional DN 40 KF flange where an exhaust line is connected.

The pump's body, all flanges and the safety valve are made of high-quality stainless steel.

Multiple Operation of Refrigerator Cryopumps

The powerful Oerlikon Leybold Vacuum compressor units COOLPAK 4000 D and 6000 D open up the possibility of operating two cold heads or refrigerator cryopumps simultaneously.

Advantages to the User

- Significantly reduced investment and operating costs
- Small footprint

Regenerating Cryopumps

An important aspect in the operation of cryopumps is that of regeneration. Since a cryopump is a gas entrapment pump, the gasses which have accumulated in the pump during the "pumping" mode must from time to time be removed from the pump. This is done by switching the compressor unit off and by warming up the cryopanels to room temperature or sightly higher so that the released substances can be pumped out by a forevacuum pump.

Cryopumps without Electric Regeneration System

The cryopump is warmed up to room temperature by purging the inside of the pump with a dry, pre-warmed inert gas (such as nitrogen). In this case it is not possible to set up defined and controlled temperatures within the cryopump. Thus the simultaneous presence of gases such as hydrogen and oxygen in the pump can not be entirely excluded. The formation of ignitable gas mixtures is only prevented by the diluting effect of the dry inert gas.

Cryopumps with Fully Automatic Electric Regeneration System from Oerlikon Leybold Vacuum

The cryopump is warmed up to room temperature by heating the 1st and 2nd stages of the cold head with electric heaters. In this case, a defined and controlled temperature distribution within the cryopump can be set up. This controlled warming process ensures that the pumped gases are removed sequentially, i.e. the pumped gases are released one after the other in the following sequence:

- Gases adsorbed at the cryopanels (e.g. hydrogen, helium, neon),
- Gases condensed at the cryopanels (e.g. nitrogen, oxygen, argon),
- Gases and vapors which have condensed on to the baffle and thermal radiation shield (e.g. water vapor).

The electric method of regeneration from Oerlikon Leybold Vacuum prevents gases such as hydrogen and oxygen from being present in the pump at the same time. This excludes the formation of ignitable gas mixtures right from the start.

Cryopumps without fully automatic control and without electric regeneration system belong to the BasicLine (BL), like the COOLVAC 800 BL, for example.

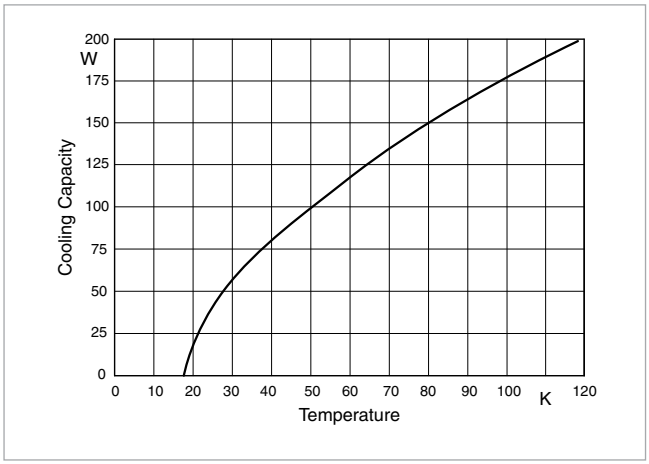
The warming up process is fully automatic. Pressure and temperature distribution within the pump are set up and controlled by the control system at all times. The sequential regeneration of pumped gases prevents the forma-tion of ignitable gases right from the start. This ensures the utmost safety during the regeneration of cryopumps from Oerlikon Leybold Vacuum.

In the case of cryogenic pumps with fully automatic control there exist two cryopump lines.

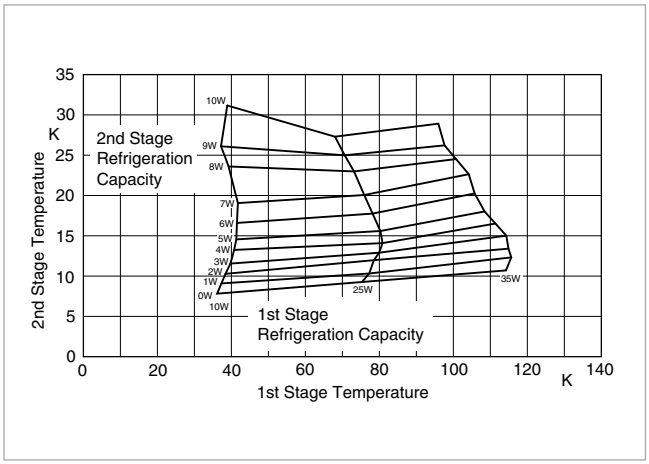
1. The COOLVAC BasicLine (COOLVAC BL) offering the following pumping speed class for Nitrogen in l/s: 800; COOLVAC 800 BL, for example.
   Other pumping speed classes from 1 500 to 18 000 l/s are available on request.
   For more information please contact your local Oerlikon Leybold Vacuum representative.
2. The COOLVAC ClassicLine (COOLVAC CL) offering the following pumping speed classes for nitrogen in l/s: 800, 1 500, 2 000, 3 000, 5 000, 10 000 and 18 000; COOLVAC 1500 CL, for example.

In the price list the designators "V" appears in connection with the pump designations.
"V":
The high-vacuum flange is located at the top and the cold head below, as is the case for the COOLVAC 1500 CL-V, DN 200 CF.

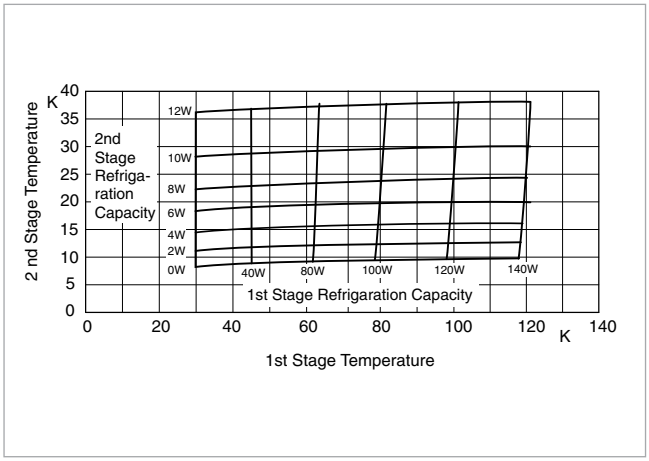
Refrigerating Capacity of Cryogenic Cold Heads



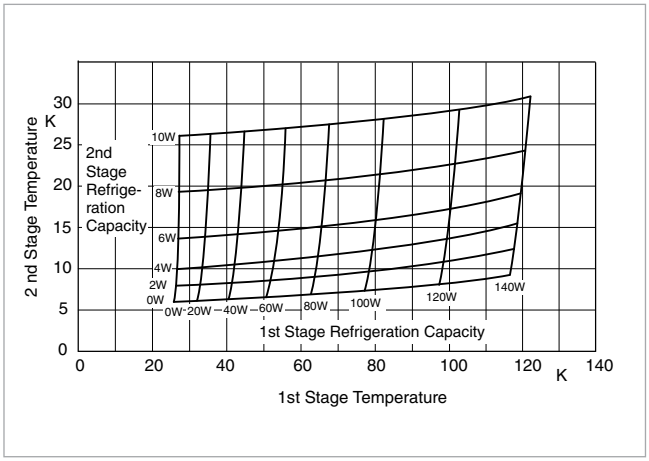
Typical refrigerating capacity of the cold head COOLPOWER 140 T



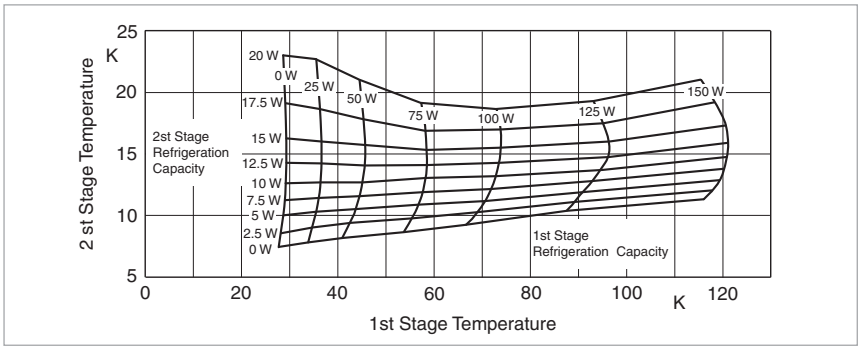
Typical refrigerating capacity of the cold head COOLPOWER 7/25



Typical refrigerating capacity of the cold head COOLPOWER 5/100



Typical refrigerating capacity of the cold head COOLPOWER 5/100 T



Typical refrigerating capacity of the cold head COOLPOWER 10 MD

The refrigerating capacities stated apply to vertical operation with the cold end at the bottom.

Cold Heads

A refrigerator (cold head) is a gas cooling machine which operates on the basis of a thermodynamic cycle to produce cryogenic temperatures ($T \leq 120$ K).

Refrigerators operating according to the Gifford/McMahon principle have succeeded over other methods of cooling cryopumps and cryostats. It is thus employed exclusively by Oerlikon Leybold Vacuum.

In order to account for individual requirements from customers, Oerlikon Leybold Vacuum offers customized cryostats as well.

Gifford/McMahon-Refrigerators

Advantages to the User

- Low temperatures on a single key press
- No liquid helium and no liquid nitrogen are required
- Very simple to operate
- High refrigerating capacity from a small volume
- Easy process control and temperature control via a computer

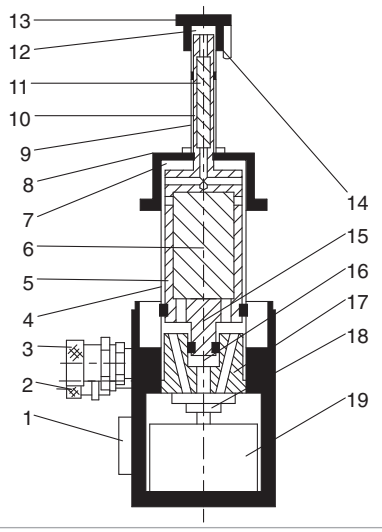
Advantages by Design

- No space problems since cold head and compressor unit can be installed and operated apart
- Installation of the cold head basically in any orientation
- High reliability
- Long periods of operation without maintenance

Typical Applications

- Cooling of cryopanels in cryopumps thereby producing high or ultra high vacuum
- Cooling of superconducting magnets; in magnetic resonance tomographs, for example
- Cooling of samples and detectors; especially for cooling of
  - samples for spectroscopic analysis in the areas of solid state and surface physics
  - high temperature superconductors
  - superconductors and semiconductors
  - infrared and gamma detectors
- Calibration of sensors

1 Electrical connection and current lead-through for cold head motor
2 Helium high pressure connection
3 Helium low pressure connection
4 Cylinder, 1st stage
5 Displacement piston, 1st stage
6 Regenerator, 1st stage
7 Expansion volume, 1st stage
8 1st (refrigerator) stage (copper flange)
9 Cylinder, 2nd stage
10 Displacement piston, 2nd stage
11 Refrigerator, 2nd stage
12 Expansion volume, 2nd stage
13 2nd (refrigerator) stage (copper flange)
14 Vapor pressure measurement chamber
15 Control piston
16 Control volume
17 Control disc
18 Control valve
19 Cold head motor



Dual-stage Gifford/McMahon cold head (schematic diagram)

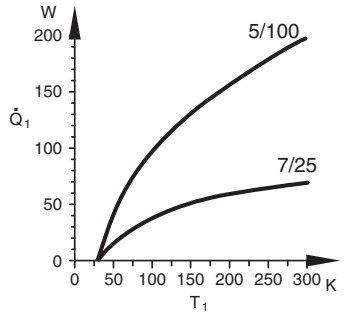
Cold Heads from the COOLPOWER Range

The standard range of single-stage and two-stage cold heads matches a wide range of applications.

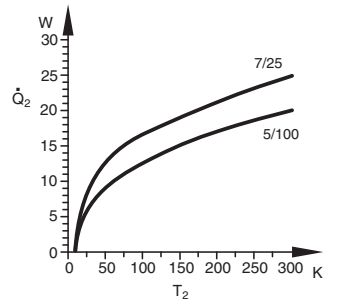
Oerlikon Leybold Vacuum is offering refrigerators with usable refrigerating powers of 140 W at 80 K (COOLPOWER 140 T, single-stage) and down to 3.5 W at 10 K (COOLPOWER 5/100 T; dual-stage).

The cold heads basically consist of three subassemblies:

- Drive and control unit for the displacer
- Displacer
- First stage of the cold head (and second stage in the case of two-stage cold heads).



Refrigerating capacity as a function of temperature; operation in connection with the recommended compressor unit at 50 Hz; measured under standard acceptance conditions:
Refrigerating capacity $\dot{Q}_1$ of the first stage as a function of temperature T_1 of the first stage (2nd stage: $\dot{Q}_2 = 0$)



Refrigerating capacity $\dot{Q}_2$ of the second stage as a function of temperature T_2, of the second stage (1st stage: T_1 = 80 K = constant).
Standard acceptance conditions:
Cold head in a vacuum, 2nd cold stage thermally shielded by a radiation shield (high-gloss nickel-plated) attached to the 1st stage, thermal loading $\dot{Q}$ simulated by electrical heating.

Pneumatically driven Cold Heads

Advantages

- **Simple Design**
  The pneumatic drive system for the displacer of these cold heads from Oerlikon Leybold Vacuum consists of only two mechanically moving components: the rotating control valve and the synchronous motor driving the control valve.
- **Easy and quick maintenance**
  All Oerlikon Leybold Vacuum cryopumps from the COOLVAC range are equipped with pneumatically driven Oerlikon Leybold Vacuum cold heads.
  Owing to the simple design of the built-in cold heads, maintenance is easy. Maintenance can be performed in place without detaching the cryopump from the vacuum chamber.

Mechanically driven Cold Heads

Advantages

In the case of the mechanically driven Oerlikon Leybold Vacuum cold heads, the displacer is moved through the so-called “Scotch yoke” directly by the drive motor. This elaborate mechanism allows the gas flow and the movement of the displacer to be precisely controlled through which it is possible to attain with two-stage cold heads especially high refrigerating capacities in the range of lowest temperatures (refrigerators of the COOLPOWER 10 MD line).

Advantages Through High Reliability

As to reliability, Oerlikon Leybold Vacuum cold heads are top performers.

Especially high reliability is required for medical instrumentation, specifically in connection with nuclear spin tomographs. In this application cold heads are used to cool superconducting magnets and they are thus exposed to strong magnetic fields.

The leading manufacturers of nuclear spin tomographs have therefore decided to use Oerlikon Leybold Vacuum cold heads to cool the superconducting magnets.

Refrigerator Cryostats (Basic Units)

Advantages to the User

- Can be installed basically in any orientation thereby offering a high degree of flexibility in experimental arrangements
- Can be set to any temperature within 6.5 and 320 K
- High refrigerating capacity, constant temperatures
- No liquid refrigerants are required
- Very simple to operate
- Temperature control without problems through standardized control and connecting components
- Possible high throughput of samples due to short cooldown and warming-up periods

Typical Applications

- Cooling of
  - high temperature superconductors
  - superconductors and semiconductors
  - infrared and gamma detectors
- Measurement of electric and thermal transport quantities, as a function of the temperature, such as
  - electric and thermal conductance
  - electromotive force

Especially in connection with:

- Spectroscopic investigations in the infrared, visible and ultraviolet spectral ranges
- Matrix spectroscopy
- Moessbauer spectroscopy
- Magneto-optic experiments

Compressor Units

COOLPAK 2000 to 6000 compressors are available for single operation of the remaining cold heads from the COOLPOWER line as well as for multiple operation of cryopumps and cryostats.

The period during which no maintenance will be required on the Oerlikon Leybold Vacuum compressor units depends on the service life of the adsorber. If the values for the ambient temperature and the cooling water entry temperature remain within the specified range, Oerlikon Leybold Vacuum guarantees a service life for the adsorber – and thus a period during which no maintenance will be required – of 18 000 operating hours.

The possibilities for single and multiple operation of refrigerator cryopumps are given in the following table:

	For the operation of	
Compressor unit	**Cold head**	**Cryopumps**
COOLPAK 2000/2200	1 x COOLPOWER 7/25	1 x COOLVAC 800/1500/2000/3000
COOLPAK 2000 (A)/2200 (A)	1 x COOLPOWER 7/25	1 x COOLVAC 800/1500/2000/3000
COOLPAK 6000 D	2 x COOLPOWER 7/25 up to 2 x COOLPOWER 5/100 [1)]	2 x COOLVAC 800/1500/2000/3000 2 x COOLVAC 5000 [1)]
COOLPAK 6000/6200	1 x COOLPOWER 140 T 1 x COOLPOWER 5/100	3 x COOLVAC 800/1500/2000 2 x COOLVAC 3000 (5000 [1)]) 1 x COOLVAC 5000/10000
COOLPAK 6000 MD/6200 MD	1 x COOLPOWER 10 MD	

[1)] at reduced power

UL Approval

The Oerlikon Leybold Vacuum refrigerators in this catalog (consisting of compressor unit COOLPAK (4000/4200, 6000/6200, flexlines FL and the cold head COOLPOWER [2)] meet – as complete systems – the requirements of the Underwriter Laboratories (UL) as Recognised Components (Urus) as well as the approval cUR performed through the Underwriter Laboratories for the Canadian Standards Association.

[2)] resp. formerly RGD

Oerlikon Leybold Vacuum refrigerators are listed under the UL/cUL reference number SA 8676. The marks as shown on the right for the entire system can only be found on the name plate of the compressor unit.

CE Approval

The Oerlikon Leybold Vacuum compressor units RW and COOLPAK meet the basic requirements regarding safety and health of the relevant EC directives. They carry on the name plates of the compressor units the following mark.

Products Cryopumps

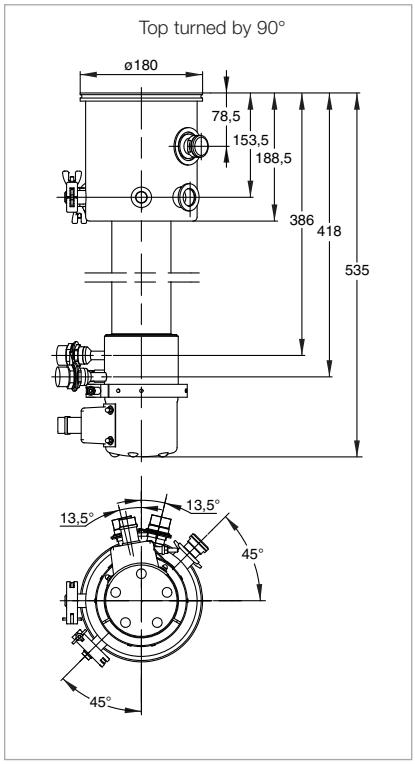
Standard Cryopumps, BasicLine
COOLVAC 800 BL

Advantages to the User

- Hydrocarbon-free high vacuum
- High capacity for argon and hydrogen
- High pumping speed for water vapor, argon and hydrogen

Typical Applications

- Lamps and tubes manufacture
- Transfer chambers / Loadlock
- General research



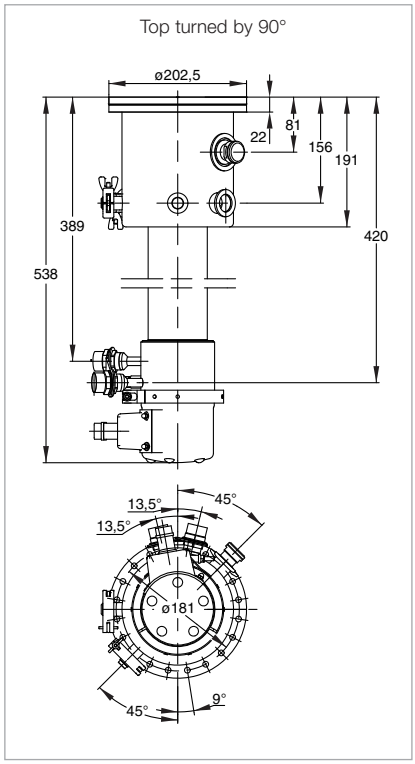
Dimensional drawing for the
COOLVAC 800 BL (160 ISO-K)

Advantages to the User

- Hydrocarbon-free ultra-high vacuum
- High pumping speed for water vapor, nitrogen and hydrogen

Typical Applications

- Beam tubes in particle accelerators
- General research



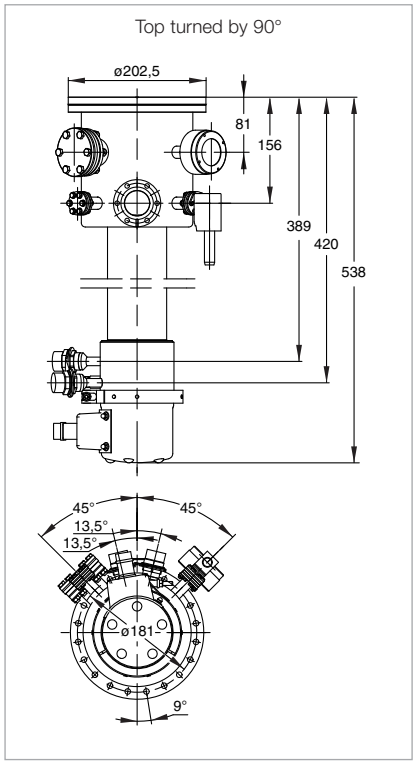
Dimensional drawing for the
COOLVAC 800 BL (160 CF)

Advantages to the User

- Hydrocarbon-free ultra-high vacuum
- High pumping speed for water vapor, nitrogen and hydrogen

Typical Applications

- Beam tubes in particle accelerators
- UHV systems



Dimensional for the
COOLVAC 800 BL UHV (160 CF)

Technical Data

		COOLVAC 800 BL (ISO-K)	COOLVAC 800 BL (CF)	COOLVAC 800 BL UHV (CF)
High vacuum flange	DN	160 ISO-K	160 CF	160 CF
Fore vacuum flange	DN	25 KF	25 KF	40 CF
Flange for other purposes	DN	16 KF (2x)	16 KF (2x)	16 CF (1x), 40 CF (1x)
Safety valve with DN 40 KF flange connection for gas exhaust line		welded-in	welded-in	burst disk mounted on DN 16 CF
Pumping speed				
H_2O	l x s^{-1}	2600	2600	2600
Ar / N_2	l x s^{-1}	640 / 800	640 / 800	640 / 800
H_2 / He	l x s^{-1}	1000 / 300	1000 / 300	1000 / 300
Capacity				
Ar/N_2	bar x l (Torr x l)	300 (225 000)	300 (225 000)	300 (225 000)
H_2 at 10^{-6} mbar	bar x l (Torr x l)	4.3 (3225)	4.3 (3225)	4.3 (3225)
He	bar x l (Torr x l)	0.5 (375)	0.5 (375)	0.5 (375)
Built-in cold head	COOLPOWER	7/25	7/25	7/25
Max. throughput				
Ar/N_2	mbar x l x s^{-1} (Torr x l x s^{-1})	4 (3)	4 (3)	4 (3)
H_2	mbar x l x s^{-1} (Torr x l x s^{-1})	2 (1.5)	2 (1.5)	2 (1.5)
Crossover value	mbar x l (Torr x l)	150 (112)	150 (112)	150 (112)
Cool down time to 20 K	min	50	50	50
Overall height	mm (in.)	535 (21.06)	538 (21.18)	538 (21.18)
Weight	kg (lbs)	12 (26.5)	12 (26.5)	12 (26.5)
Silicon diode for temperature measurements at second stage of the cold head		built-in to a DN 16 KF with 4 way HV current feedthrough	built-in to a DN 16 KF with 4 way HV current feedthrough	built-in to a DN 16 CF with 4 way with UHV feedthrough

Ordering Information

	COOLVAC 800 BL (ISO-K)	COOLVAC 800 BL (CF)	COOLVAC 800 BL UHV (CF)
	Part No.	**Part No.**	**Part No.**
COOLVAC	**844160V1006**	**844160V1002**	**844160V9002**
Compressor unit			
COOLPAK 2000	**840000V2000**	**840000V2000**	**840000V2000**
COOLPAK 2200	**840000V2200**	**840000V2200**	**840000V2200**
COOLPAK 2000 A	**840000V2010**	**840000V2010**	**840000V2010**
COOLPAK 2200 A	**840000V2210**	**840000V2210**	**840000V2210**
Connecting cable Compressor – cold head, 4.5 m (15.75 ft)	**E 400000323**	**E 400000323**	**E 400000323**
Electric extension cable EL 4.5	**893 74**	**893 74**	**893 74**
Flexlines			
FL 4.5 (1/2", 1/2")	**892 87**	**892 87**	**892 87**
or FL 9.0 (1/2", 1/2")	**892 88**	**892 88**	**892 88**
Low temperature measuring instrument	**upon request**	**upon request**	**upon request**
Cable for the silicon diode, 10 m (35.0 ft) long	**upon request**	**upon request**	**upon request**

Cryopumps with Fully Automatic Control, ClassicLine

COOLVAC 800 CL

COOLVAC 1.500 CL

COOLVAC 1.500 CL

Advantages to the User

- Hydrocarbon-free high vacuum
- High capacity for argon and hydrogen
- High crossover value
- Simple operation
- Trouble-free integration into complex systems
- Fully automatic regeneration through Cryo Compact Control
- Easy servicing

Typical Applications

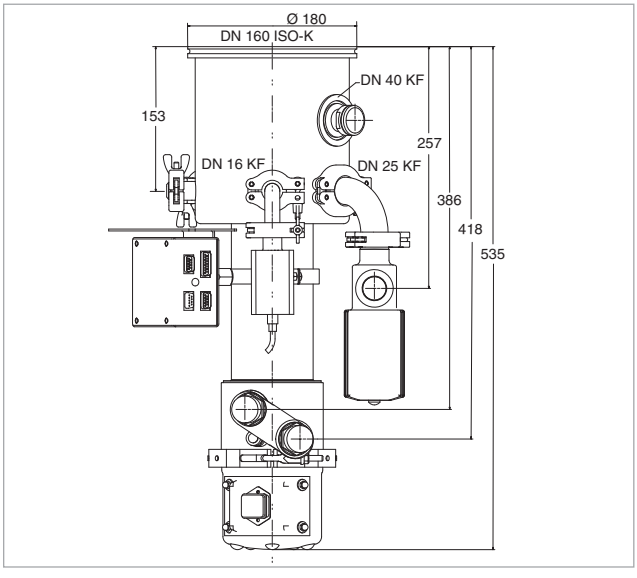
- Evaporators
- Sputtering systems
- Ion implanters
- Optical coating systems
- Metallization systems

Advantages to the User

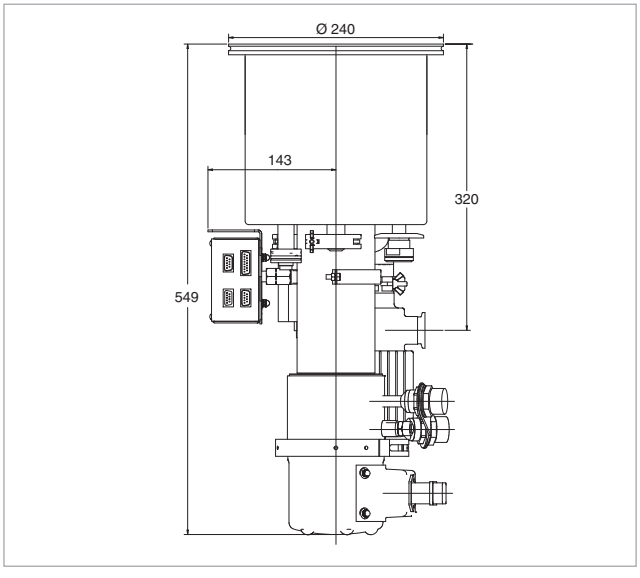
- Hydrocarbon-free high vacuum
- High capacity for argon and hydrogen
- High crossover value
- Simple operation
- Trouble-free integration into complex systems
- Fully automatic regeneration through Cryo Compact Control
- Easy servicing

Typical Applications

- Evaporators
- Sputtering systems
- Ion implanters
- Optical coating systems
- Metallization systems



Dimensional drawing for the COOLVAC 800 CL (DN 160 ISO-K)



Dimensional drawing for the COOLVAC 1.500 CL (DN 200 ISO-K)

Technical Data

		COOLVAC	
		800 CL	1.500 CL
High vacuum (HV) flange	DN	160 ISO-K / 160 CF	200 ISO-K / 200 CF / 6" ANSI
Fore vacuum flange	DN	25 KF	25 KF
Flange for connection a gauge head	DN	16 KF	16 KF
Flange for the electrical connection	DN	16 KF	16 KF
Safety valve with flange connection for gas exhaust line	DN	40 KF	40 KF
4-way current feedthrough for Si diode on a flange	DN	16 KF	16 KF
Heaters			
1st stage	W	160	160
	V AC	42	42
2nd stage	W	90	90
	V AC	42	42
Temperature sensor			
1st stage		PT 100	PT 100
2nd stage		Si diode	Si diode
Built-in cold head	COOLPOWER	7/25	7/25
Weight	kg (lbs)	15 (33.1)	25 (55.2)
Cooldown time to T_2 = 20 K	min	50	60
Crossover value	mbar x l (Torr x l)	150 (112)	210 (157)
Pumping speed			
H_2O	l x s^{-1}	2600	4600
Ar / N_2	l x s^{-1}	640 / 800	1200 / 1500
H_2	l x s^{-1}	1000	2500
Capacity			
Ar/N_2	bar x l	300	1000
H_2 at 10^{-6} mbar	bar x l	4.5	12.0
Max. throughput			
Ar/N_2	mbar x l x s^{-1} (Torr x l x s^{-1})	4 (3)	12 (9)
H_2O	mbar x l x s^{-1} (Torr x l x s^{-1})	2 (1.5)	6 (4.5)
Helium connections (Self-sealing couplings: outside thread, type 5400-S2-8)	DN	1/2"	1/2"

Ordering Information

COOLVAC 800 CL

	Single Operation		Dual operation			Multiple Operation	
	Europe	USA/Japan	Europe	Europe	USA/Japan	Europe	USA/Japan
COOLVAC 800 CL	Part No.		Part No.			Part No.	
DN 160 CF	844160V0002		844160V0002 (2x)			844160V0002 (3x)	
DN 160 ISO-K	844160V0006		844160V0006 (2x)			844160V0006 (3x)	
Electronics and Cables							
System controller SC	844 230		844 230	844 230	844 230	844 230	
Power supply PS (50/60 Hz)							
230 V, 1 ph. (switchable to 115 V)	844 135		844 135	–	–	–	
200 V, 3 ph. (switchable to 400 V)	–		–	844 235	844 235	844 235	
Network communication cable – System controller to the pump(s)							
10 m (35.0 ft)	844 261		844 261	844 261	844 261	844 261	
20 m (70.0 ft)	844 262		844 262	844 262	844 262	844 262	
Network PM cable for the link between the pumps							
3 m (10.5 ft)	–		844 256	844 256	844 256	844 256 (2x)	
10 m (35.0 ft)	–		844 258	844 258	844 258	844 258 (2x)	
Power supply cable from power supply to pump							
10 m (35.0 ft)	–		–	844 251 (2x)	844 251 (2x)	844 251 (3x)	
20 m (70.0 ft)	–		–	844 252 (2x)	844 252 (2x)	844 252 (3x)	
Remote control cable CP, 1 m (3.5 ft)	–		–	844 265	844 265	844 265	
Cable compressor – Power supply							
10 m (35.0 ft)	844 129		844 129	–	–	–	
20 m (70.0 ft)	844 139		844 139	–	–	–	
Cable system controller – Power supply							
1 m (3.5 ft)	844 141		844 141	–	–	–	
Cable pump module PM – Power supply							
10 m (35.0 ft)	844 128		844 128 (2x)	–	–	–	
20 m (70.0 ft)	844 138		844 138 (2x)	–	–	–	
Connecting cable compressor – pump, 4.5 m (15.75 ft)	E 400 000 323		E 400 000 323 (2x)	–	–	–	
Electric extension cable EL 4.5	893 74		893 74 (2x)	–	–	–	
Compressors and Flexlines							
Compressor							
CP 2000	840000V2000	–	–	–	–	–	–
CP 2000 A	840000V2010	–	–	–	–	–	–
CP 2200	–	840000V2200	–	–	–	–	–
CP 2200 A	–	840000V2210	–	–	–	–	–
CP 6000 D	–	–	892 46	–	–	–	–
CP 6000	–	–	–	840000V6000	–	840000V6000	–
CP 6200	–	–	–	–	840000V6200	–	840000V6200
Accessories							
Water cooling discharge throttle	–	–	E 840000133	–	–	–	–
Power supply cable for compressor	1)		1)	1)	1)	1)	
Set of flexlines							
FL 4.5 (1/2", 1/2")	892 87		892 87 (2x)	892 87 (2x)	892 87 (2x)	892 87 (3x)	
or FL 9.0 (1/2", 1/2")	892 88		892 88 (2x)	892 88 (2x)	892 88 (2x)	892 88 (3x)	
Gas manifold (1 piece each)							
GD 2	–		840 253 (2x)	840 253 (2x)	840 253 (2x)	–	
GD 4	–		–	–	–	840 254 (2x)	

The arrangement of the components is shown in the section “Accessories” under the heading “COOLVAC ClassicLine, System Components”.

1) see Ordering Information for the compressor units COOLPAK

Ordering Information

COOLVAC 1.500 CL

	Single Operation		Dual operation			Multiple Operation	
	Europe	USA/Japan	Europe	Europe	USA/Japan	Europe	USA/Japan
COOLVAC 1.500 CL	Part No.		Part No.			Part No.	
DN 200 CF	844200V0002		844200V0002 (2x)			844200V0002 (3x)	
DN 6" ANSI	844200V0004		844200V0004 (2x)			844200V0004 (3x)	
DN 200 ISO-K	844200V0006		844200V0006 (2x)			844200V0006 (3x)	
Electronics and Cables							
System controller SC	844 230		844 230	844 230	844 230	844 230	
Power supply PS (50/60 Hz)							
230 V, 1 ph. (switchable to 115 V)	844 135		844 135	–	–	–	
200 V, 3 ph. (switchable to 400 V)	–		–	844 235	844 235	844 235	
Network communication cable – System controller to the pump(s)							
10 m (35.0 ft)	844 261		844 261	844 261	844 261	844 261	
20 m (70.0 ft)	844 262		844 262	844 262	844 262	844 262	
Network PM cable for the link between the pumps							
3 m (10.5 ft)	–		844 256	844 256	844 256	844 256 (2x)	
10 m (35.0 ft)	–		844 258	844 258	844 258	844 258 (2x)	
Power supply cable from power supply to pump							
10 m (35.0 ft)	–		–	844 251 (2x)	844 251 (2x)	844 251 (3x)	
20 m (70.0 ft)	–		–	844 252 (2x)	844 252 (2x)	844 252 (3x)	
Remote control cable CP, 1 m (3.5 ft)	–		–	844 265	844 265	844 265	
Cable compressor – Power supply							
10 m (35.0 ft)	844 129		844 129	–	–	–	
20 m (70.0 ft)	844 139		844 139	–	–	–	
Cable system controller – Power supply							
1 m (3.5 ft)	844 141		844 141	–	–	–	
Cable pump module PM – Power supply							
10 m (35.0 ft)	844 128		844 128 (2x)	–	–	–	
20 m (70.0 ft)	844 138		844 138 (2x)	–	–	–	
Connecting cable compressor – pump, 4.5 m (15.75 ft)	E 400 000 323		E 400 000 323 (2x)	–	–	–	
Electric extension cable EL 4.5	893 74		893 74 (2x)	–	–	–	
Compressors and Flexlines							
Compressor							
CP 2000	840000V2000	–	–	–	–	–	–
CP 2000 A	840000V2010	–	–	–	–	–	–
CP 2200	–	840000V2200	–	–	–	–	–
CP 2200 A	–	840000V2210	–	–	–	–	–
CP 6000 D	–	–	892 46	–	–	–	–
CP 6000	–	–	–	840000V6000	–	840000V6000	–
CP 6200	–	–	–	–	840000V6200	–	840000V6200
Accessories							
Water cooling discharge throttle	–	–	E 840000133	–	–	–	–
Power supply cable for compressor	1)		1)	1)	1)	1)	
Set of FLEXLINES							
FL 4.5 (1/2", 1/2")	892 87		892 87 (2x)	892 87 (2x)	892 87 (2x)	892 87 (3x)	
or FL 9.0 (1/2", 1/2")	892 88		892 88 (2x)	892 88 (2x)	892 88 (2x)	892 88 (3x)	
Gas manifold (1 piece each)							
GD 2	–		840 253 (2x)	840 253 (2x)	840 253 (2x)	–	
GD 4	–		–	–	–	840 254 (2x)	

The arrangement of the components is shown in the section “Accessories” under the heading “COOLVAC ClassicLine, System Components”.

1) see Ordering Information for the compressor units COOLPAK

COOLVAC 2.000 CL

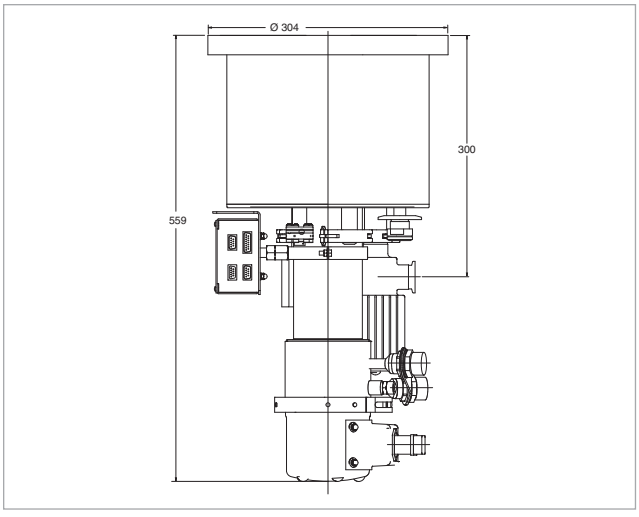
COOLVAC 2.000 CL

Advantages to the User

- Hydrocarbon-free high vacuum
- High capacity for argon and hydrogen
- High crossover value
- Simple operation
- Trouble-free integration into complex systems
- Fully automatic regeneration through Cryo Compact Control
- Easy servicing

Typical Applications

- Evaporators
- Sputtering systems
- Ion implanters
- Optical coating systems
- Metallization systems



Dimensional drawing for the COOLVAC 2.000 CL (DN 250 CF)

COOLVAC 3.000 CL

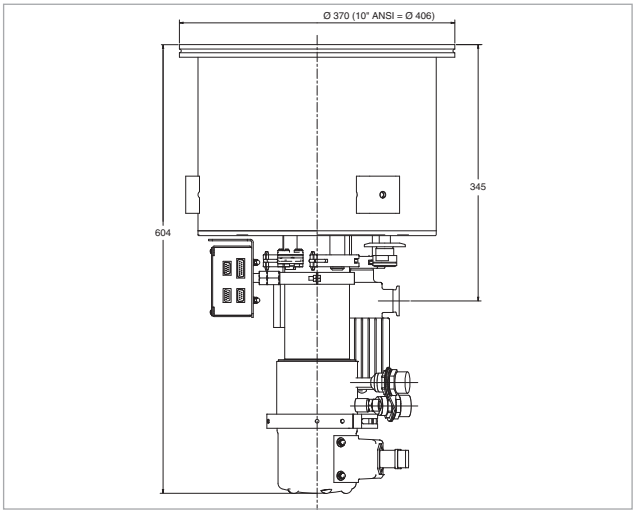
COOLVAC 3.000 CL

Advantages to the User

- Hydrocarbon-free high vacuum
- High capacity for argon and hydrogen
- High crossover value
- Simple operation
- Trouble-free integration into complex systems
- Fully automatic regeneration through Cryo Compact Control
- Easy servicing

Typical Applications

- Evaporators
- Sputtering systems
- Ion implanters
- Optical coating systems
- Metallization systems



Dimensional drawing for the COOLVAC 3.000 CL (DN 320 ISO-K / 10" ANSI)

Technical Data

		COOLVAC	
		2.000 CL	3.000 CL
High vacuum (HV) flange	DN	250 ISO-K / 250 CF / 8" ANSI	320 ISO-K / 10" ANSI
Fore vacuum flange	DN	25 KF	25 KF
Flange for connection a gauge head	DN	16 KF	16 KF
Flange for the electrical connection	DN	16 CF	16 CF
Safety valve with flange connection for gas exhaust line	DN	40 KF	40 KF
4-way current feedthrough for Si diode on a flange	DN	16 KF	16 KF
Heaters			
1st stage	W	160	160
	V AC	42	42
2nd stage	W	90	90
	V AC	42	42
Temperature sensor			
1st stage		PT 100	PT 100
2nd stage		Si diode	Si diode
Built-in cold head	COOLPOWER	7/25	7/25
Weight	kg (lbs)	25 (55.2)	35 (77.3)
Cooldown time to T_2 = 20 K	min	70	80
Crossover value	mbar x l (Torr x l)	250 (187)	500 (375)
Pumping speed			
H_2O	l x s^{-1}	7000	10500
Ar / N_2	l x s^{-1}	1600 / 2100	2500 / 3000
H_2	l x s^{-1}	3200	6000
Capacity			
Ar/N_2	bar x l	1600	2500
H_2 at 10^{-6} mbar	bar x l	15	28
Max. throughput			
Ar/N_2	mbar x l x s^{-1} (Torr x l x s^{-1})	12 (9)	15 (11.2)
H_2O	mbar x l x s^{-1} (Torr x l x s^{-1})	6 (4.5)	10 (7.5)
Helium connections (Self-sealing couplings: outside thread, type 5400-S2-8)	DN	1/2"	1/2"

Ordering Information

COOLVAC 2.000 CL

	Single Operation		Dual operation			Multiple Operation	
	Europe	USA/Japan	Europe	Europe	USA/Japan	Europe	USA/Japan
COOLVAC 2.000 CL	Part No.		Part No.			Part No.	
DN 250 CF	844250V0002		844250V0002 (2x)			844250V0002 (3x)	
DN 8" ANSI	844250V0004		844250V0004 (2x)			844250V0004 (3x)	
DN 250 ISO-K	844250V0006		844250V0006 (2x)			844250V0006 (3x)	
Electronics and Cables							
System controller SC	844 230		844 230	844 230	844 230	844 230	
Power supply PS (50/60 Hz)							
230 V, 1 ph. (switchable to 115 V)	844 135		844 135	–	–	–	
200 V, 3 ph. (switchable to 400 V)	–		–	844 235	844 235	844 235	
Network communication cable – System controller to the pump(s)							
10 m (35.0 ft)	844 261		844 261	844 261	844 261	844 261	
20 m (70.0 ft)	844 262		844 262	844 262	844 262	844 262	
Network PM cable for the link between the pumps							
3 m (10.5 ft)	–		844 256	844 256	844 256	844 256 (2x)	
10 m (35.0 ft)	–		844 258	844 258	844 258	844 258 (2x)	
Power supply cable from power supply to pump							
10 m (35.0 ft)	–		–	844 251 (2x)	844 251 (2x)	844 251 (3x)	
20 m (70.0 ft)	–		–	844 252 (2x)	844 252 (2x)	844 252 (3x)	
Remote control cable CP, 1 m (3.5 ft)	–		–	844 265	844 265	844 265	
Cable compressor – Power supply							
10 m (35.0 ft)	844 129		844 129	–	–	–	
20 m (70.0 ft)	844 139		844 139	–	–	–	
Cable System Controller – Power Supply 1 m (3.5 ft)	844 141		844 141	–	–	–	
Cable pump module PM – Power supply							
10 m (35.0 ft)	844 128		844 128 (2x)	–	–	–	
20 m (70.0 ft)	844 138		844 138 (2x)	–	–	–	
Connecting cable compressor – pump, 4.5 m (15.75 ft)	E 400 000 323		E 400 000 323 (2x)	–	–	–	
Electric extension cable EL 4.5	893 74		893 74 (2x)	–	–	–	
Compressors and Flexlines							
Compressor							
CP 2000	840000V2000	–	–	–	–	–	–
CP 2000 A	840000V2010	–	–	–	–	–	–
CP 2200	–	840000V2200	–	–	–	–	–
CP 2200 A	–	840000V2210	–	–	–	–	–
CP 6000 D	–	–	892 46	–	–	–	–
CP 6000	–	–	–	840000V6000	–	840000V6000	–
CP 6200	–	–	–	–	840000V6200	–	840000V6200
Accessories							
Water cooling discharge throttle	–	–	E 840000133	–	–	–	–
Power supply cable for compressor	1)		1)	1)	1)	1)	
Set of flexlines							
FL 4.5 (1/2", 1/2")	892 87		892 87 (2x)	892 87 (2x)	892 87 (2x)	892 87 (3x)	
or FL 9.0 (1/2", 1/2")	892 88		892 88 (2x)	892 88 (2x)	892 88 (2x)	892 88 (3x)	
Gas manifold (1 piece each)							
GD 2	–		840 253 (2x)	840 253 (2x)	840 253 (2x)	–	
GD 4	–		–	–	–	840 254 (2x)	

The arrangement of the components is shown in the section “Accessories” under the heading “COOLVAC ClassicLine, System Components”.

1) see Ordering Information for the compressor units COOLPAK

Ordering Information

COOLVAC 3.000 CL

	Single operation		Dual operation		
	Europe	USA/Japan	Europe	Europe	USA/Japan
COOLVAC 3.000 CL DN 10" ANSI DN 320 ISO-K	Part No. 844320V0004 844320V0006		Part No. 844320V0004 (2x) 844320V0006 (2x)		
Electronics and Cables					
System controller SC	844 230	844 230	844 230	844 230	844 230
Power supply PS (50/60 Hz) 230 V, 1 ph. (switchable to 115 V) 200 V, 3 ph. (switchable to 400 V)	 844 135 –	 844 135 –	 844 135 –	 – 844 235	 – 844 235
Network communication cable – System controller to the pump(s) 10 m (35.0 ft) 20 m (70.0 ft)	 844 261 844 262	 844 261 844 262	 844 261 844 262	 844 261 844 262	 844 261 844 262
Network PM cable for the link between the pumps 3 m (10.5 ft) 10 m (35.0 ft)	 – –	 – –	 844 256 844 258	 844 256 844 258	 844 256 844 258
Power supply cable from power supply to pump 10 m (35.0 ft) 20 m (70.0 ft)	 – –	 – –	 – –	 844 251 (2x) 844 252 (2x)	 844 251 (2x) 844 252 (2x)
Remote control cable CP, 1 m (3.5 ft)	–	–	–	844 265	844 265
Cable compressor – Power supply 10 m (35.0 ft) 20 m (70.0 ft)	 844 129 844 139	 844 129 844 139	 844 129 844 139	 – –	 – –
Cable system controller – Power supply 1 m (3.5 ft)	 844 141	 844 141	 844 141	 –	 –
Cable pump module PM – Power supply 10 m (35.0 ft) 20 m (70.0 ft)	 844 128 844 138	 844 128 844 138	 844 128 (2x) 844 138 (2x)	 – –	 – –
Connecting cable compressor – pump, 4.5 m (15.75 ft)	E 400000323	E 400000323	E 400000323 (2x)	–	–
Electric extension cable EL 4.5	893 74	893 74 (2x)	–	–	–
Compressors and Flexlines					
Compressor CP 2000 CP 2000 A CP 2200 CP 2200 A CP 6000 D CP 6000 CP 6200	 840000V2000 840000V2010 – – – – –	 – – 840000V2200 840000V2210 – – –	 – – – – 892 46 – 	 – – – – – 840000V6000 –	 – – – – – – 840000V6200
Accessories Water cooling discharge throttle	 –	 –	 E 840000133	 –	 –
Power supply cable for compressor	1)		1)	1)	1)
Set of flexlines FL 4.5 (1/2", 1/2") or FL 9.0 (1/2", 1/2")	 892 87 892 88	 892 87 (2x) 892 88 (2x)	 892 87 (2x) 892 88 (2x)	 892 87 (2x) 892 88 (2x)	 892 87 (2x) 892 88 (2x)
Gas manifold (1 piece each) GD 2	 –	 –	 840 253 (2x)	 840 253 (2x)	 840 253 (2x)

The arrangement of the components is shown in the section “Accessories” under the heading “COOLVAC ClassicLine, System Components”.

1) see Ordering Information for the compressor units COOLPAK

COOLVAC 5.000 CL

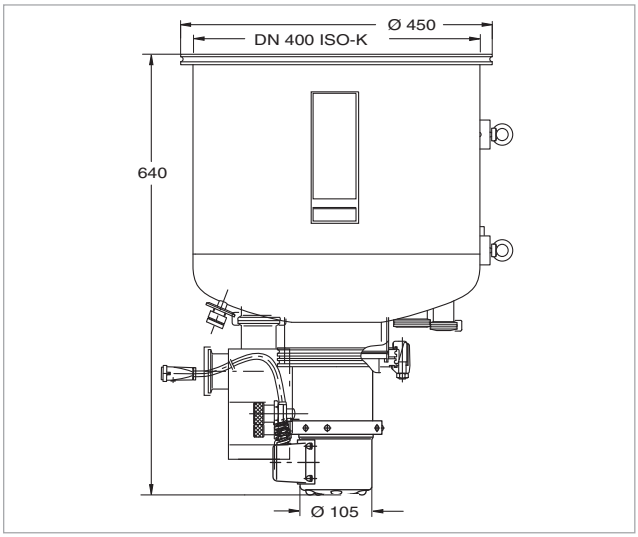
COOLVAC 5.000 CL

Advantages to the User

- Hydrocarbon-free high vacuum
- High capacity for argon and hydrogen
- High crossover value
- Simple operation
- Trouble-free integration into complex systems
- Fully automatic regeneration through Cryo Compact Control
- Easy servicing

Typical Applications

- Evaporators
- Ion implanters
- Electron beam welding systems
- Optical coating systems
- Metallization systems



Dimensional drawing for the COOLVAC 5.000 CL

COOLVAC 10.000 CL

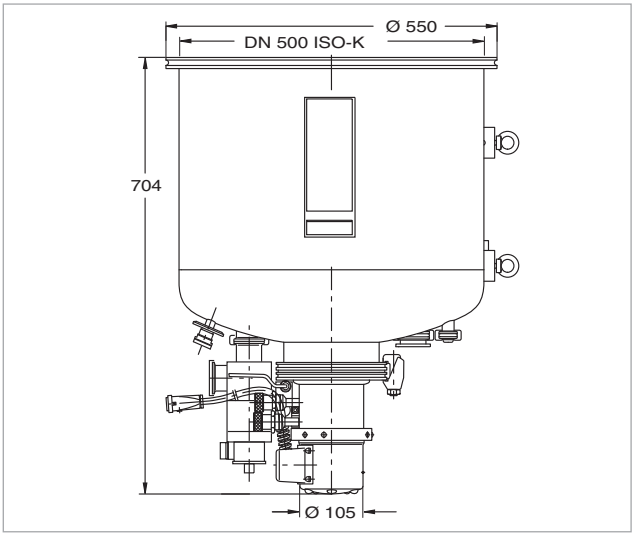
COOLVAC 10.000 CL

Advantages to the User

- Hydrocarbon-free high vacuum
- High capacity for argon and hydrogen
- High crossover value
- Simple operation
- Trouble-free integration into complex systems
- Fully automatic regeneration through Cryo Compact Control
- Easy servicing

Typical Applications

- Evaporators
- Space simulation chambers
- Electron beam welding systems
- Optical coating systems
- Metallization systems



Dimensional drawing for the COOLVAC 10.000 CL

Technical Data

		COOLVAC	
		5.000 CL	10.000 CL
High vacuum (HV) flange	DN	400 ISO-K	500 ISO-K
Fore vacuum flange	DN	40 KF	40 KF
Flange for connection of a gauge head	DN	16 KF	16 KF
Flange for the electrical connection	DN	40 KF	40 KF
Safety valve with flange connection for gas exhaust line	DN	40 KF	40 KF
4-way current feedthrough for Si diode on a flange	DN	16 KF	16 KF
Heaters			
1st stage	W	160	160
	V AC	42	42
2nd stage	W	90	90
	V AC	42	42
Temperature sensor			
1st stage		PT 100	PT 100
2nd stage		Si diode	Si diode
Built-in cold head	COOLPOWER	5/100	5/100
Weight	kg (lbs)	42 (92.7)	50 (110.4)
Cooldown time to T_2 = 20 K	min	100	150
Crossover value	mbar x l (Torr x l)	700 (525)	800 (600)
Pumping speed			
H_2O	l x s^{-1}	18000	30000
Ar / N_2	l x s^{-1}	4000 / 5200	8400 / 10000
H_2	l x s^{-1}	6200	12000
Capacity			
Ar/N_2	bar x l	3000	5500
H_2 at 10^{-6} mbar	bar x l	32	45
Max. throughput			
Ar/N_2	mbar x l x s^{-1} (Torr x l x s^{-1})	10 (7.5)	10 (7.5)
H_2	mbar x l x s^{-1} (Torr x l x s^{-1})	7 (5.3)	7 (5.3)
Helium connection (Self-sealing couplings: outside thread, types 5400-S2-8	DN	1/2"	1/2"

Ordering Information

	COOLVAC 5.000 CL		COOLVAC 10.000 CL	
	Europe	USA/Japan	Europe	USA/Japan
COOLVAC	**Part No.**	**Part No.**		
5.000 CL, DN 400 ISO-K	**844 410**	**844 410**	**–**	**–**
10.000 CL, DN 500 ISO-K	**–**	**–**	**Part No. 844610V0006**	**Part No. 844610V0006**
Electronics and Cables				
System controller SC	**Part No. 844 230**	**Part No. 844 230**	**Part No. 844 230**	**Part No. 844 230**
Power supply PS				
230 V, 1 ph.	**844 135**	**844 135**	**844 135**	**844 135**
Network communication cable – System controller to the pump(s)				
10 m (35.0 ft)	**844 261**	**844 261**	**844 261**	**844 261**
20 m (70.0 ft)	**844 262**	**844 262**	**844 262**	**844 262**
Cable compressor – Power supply PS				
10 m (35.0 ft)	**844 129**	**844 129**	**844 129**	**844 129**
20 m (70.0 ft)	**844 139**	**844 139**	**844 139**	**844 139**
Cable system controller – Power supply				
1 m (3.5 ft)	**844 141**	**844 141**	**844 141**	**844 141**
Cable pump module PM – Power supply				
10 m (35.0 ft)	**844 128**	**844 128**	**844 128**	**844 128**
20 m (70.0 ft)	**844 138**	**P844 138**	**844 138**	**844 138**
Compressors and Flexlines				
Compressor	**Part No.**	**Part No.**	**Part No.**	**Part No.**
CP 6000	**840000V6000**	**–**	**840000V6000**	**–**
CP 6200	**–**	**840000V6200**	**–**	**840000V6200**
Power supply cable for compressor	see Ordering Information for the Compressor Units COOLPAK	see Ordering Information for the Compressor Units COOLPAK	see Ordering Information for the Compressor Units COOLPAK	see Ordering Information for the Compressor Units COOLPAK
Set of flexlines				
FL 4.5 (1/2", 1/2")	**892 87**	**892 87**	**892 87**	**892 87**
or FL 9.0 (1/2", 1/2")	**892 88**	**892 88**	**892 88**	**892 88**
and EL 4.5 (electric extension cable)	**893 74**	**893 74**	**893 74**	**893 74**

The arrangement of the components is shown in the section “Accessories” under the heading “COOLVAC ClassicLine, System Components”

Notes

COOLVAC 18.000 CL

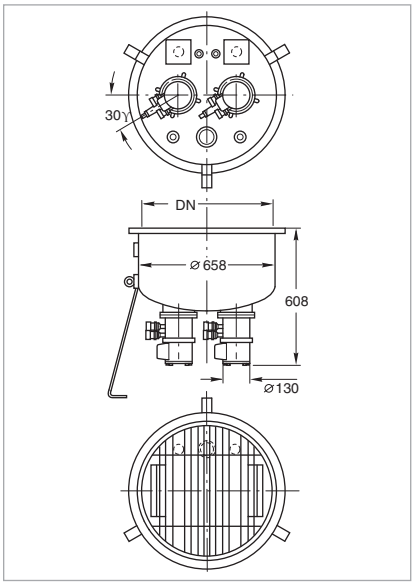
COOLVAC 18.000 CL with special flanges

Advantages to the User

- Hydrocarbon-free high vacuum
- High pumping speed for water vapor and nitrogen
- Fast, safe and efficient regeneration with the electric regeneration system
- Simple operation

Typical Applications

- Space simulation chambers
- Evaporators
- Electron beam welding systems
- Optical coating systems
- Metallization systems



Dimensional drawing for the COOLVAC 18.000 CL

COOLVAC 30.000

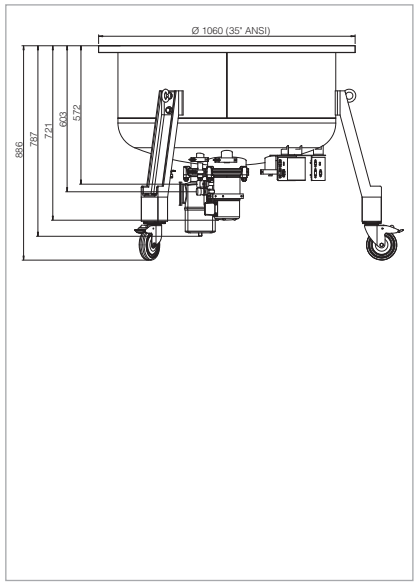
COOLVAC 30.000 with special flanges

Advantages to the User

- Hydrocarbon-free high vacuum
- High pumping speed for water vapor and nitrogen
- Fast, safe and efficient regeneration with the electric regeneration system
- Simple operation

Typical Applications

- Space simulation chambers
- Evaporators
- Electron beam welding systems
- Optical coating systems
- Metallization systems



Dimensional drawing for the COOLVAC 30.000

COOLVAC 60.000

COOLVAC 60.000 LN_2 cooled upon request

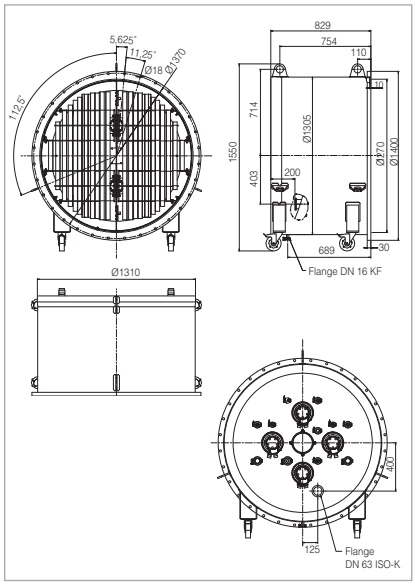
COOLVAC 60.000 with special flanges

Advantages to the User

- Hydrocarbon-free high vacuum
- High pumping speed for water vapor and nitrogen
- Fast, safe and efficient regeneration with the electric regeneration system
- Simple operation

Typical Applications

- Space simulation chambers
- Evaporators
- Electron beam welding systems
- Optical coating systems
- Metallization systems



Dimensional drawing for the COOLVAC 60.000

Technical Data

		COOLVAC 18.000 CL	COOLVAC 30.000	COOLVAC 60.000
High vacuum flange	DN	630 ISO-F	35" ANSI	1250 ISO-F
Fore vacuum flange	DN	63 ISO-K	63 ISO-K	63 ISO-K
Flange with current feedthrough for silicon diode	DN	25 KF (2x)	16 KF (2x)	16 KF (2x)
Flange for other purposes	DN	40 KF	40 KF	40 KF
Safety valve with DN 40 KF flange connection for gas exhaust line (opening pressure)	DN mbar	40 KF 1100	40 KF 1100	40 KF 1100
Pumping speed				
H_2O	l x s^{-1}	46000	93000	180000
Ar / N_2	l x s^{-1}	13500 / 18000	25000 / 30000	47000 / 57000
H_2 / He	l x s^{-1}	14000 / 4000	30000 / 7000	60000 / 15000
Capacity				
Ar/N_2	bar x l	5000	6500	9000
H_2 at 10^{-6} mbar	bar x l	65	100	150
H_2O	bar x l	945		
Built-in cold head	COOLPOWER	5/100 (2x)	5/100 (2x) and 140T (1x)	5/100 (2x) and 140T (2x)
Max. throughput				
Ar/N_2	mbar x l x s^{-1} (Torr x l x s^{-1})	14	14	25
H_2	mbar x l x s^{-1} (Torr x l x s^{-1})	7	7	12
Crossover value at 20 K	mbar x l (Torr x l)	850	1200	1000
Cool down time to 20 K	min	180	260	330
Overall height	min	606	see drawing	see drawing
Weight	kg (lbs)	65	245	450
Silicon diode for temperature measurements at the second stage of the cold head		built-in(2x)	built-in(2x)	built-in(2x)
Regeneration heaters at the first and second stage of the cold head		built-in (2x)	–	–

Ordering Information

	COOLVAC 18.000 CL	COOLVAC 30.000	COOLVAC 60.000
Cryopump			
COOLVAC 18.000 CL, 630 ISO-F	**Part No. 844630V0006**	**–**	**–**
COOLVAC 30.000, 35" ANSI	**–**	**upon request**	**–**
COOLVAC 60.000, 1250 ISO-F	**–**	**–**	**upon request**
Compressor unit			
COOLPAK 6000	**upon request (2x)**	**upon request (3x)**	**upon request (4x)**
COOLPAK 6200	**upon request (2x)**	**upon request (3x)**	**upon request (4x)**
Power supply cable	see Ordering Information for the compressor units COOLPAK		
Set of flexlines			
FL 4.5 (1/2", 1/2")	**Part No. 892 87 (2x)**	**Part No. 892 87 (3x)**	**Part No. 892 87 (4x)**
or FL 9.0 (1/2", 1/2")	**Part No. 892 88 (2x)**	**Part No. 892 88 (3x)**	**Part No. 892 88 (4x)**
and EL 4.5 (electric extension cable)	**Part No. 893 74 (2x)**	**Part No. 893 74 (3x)**	**Part No. 893 74 (4x)**
Compact controller and cable kit	**upon request**	**upon request**	**upon request**

Products Cryogenics

Cold Heads, Pneumatically Driven
Single Stage Cold Head COOLPOWER 140 T

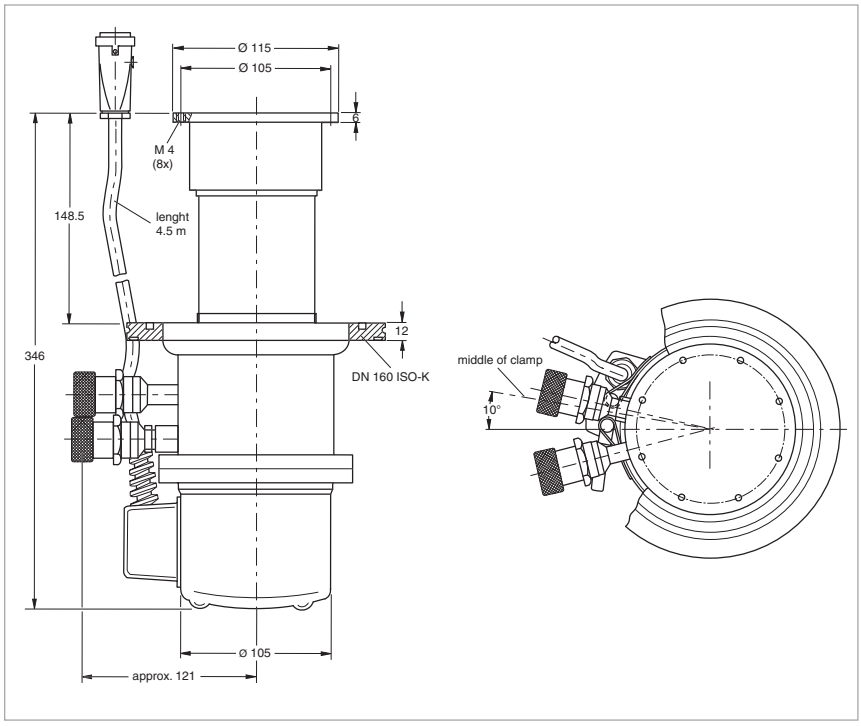
Single stage cold head COOLPOWER 140 T

Advantages to the User

- For installation mostly in any orientation
- High refrigerating capacity
- No liquid refrigerants are required
- Very simple to operate
- Short cooldown time

Typical Applications

- Cooling of cryopanels in cryopumps and thus generation of high vacuum and ultra-high vacuum pressures- Cooling of samples and detectors; especially for cooling of
  - samples for spectroscopic investigations in solid state and surface physics
  - high temperature superconductor and semiconductor conditions
  - infrared and gamma detectors
- Calibration of sensors



Dimensional drawing for the COOLPOWER 140 T

Technical Data		COOLPOWER 140 T
Refrigeration capacity at 50/60 Hz [1]		
at 80 K, approx.	W	140
at 20 K, approx.	W	20
Lowest attainable temperature [1]	K	≤ 15
Cooldown time down to 20 K	min	≤ 55
Permissible ambient temperature	°C	+10 to +40
He filling pressure at room temperature	bar	16
He connections		
Self-sealing screwed connections		
High pressure connection		1/2" (#8 [2])
Low pressure connection		1/2" (#8)
Weight	kg (lbs)	12 (26.5)
Length of the electrical connection line to the compressor unit	m (ft)	4.5 (15.75)

Ordering Information	COOLPOWER 140 T
Cold head COOLPOWER 140 T	
with DN 160 ISO-K	**Part No. 842 030**
Other flanges	**upon request**
Accessories	
Compressor unit (for operation of one cold head)	
COOLPAK 6000	
400 V/50 Hz; 470 V/60 Hz	**Part No. 840000V6000**
COOLPAK 6200	
200 V/50 Hz; 200 V, 230 V/60 Hz	**Part No. 840000V6200**
Power supply cable	see Ordering Information for the compressor units COOLPAK
Set of flexlines	
FL 4.5 (1/2", 1/2")	**Part No. 892 87**
or FL 9.0 (1/2", 1/2")	**Part No. 892 88**
and EL 4.5 (electric extension cable)	**Part No. 893 74**
Options	
Temperature measurement	
Silicon diode	**Part No. 890 89**
Low temperature measuring instrument	**upon request**
Measuring cable	**upon request**

[1] The refrigerating capacities and temperatures stated apply only to vertical operation with the cold end at the bottom

[2] Series 8 from Aeroquip

Dual Stage Cold Heads
COOLPOWER 7/25, 5/100 and 5/100 T

Dual stage cold head COOLPOWER 7/25

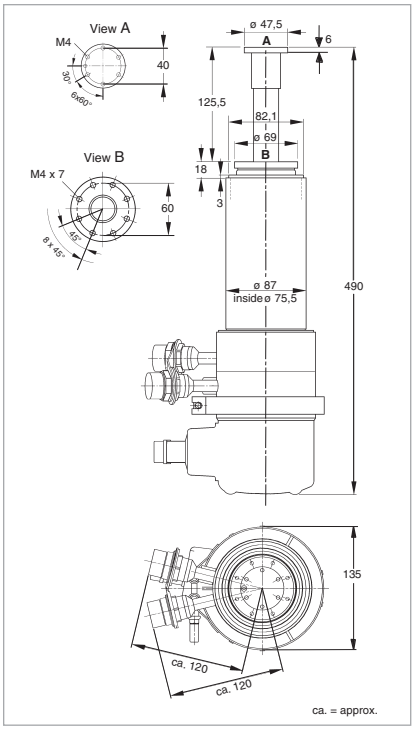
Dual stage cold heads COOLPOWER 5/100 and COOLPOWER 5/100 T

Advantages to the User

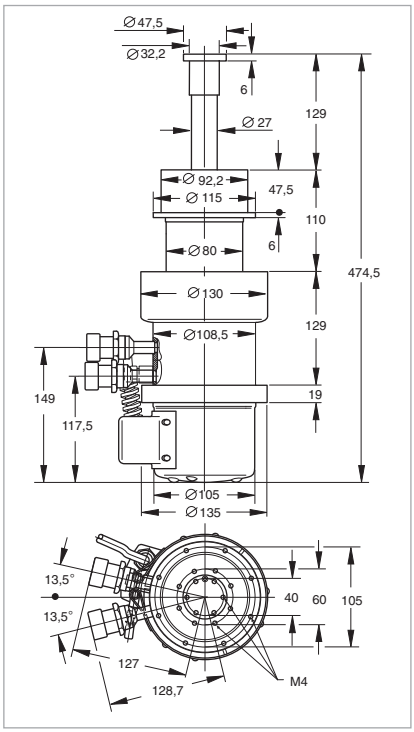
- For installation in any orientation
- High refrigerating capacity
- No liquid refrigerants are required
- Very simple to operate
- Short cooldown time

Typical Applications

- Cooling of cryopanels in cryopumps and thus generation of high vacuum and ultra-high vacuum pressures
- Cooling of samples and detectors; especially for cooling of
  - samples for spectroscopic investigations in solid state and surface physics
  - high temperature superconductors
  - superconductors and semiconductors
  - infrared and gamma detectors
- Calibration of sensors
- Cooling of accelerator components in the area of high energy physics
- Cooling of superconducting magnets; in nuclear magnetic resonance tomographs, for example (only COOLPOWER 5/100 and 5/100 T)



Dimensional drawing for the COOLPOWER 7/24



Dimensional drawing for the COOLPOWER 5/100 and COOLPOWER 5/100 T

Technical Data

		COOLPOWER 7/25	COOLPOWER 5/100	COOLPOWER 5/100 T
Refrigeration capacity at 50/60 Hz [1]				
1st stage at 80 K, approx.	W	25	100	100
2st stage at 20 K, approx.	W	7	5	7.5
2st stage at 10 K, approx.	W	–	–	3.5
2st stage at 40 K, approx.	W	–	–	35
Lowest attainable temperature [1]				
1st stage, approx.	K	≤ 35	≤ 35	≤ 5
2nd stage, approx.	K	≤ 10	≤ 10	6
Cooldown time of the				
2nd stage to 20 K, approx.	min	20	20	20
1st stage to 80 K, approx.	min	20	20	20
2nd stage to 10 K, approx.	min	–	–	35
1st stage to 40 K, approx.	min	–	–	30
2nd stage to 6 K, approx.	min	–	–	45
1st stage to 30 K, approx.	min	–	–	40
Permissible ambient temperature	°C	+5 to +40	+5 to +40	+5 to +40
He filling pressure at room temperature	bar	16	16	16
He connections				
Self-sealing screwed connections				
High pressure connection		1/2" (#8 [2])	1/2" (#8 [2])	1/2" (#8 [2])
Low pressure connection		1/2" (#8)	1/2" (#8)	1/2" (#8)
Weight	kg (lbs)	11 (24.3)	11 (24.3)	11 (24.3)
Length of the electrical connection line to the compressor unit (included with cold head)	m (ft)	4.5 (15.75)	4.5 (15.75)	4.5 (15.75)

Ordering Information

	COOLPOWER 7/25	COOLPOWER 5/100	COOLPOWER 5/100 T
Cold head	**Part No.**	**Part No.**	**Part No.**
COOLPOWER 7/25	**842 040**	**–**	**–**
COOLPOWER 5/100	**–**	**893 05**	**–**
COOLPOWER 5/100 T	**–**	**–**	**129 78**
Accessories			
Connecting cable compressor – cold head, 4.5 m (15.75 ft)	**E 400000323**	included with the cold head	included with the cold head
Compressor unit (for operation of one cold head)			
COOLPAK 2000	**840000V2000**	**–**	**–**
COOLPAK 2000 A	**840000V2010**	**–**	**–**
COOLPAK 2200	**840000V2200**	**–**	**–**
COOLPAK 2200 A	**840000V2210**	**–**	**–**
COOLPAK 6000	**–**	**840000V6000**	**840000V6000**
COOLPAK 6200	**–**	**840000V6200**	**840000V6200**
Power supply cable	**3)**	**3)**	**3)**
Set of flexlines			
FL 4.5 (1/2", 1/2")	**892 87**	**892 87**	**892 87**
or FL 9.0 (1/2", 1/2")	**892 88**	**892 88**	**892 88**
and EL 4.5 (electric extension cable)	**893 74**	**893 74**	**893 74**
Options			
Temperature measurement / control			
Silicon diode	**890 89**	**890 89**	**890 89**
Low temperature measuring instrument	**upon request**	**upon request**	**upon request**
Measuring cable	**upon request**	**upon request**	**upon request**
Electrical heaters	**upon request**	**upon request**	**upon request**
Low temperature controller Modell 9700	**842 400**	**842 400**	**842 400**
Measuring cable, 3 m (10.5 ft) long	**842 401**	**842 401**	**842 401**

[1] The refrigerating capacities and temperatures stated apply to vertical operation with the cold end at the bottom

[2] Series 8 from Aeroquip

[3] see Ordering Information for the compressor units COOLPAK

Cold Heads, Mechanically Driven
Dual Stage Cold Head COOLPOWER 10 MD

Dual Stage Cold Head COOLPOWER 10 MD

COOLPOWER 10 MD - the strongest 10 K GM cooler available on the market:

- High 2nd. stage cooling capacity of > 18 W at 20 K
- High 1st. stage cooling capacity of > 25 W at 40 K and ~ 110 W at 80 K

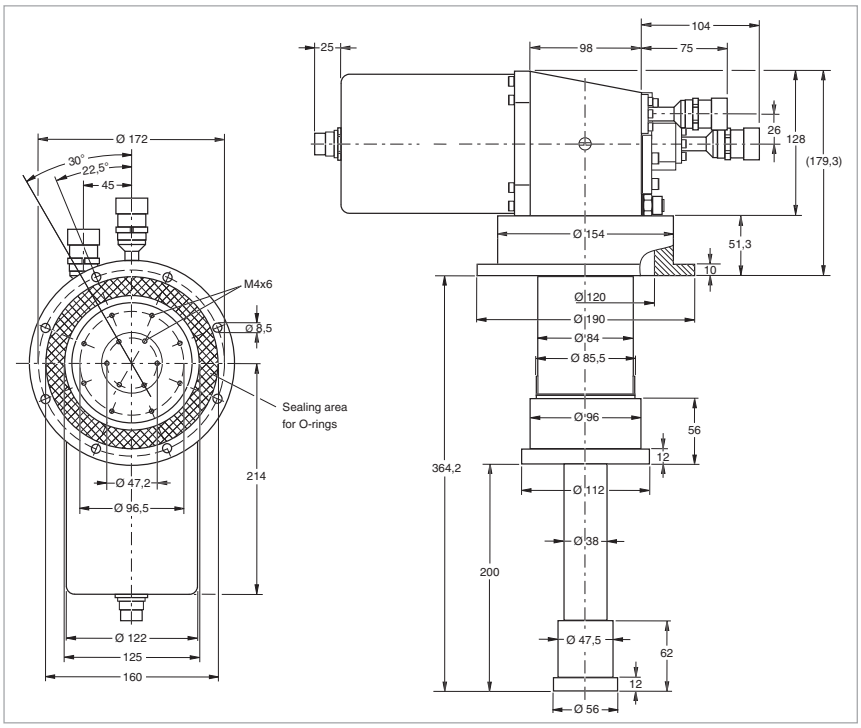
Advantages to the User

- Excellent cooling performance
- 18 W at 20 K by press-button operation
- High reliability
- Design optimized for MTBF 100,000 h
- Long and maintenance-free operation
- Low vibration due to directly driven displacer
- No liquid refrigerants are required
- Very simple to operate
- Short cooldown time
- Easy operation
  - Plug & Cool - as usual for all Oerlikon Leybold Vacuum GM coolers
  - Simple variation of motor speed via the new COOLPAK MD compressor unit

Typical Applications

The COOLPOWER 10 MD is a mechanically driven double-stage Gifford McMahon (GM) cryo cooler and ideally suited for

- Cooling of cryo probes in NMR spectrometers
- Shield cooling of superconducting magnets in MRI
- Cooling of cryopanels in special cryopumps and thus generation of high vacuum and ultra high vacuum pressures
- Cooling of larger samples and devices; especially
  - High temperature superconductor coils, wires and bulk materials
  - Recondensation of liquid refrigerants such as H_2, Ne
  - Samples for spectroscopic investigations in solid state and surface physics
  - Infrared and gamma detectors
- Calibration of sensors



Dimensional drawing for the COOLPOWER 10 MD

Technical Data — COOLPOWER 10 MD

Refrigeration capacity at 50/60 Hz [1]		
1st stage at 80 K, approx.	W	110
2st stage at 20 K, approx.	W	18
Lowest attainable temperature [1]		
1st stage, approx.	K	≤ 28
2nd stage, approx.	K	≤ 8
Cooldown time of the		
2nd stage to 20 K, approx.	min	25
Permissible ambient temperature	°C	+5 to +40
He filling pressure at room temperature	bar	16
He connections		
Self-sealing screwed connections		
High pressure connection		1/2" (#8 [2])
Low pressure connection		1/2" (#8)
Weight	kg (lbs)	20 (44.15)

Ordering Information — COOLPOWER 10 MD

Cold head COOLPOWER 10 MD	**Part No. 842 010**
Accessories	see Ordering Information for the compressor unit COOLPAK 6000 MD/6200 MD, connecting cable and flexline

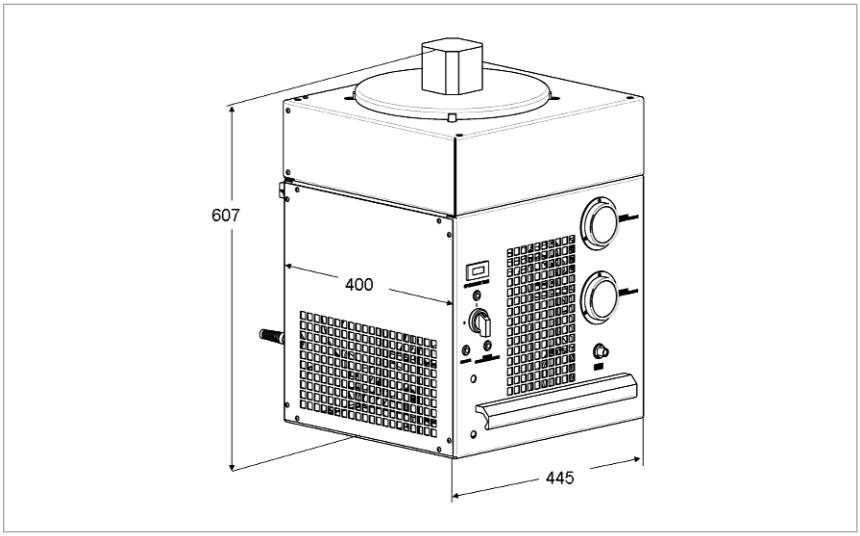
1) The refrigerating capacities and temperatures stated apply to vertical operation with the cold end at the bottom
2) Series 8 from Aeroquip

Compressor Units for Pneumatically Driven Cold Heads and Pumps, Air Cooling COOLPAK 2000 A/2200 A

Compressor unit COOLPAK 2000 A (2200 A is similar)

Advantages to the User

- High efficiency and increased performance for cryogenic pumps and refrigerators
- High long-term reliability due to long-life and highly efficient components and improved oil management
- Very quiet and low vibration operation through the innovative horizontally suspended scroll compressor
- Simple installation and operation
- Global mains voltage compatibility
- Perfect integration within complex systems due to the 24 V Sub-D interface
- Simple adsorber replacement, otherwise maintenance-free
- Small footprint
- Low cost of ownership



Dimensional drawing of the COOLPAK 2000/2200

Technical Data

		COOLPAK	
		2000 A (50 Hz)	2200 A (60 Hz)
Number of electrical connections for cold heads		1	1
Helium system filling pressure at room temperature	bar	15	14
Ambient temperature	°C	+5 to +30	+5 to +30
Mains voltage (single phase)	V	230 ± 10%	208 ± 10%
Operating current			
with cooled down cold head	A	9.5 to 10.5	11.5 to 12.5
with warmed up cold head	A	12.0	13.0
Electric power consumption			
with cooled down cold head	kW	2.2	2.3
with warmed up cold head	kW	2.4	2.5
Remote control through interface		24 V DC	24 V DC
Helium connections			
self-sealing fittings			
high-pressure side (outside thread)		1/2"	1/2"
low-pressure side (outside thread)		1/2"	1/2"
Noise level (at a distance of 1 m (3.5 ft))	dB(A)	< 55	< 55
Dimensions (W x H x D)	mm (in.)	445 x 607 x 400 (17.52 x 23.90 x 15.74)	445 x 607 x 400 (17.52 x 23.90 x 15.74)
Weight	kg (lbs)	69 (152.32)	69 (152.32)

Ordering Information

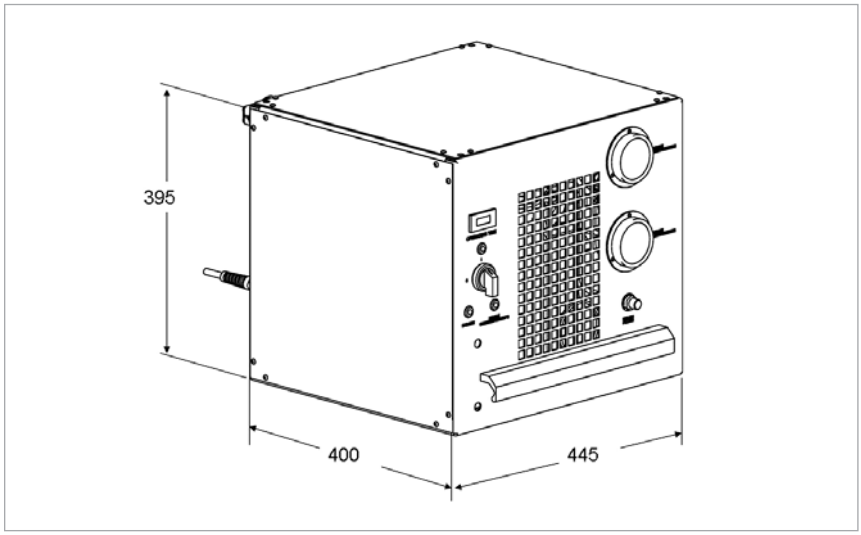
	COOLPAK	
	2000 A (50 Hz)	2200 A (60 Hz)
Compressor unit	**Part No. 840000V2010**	**Part No. 840000V2210**
Accessories, optional		
19 in. installation kit	**Part No. 840 022**	**Part No. 840 022**
RC adapter box (for operating older cold heads of type RGD, RGS or COOLPOWER 20 / 210 / 30 / 510)	**Part No. 840 910**	**Part No. 840 910**
Spare parts		
Absorber CPS-V8	**Part No. E 840001973**	**Part No. E 840001973**

Compressor Units for Pneumatically Driven Cold Heads and Pumps, Water Cooling COOLPAK 2000/2200

Compressor unit COOLPAK 2000 (2200 is similar)

Advantages to the User

- High efficiency and increased performance for cryogenic pumps and refrigerators
- High long-term reliability due to long-life and highly efficient components and improved oil management
- Very quiet and low vibration operation through the innovative horizontally suspended scroll compressor
- Simple installation and operation
- Global mains voltage compatibility
- Perfect integration within complex systems due to the 24 V Sub-D interface
- Simple adsorber replacement, otherwise maintenance-free
- Small footprint
- Low cost of ownership



Dimensional drawing of the COOLPAK 2000 A/2200 A

Technical Data

		COOLPAK	
		2000 (50 Hz)	2200 (60 Hz)
Number of electrical connections for cold heads		1	1
Helium system filling pressure at room temperature	bar	15	14
Ambient temperature	°C	+5 to +40	+5 to +40
Cooling water consumption		< 5	< 5
Cooling water feed temperature	°C	+5 to +25	+5 to +25
Mains voltage (single phase)	V	230 ± 10%	208 ± 10%
Operating current			
with cooled down cold head	A	9.5 to 10.5	11.5 to 12.5
with warmed up cold head	A	12.0	13.0
Electric power consumption			
with cooled down cold head	kW	2.2	2.3
with warmed up cold head	kW	2.4	2.5
Remote control through interface	V DC	24	24
Helium connections			
self-sealing fittings			
high-pressure side (outside thread)		1/2"	1/2"
low-pressure side (outside thread)		1/2"	1/2"
Water connections	DN	10	10
Noise level (at a distance of 1 m (3.5 ft))	dB(A)	< 55	< 55
Dimensions (W x H x D)	mm (in.)	445 x 395 x 400 (17.52 x 15.55 x 15.74)	445 x 395 x 400 (17.52 x 15.55 x 15.74)
Weight	kg (lbs)	69 (152.32)	69 (152.32)

Ordering Information

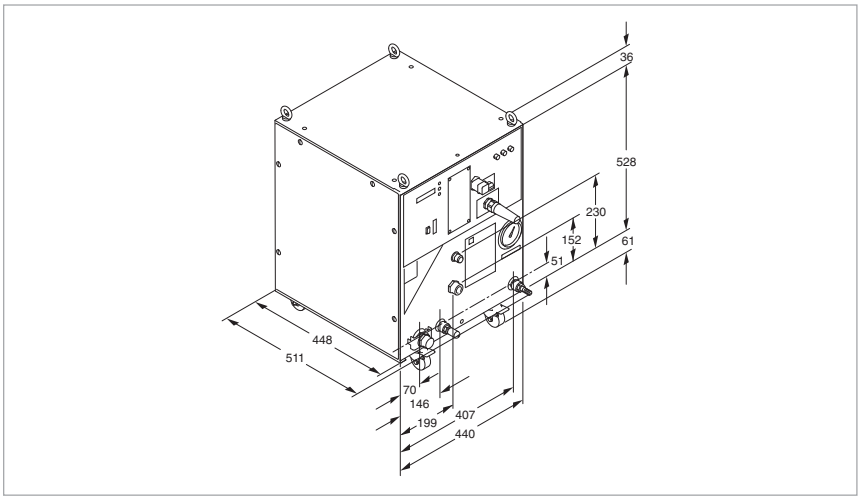
	COOLPAK	
	2000 (50 Hz)	2200 (60 Hz)
Compressor unit	**Part No. 840000V2000**	**Part No. 840000V2200**
Accessories, optional		
19 in. installation kit	**Part No. 840 022**	**Part No. 840 022**
RC adapter box (for operating older cold heads of type RGD, RGS or COOLPOWER 20 / 210 / 30 / 510)	**Part No. 840 910**	**Part No. 840 910**
Spare parts		
Absorber CPS-V8	**Part No. E 840001973**	**Part No. E 840001973**

Compressor Units for Pneumatically Driven Cold Heads and Pumps, Water Cooling COOLPAK 4000/4200 COOLPAK 6000/6200

Compressor units COOLPAK 4000/4200 (COOLPAK 6000/6200 similar)

Advantages to the User

- Highly effective and even more powerful when connected with Oerlikon Leybold Vacuum cryo-pumps and refrigerators
- Excellent long-term reliability owing to the modular design and the long life components
- Silent and low vibration operation through scroll compressors
- Simple installation and operation
- Global power supply compatibility
- Easy integration in complex systems due to 24 V DC or RS 232 C interfaces
- Almost maintenance-free
- Small footprint
- Low cost of ownership



Dimensional drawing for the COOLPAK 4000/4200 and COOLPAK 6000/6200

Technical Data

		COOLPAK 4000		4200		6000		6200	
		50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
Number of electrical connections for cold heads		1	1	1	1	1	1	1	1
Helium system filling pressure at room temperature	bar	14	13	14	13	15	14	14	13
Ambient temperature	°C	+5 to +40	+5 to +40	+5 to +40	+5 to +40	+5 to +40	+5 to +40	+5 to +40	+5 to +40
Cooling-water consumption [1]	l/min	3.5	3.5	3.5	3.5	5.0	5.0	5.0	5.0
Cooling-water entry temperature	°C	+5 to +25	+5 to +25	+5 to +25	+5 to +25	+5 to +25	+5 to +25	+5 to +25	+5 to +25
Main voltage (3 phase) upon delivery	V	400 ± 10%	–	200 ± 10%	200 [2] +10% -5%	400 ± 10%	–	230 [3] - 10%	230 ± 10%
alternative setting	V	–	470 ± 10%	230 [3] -10%	230 ± 10%	–	470 ± 10%	200 ± 10%	200 ± 10%
Operating currents									
with the cold head cool	A	6.4 to 7.4	6.2 to 7.3	14.6 to 16.5	13.8 to 17.0	9.5 to 10.5	9.0 to 10.0	15.5 to 22.0	16.0 to 23.0
with the cold head warm	A	8.5	8.1	18.3	19.5	13.7	12.0	25.0	25.0
Electrical power consumption									
with the cold head cool	kW	3.8 to 4.5	4.2 to 5.3	4.0 to 4.6	4.4 to 5.3	6.0 to 6.5	6.5 to 6.9	5.5 to 6.2	5.9 to 6.7
with the cold head warm	kW	5.3	5.8	5.3	5.9	8.2	8.7	7.6	7.8
Remote control via interface		A)	A)	A)	A)	A)	A)	A)	A)
Helium connections									
Self-sealing couplings									
High pressure connection (outside thread)		1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"
Low pressure connection (outside thread)		1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"
Water connections		B)	B)	B)	B)	B)	B)	B)	B)
Sound level (at 1 m (3.5 ft) distance)	dB(A)	53	53	53	53	53	53	53	53
Dimensions (W x H x D)	mm (in.)	C)	C)	C)	C)	C)	C)	C)	C)
Weight	kg (lbs)	93 (205)	93 (205)	93 (205)	93 (205)	94 (207)	94 (207)	94 (207)	94 (207)

Ordering Information

	COOLPAK 4000 Europe	4000 USA/Japan	4200 USA/Japan	6000 Europe	6000 USA/Japan	6200 USA/Japan
Compressor unit without power supply cable	Part No.		Part No.	Part No.		Part No.
Connection for 1 cold head	892 31		892 33	840000V6000 or 892 36		840000V6200 or 892 37
Connection for 2 cold heads	892 3000 [4]		–	892 46 [5]		–
Power supply cable 3.5 m (12.25 ft)						
CEE plug, 32 A/6h, 3 pole+N+PE	893 95	–	–	893 95	–	–
NEMA plug, L 16-20 P, 20 A/480 V, 3 pole+PE (AWG 12)	–	893 96	–	–	893 96	–
NEMA plug, L 15-20 P, 20 A/250 V, 4 pole - PE (AWG 12)	–	–	840 110	–	–	–
10 m (35.0 ft) with end splice (AWG 10)	–	–	840 111 [6]	–	–	840 111 [6]
20 m (70.0 ft) with end splice (AWG 10)	–	–	840 112 [6]	–	–	840 112 [6]
Accessories Water cooling discharge throttle	E 840000133		E 840000133	E 840000133		E 840000133
Spare parts Adsorber CACP 4000/6000	893 52	893 52	893 52	893 52	893 52	893 52

[1] At a cooling water entry temperature of 25 °C
[2] ± 10% at 12 bar filling pressure
[3] At 13 bar filling pressure
[4] COOLPAK 4000 D
[5] COOLPAK 6000 D
[6] Also suitable for COOLPAK 4000(D)/6000(D)
[A] 24 V DC or RS 232 C
[B] Hose nozzle DN 12 / G 1/2" outside thread
[C] 440 x 589 x 511 (17.32 x 23.19 x 20.12)

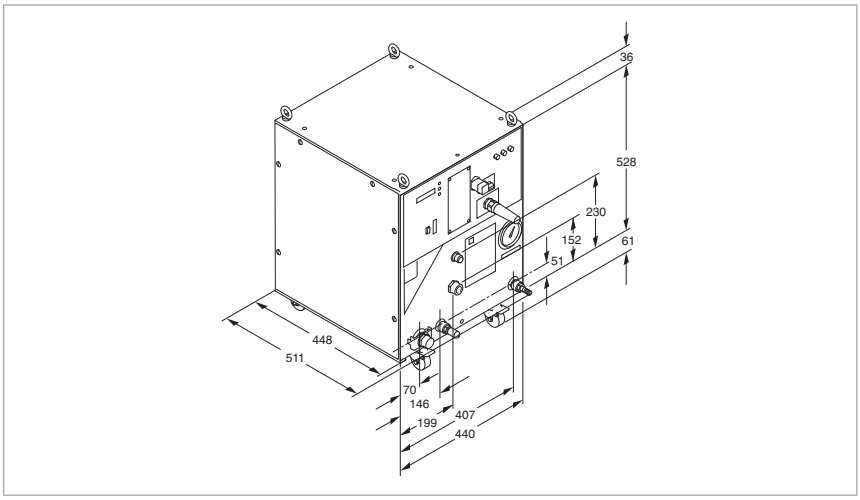
Compressor Units for Mechanically Driven Cold Heads and Pumps, Water Cooling COOLPAK 6000 MD/6200 MD

Compressor unit COOLPAK 6000 MD/6200 MD (similar COOLPAK 4000/4200)

Serves the purpose of individually driving the cold heads with mechanically driven displacers; i.e. COOLPOWER 10 MD, but also older cold heads like COOLPOWER 150, 130, 4.2 GM, 0.5 WATT and 4.2 ONE WATT.

Advantages to the User

- Compact
- Simple to operate
- Can be controlled remotely
- Selectable voltages
- Low noise
- UL approved
- Long maintenance-free period of operation
- Variable cold head motor speed



Dimensional drawing for the COOLPAK 6000 MD/6200 MD

Technical Data

	COOLPAK 6000 MD	COOLPAK 6200 MD
Mains voltage	50 Hz, 400 ± 10% 60 Hz, 460 ± 10%	50 Hz, 200 ± 10% 60 Hz, 200 - 230 ± 10%
	For all other Technical Data, see COOLPAK 6000 and 6200	

Ordering Information

	COOLPAK 6000 MD	COOLPAK 6200 MD
Compressor type	**Part No.**	**Part No.**
400 V/3-ph. 50 Hz or 460 V/3-ph. 60 Hz ± 10%	**892 42**	**–**
200 V/3-ph. 50 Hz or 200-230 V/3-ph. 60 Hz ± 10%	**–**	**892 43**
Flexible pressure line (for operating mechanically driven cold heads)		
6 m (21.0 ft) (High-pressure) FL6 HP-DN 20 (8f/8f)	**840 210**	**840 210**
6 m (21.0 ft) (Low-pressure) FL6 LP-DN 16 (8f/8f)	**840 211**	**840 211**
9 m (31.5 ft) (High-pressure) FL9 HP-DN 20 (8f/8f)	**840 217**	**840 217**
9 m (31.5 ft) (Low-pressure) FL9 LP-DN 16 (8f/8f)	**840 218**	**840 218**
20 m (75.0 ft) (High-pressure) FL20 HP-DN 16 (8f/8f)	**840 230**	**840 230**
20 m (75.0 ft) (Low-pressure) FL20 LP-DN 16 (8f/8f)	**840 231**	**840 231**
Connection cable for the cold heads COOLPOWER 10 MD, 150, 130, 4.2 GM, 0.5 WATT and 4.2 ONE WATT		
9.0 m (31.5 ft)	**842 110**	**842 110**
20.0 m (75.0 ft)	**842 112**	**842 112**
30.0 m (105.0 ft)	**842 114**	**842 114**
Power supply cable		
3.5 m (12.25 ft)		
CEE plug, 32 A/6h, 3 pol +N+PE	**893 95**	**–**
NEMA plug, L 16-20 P, 20 A/480 V, 3 pole+PE (AWG 12)	**893 96**	**–**
10 m (35.0 ft) with end splice (AWG 10)	**–**	**840 111** [1]
20 m (75.0 ft) with end splice (AWG 10)	**–**	**840 112** [1]
Accessories		
Water cooling discharge throttle	**E 840000133**	**E 840000133**

[1] Also suitable for COOLPAK 4000(D)/6000(D)

Accessories

General Accessories for Compressor Units COOLPAK

Technical Data	Length	Connections on both sides (inside thread)	
		High pressure line (HD)	Low pressure line (ND)
Flexlines [1), 2)]			
FL 4.5 (1/2", 1/2")	4.5 m (15.75 ft)	1/2"	1/2"
FL 9.0 (1/2", 1/2")	9.0 m (31.50 ft)	1/2"	1/2"

Accessories for Flexlines	Adaptor Outside thread (m)	Adaptor Inside thread (f)
Adapter for flexlines		
AD (1/2" m, 3/4" f)	1/2"	3/4"
AD (1/2" f, 3/4" m)	3/4"	1/2"

	Connections Outside thread (m)	Connections Inside thread (f)
Elbow 1/2" for flexlines	1/2"	1/2"
Isolating piece 1/2" for flexlines	1/2"	1/2"

	Connections on both sides Outside thread (m)
Coupling 1/2" for interconnecting two 1/2“ flexlines	1/2"

	Gas distributors required quantity	Gas manifold - Connections At the compressor (inside thread)	Gas manifold - Connections At the cold head (outside thread)
Gas manifold (1 piece each)			
GD 2 (for dual operation) [2)]	2	1/2"	2 x 1/2"
GD 4 (for up to quad operation) [2)]	2	1/2"	4 x 1/2"

	Length
EL 4.5 extension cable for linking cold head and compressor unit	4.5 m (15.75 ft)

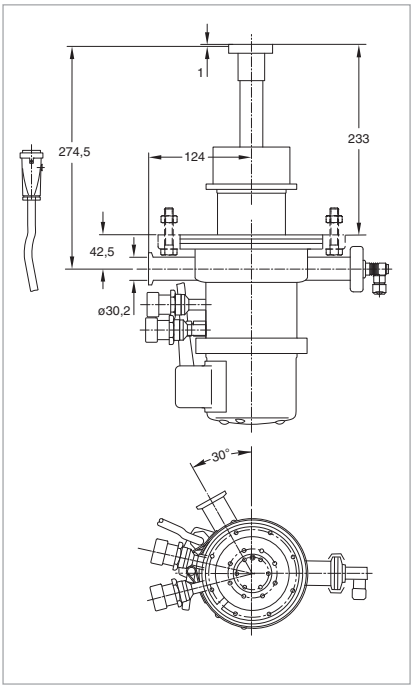
Ordering Information

	General Accessories
Flexlines [1), 2)]	**Part No.**
FL 4.5 (1/2", 1/2")	**892 87**
FL 9.0 (1/2", 1/2")	**892 88**
Adaptor	
AD (1/2" m, 3/4" f)	**892 89**
AD (1/2" f, 3/4" m)	**892 90**
Elbow 1/2"	**891 73**
Coupling 1/2"	**891 71**
Gas manifold (1 piece each)	
GD 2 (for dual operation) [2)]	**840 253 (2x)**
GD 4 (for up to quad operation) [2)]	**840 254 (2x)**
EL 25 extension cable for linking cold head and compressor unit [2)]	**200 20 900**
EL 4.5 extension cable for linking cold head and compressor unit [2)]	**893 74**

All flexible pressure lines, adaptor pieces, bends, isolating pieces, line couplings and gas manifolds are equipped with self-sealing Aeroquip fittings and filled in the factory with high-purity helium gas (purity: 99.999%). The filling pressure is 16 bar

1) Minimum bending radius: 30 cm (11.81 in.)
2) Only suited for pneumatically driven cold heads and cryopumps

Refrigerator Cryostat based on the RDK 6-320



Basic unit RDK 6-320

The RDK 6-320 basic unit includes the COOLPOWER 5/100 T two-stage cold head. Its high refrigerating capacity at low temperatures permits experiments which previously could not be performed by relying on refrigerators and which required the use of liquid helium.

The RDK 6-320 basic unit is a complete system for measurements in the temperature range between 6 and 320 K.

The COOLPOWER 5/100 cold head is augmented by:

- Silicon diode for measuring the temperatures at the second stage of the cold head
- Heater at the second stage of the cold head provided with overheating protection
- 11-way current feedthrough with matching external connector
- DN 25 KF pumpdown port
- DN 160 ISO-K vacuum flange

Advantages to the User

- Compact
- Very reliable
- Comprehensive range of accessories from one source
- For installation in any orientation
- Simple to operate
- Short cooldown time
- Cost-effective in long-term experiments since no liquid helium is required
- Simple and rapid servicing through the use of the standard COOLPOWER 5/100 cold head with pneumatic drive system for the displacer

Typical Applications

- Cooling of samples and detectors
- Material research and testing
- Spectroscopic applications
- Matrix isolation spectroscopy with neon and argon

General Remarks on Refrigerator Cryostats

Isolating Vacuum

A two-stage rotary vacuum pump will normally be adequate to produce an isolating vacuum. However, this pump should be equipped on the suction side with an adsorption trap and a isolation valve.

If the application requires that the cold surfaces remain free of hydrocarbons, we recommend the use of our small turbomolecular pump system PT 50 (see Product Section C10).

Temperature Measurement

In order to avoid measurement errors due to thermal resistances, the temperature at the sample should preferably be measured by a second optional sicon diode which is installed as close to the sample as possible. If possible it should be maintained at the same temperature level as that of the probe.

Temperature Control

The temperature at the second stage of the cold head (or that of the probe) is controlled by heating against the cooling effect produced by the refrigerator (while the cold head is running).

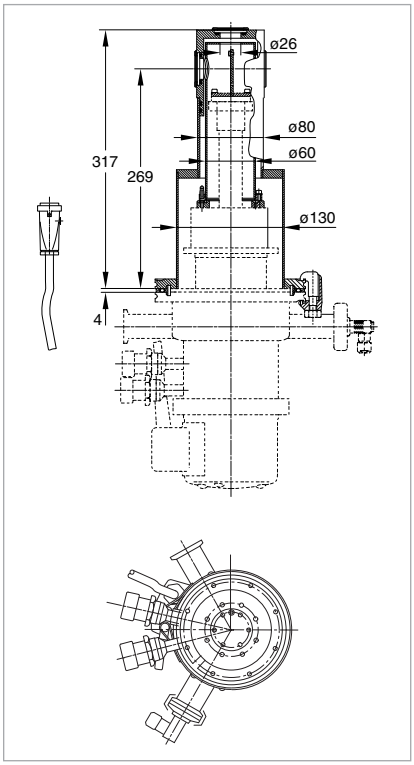
Optical Refrigerator Cryostat based on the RDK 6-320

Optical refrigerator cryostat RDK 6-320

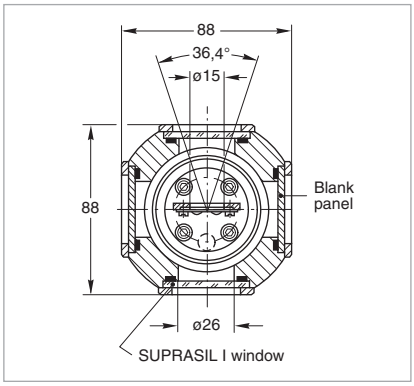
Upgraded as an optical cryostat (option) the RDK 6-320 is tailor-made for experiments involving temperatures down to about 7 K.

Supplied Equipment

- Basic unit RDK 6-320
- Temperature attenuation disk out of Pb Sn
- Sample holder out of Al 99.5
- Thermal radiation shield out of E-Cu
- Vacuum jacket out of aluminum / stainless steel
- Five exchangeable windows (four windows on the sides, one window in the longitudinal axis of the cryostat); two windows on the sides and the window in the longitudinal axis are made of SUPRASIL I, the two other windows are blanked off and are made of brass



Dimensional drawing for the optical refrigerator cryostat



Section through the window area

Technical Data

	RDK 6-320
Temperature range	
2nd stage of the cold head K	6 to 320
1st stage of the cold head K	28 to 320
Silicon diode for temperature measurements at the 2nd stage of the cold head	built-in
Heater at the 2nd stage of the cold head	built-in
Heating power W	50
Heating current A	1
Heating voltage V DC	50
Permissible ambient temperature °C	+5 to +40
He filling pressure at room temperature bar	16
He connections	
Self-sealing screwed connections	
High pressure connection (outside thread)	1/2"
Low pressure connection (outside thread)	1/2"
Length of the connection cable to the compressor unit m (ft)	4.5 (15.75) [included)]
Weight kg (lbs)	13 (28.7)

Ordering Information

	RDK 6-320
Basic unit RDK 6-320	**Part No. 842 403**
Optical cryostat consisting of RDK 6-320 and Expansion Kit ROK	**Part No. 842 404**
Compressor unit	
COOLPAK 6000, 400 V/50 Hz; 470 V/60 Hz	**Part No. 840000V6000**
COOLPAK 6200, 200 V/50 Hz; 200 V, 230 V/60 Hz	**Part No. 840000V6200**
Power supply cable	see Ordering Information for the compressor units COOLPAK
Flexlines FL 4.5 (1/2", 1/2")	**Part No. 892 87**
Temperature measurement at 2nd stage with low temperature controller Modell 9700	**Part No. 842 400**
Sensor cable, 3 m (10.5 ft) long	**Part No. 842 401**

Accessories for Cryopumps / Cryogenics

Controllers and Monitoring Units for Cryopumps

Advantages to the User

- Interface to external system controller
- For easy integration with external system controllers
- For safe pumping of hydrogen

Typical Applications

- For automated operation of the COOLVAC cryopumps of the ClassicLine

System Controller COOLVAC SC

System controller COOLVAC SC

Design Features

- 1/4 19" rack module
- 3 height units (HU)
- Dimensions (W x H x D) 106 x 129 x 178 mm (4.17 x 5.08 x 7.01)
- Operation through pushbuttons

The intelligent COOLVAC system controller SC automatically controls and monitors up to 30 COOLVAC pumps.
Online monitoring, help functions and a service interface for easy diagnostic are just a few user friendly features.
It can be installed as a “stand alone system” or remote controlled via an interface.

Supplied equipment

- Network terminator (Part No. 400 000 114)
- Hardware interlock plug (Part No. 400 000 133)
- 0 modem adapter for connection to the PC

Technical Data		COOLVAC SC
Operating voltage		Supply through RS 485 C cable from COOLVAC PM
Dimensions (W x H x D)	mm (in.)	106 x 129 x 178 (4.17 x 5.08 x 7.01) [1/4 19", 3 HU]

Ordering Information	COOLVAC SC
System controller COOLVAC SC	**Part No. 844 230**
System controller COOLVAC SC with Profibus interface	**Part No. 844230V0004**

Power Supply PS for up to Two Cryopumps

Power supply PS

Design Features

- 19" rack module
- 3 height units (HIU)
- Dimensions (W x H x D)
  483 x 135 x 320 mm
  (19.02 x 5.31 x 12.60)

Supplied equipment

- Approximately 3 m long mains cord

The COOLVAC power supply PS provides the power for the cold head motor, the electrical heaters and the supplies voltage to the electronics for up to 2 COOLVAC pumps.
Controlled via the system controller SC the PS turns the compressor unit on and off if required by the connected pumps.

The system controller COOLVAC SC (not included) will fit into the empty space.

Technical Data

		PS for double connection
Power consumption, approx.	VA	900
Supply voltage, factory preset (optional 115 V AC is possible [1])	V AC	230 ± 10%, 1 phase
Output power	W	2 x 250
Rack mounting		Through 19" installation frame
Dimensions (W x H x D)	mm (in.)	483 x 135 x 320 (19.02 x 5.31 x 12.60) [3/4 19", 3 HU]
Weight	kg (lbs)	10 (22.1)

Ordering Information

	PS for double connection
Power supply PS for up to 2 Cryopumps	**Part No. 844 135**

[1] please contact Oerlikon Leybold Vacuum

Power supply PS for up to Three Cryopumps

Power supply PS

Design Features

- 19" rack module
- 4 height units (HU)
- Dimensions (W x H x D)
  483 x 177 x 440 mm
  (19.02 x 6.97 x 17.32)
- Single LED indicates correct direction of rotation for the rotating field

The COOLVAC power supply PS provides the power for the cold head motor, the electrical heaters and the supplies voltage to the electronics for up to 3 COOLVAC pumps.
Controlled via the system controller SC the PS turns the compressor unit on and off if required by the connected pumps.

Supplied equipment

- 20 m long mains cord, fitted, without plug
- 19" mounting brackets for rack mounting

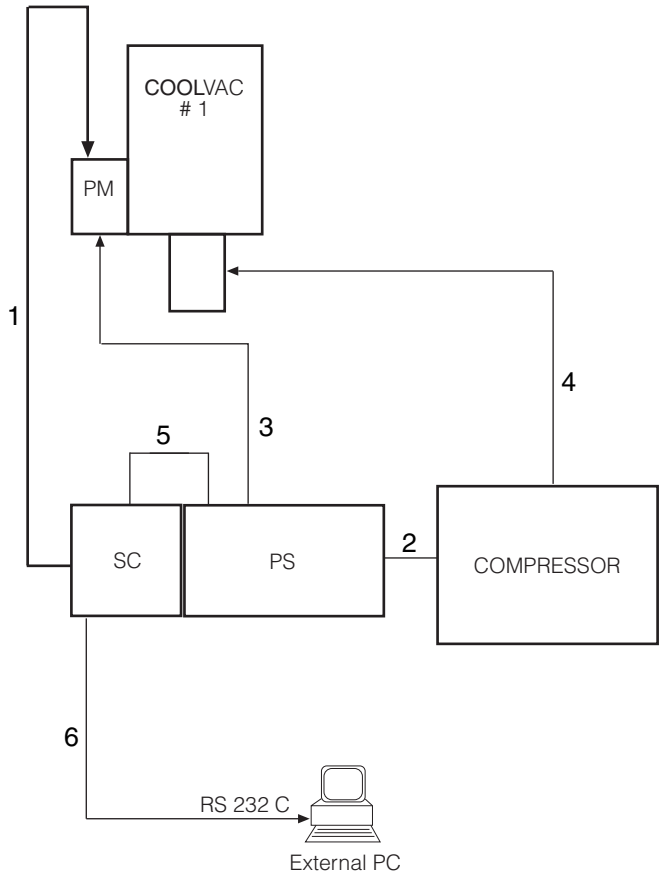
Technical Data

		PS for multiple connection
Nominal voltage (3 phase) factory default switchable to	 V AC V AC	 3 x 200 + PE 3 x 400 + PE 3 x 460 to 480 + PE
Voltage tolerance		± 10%
Frequency range	Hz	47 to 63
Fusing		Power switch
Ambient temperature range	°C	0 to +40
Protection type	IP	20
Dimensions (W x H x D) [without handles]	mm (in.)	483 x 177 x 440 (19.02 x 6.97 x 17.32) [19", 4 HU]
Weight (including cord)	kg (lbs)	38.8 (85.65)

Ordering Information

	PS for multiple connection
Power supply PS for up to 3 cryopumps	**Part No. 844 235**

COOLVAC ClassicLine, Single System Configuration

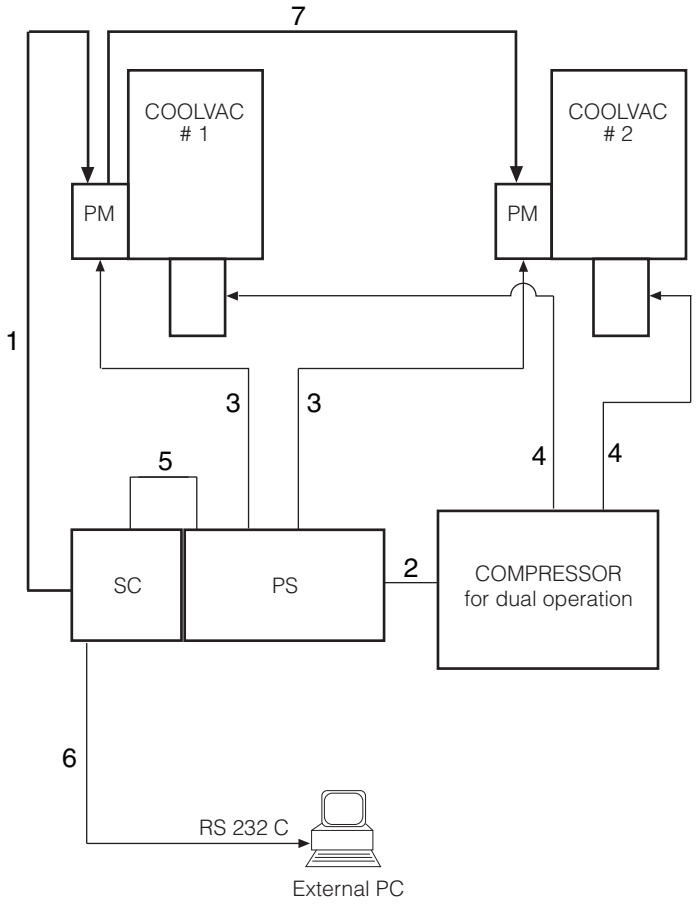


PM = Pump module (included with the pump)
SC = System controller
PS = Power supply
1 = e.g. Part No. 844 262
2 = e.g. Part No. 844 139
3 = e.g. Part No. 844 138
4 = Part No. E 400000323 (necessary only for COOLVAC 1500 CL, 2000 CL und 3000 CL)
5 = Part No. 844 141
6 = to be provided by the customer

Single System Configuration

COOLVAC ClassicLine, Dual System Configuration

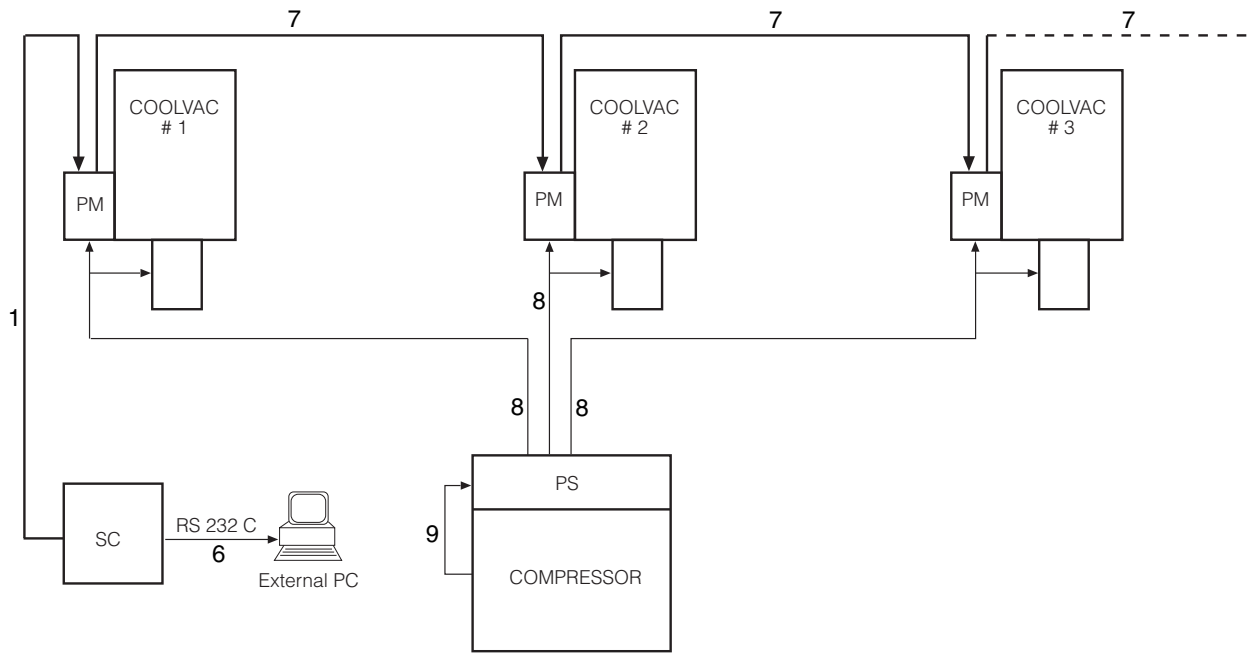
Only for European mains voltages and for compressors suited for dual operation



PM = Pump module (included with the pump)
SC = System controller
PS = Power supply
1 = e.g. Part No. 844 262
2 = e.g. Part No. 844 139
3 = e.g. Part No. 844 138
4 = Part No. E 400000323 (necessary only for COOLVAC 1500 CL, 2000 CL und 3000 CL)
5 = Part No. 844 141
6 = to be provided by the customer
7 = e.g. Part No. 844 256

Dual System Configuration

COOLVAC ClassicLine,
Dual and Mutiple System Configuration



PM = Pump module (included with the pump)
SC = System controller
PS = Power supply
1 = e.g. Part No. 844 262
6 = to be provided by the customer
7 = e.g. Part No. 844 256
8 = e.g. Part No. 844 252
9 = Part No. 844 265

Dual and Mutiple System Configuration

Low Temperature Controller Modell 9700

Low temperature controller Modell 9700

Advantages to the User

- Microprocessor controlled PID controller
- Digital temperature readout in Kelvin
- Control by means of counter heating
- High control accuracy over the entire temperatur range (1.5 to 450 K)
- Electric heating power up to 50 W
- Programmable heater power limit
- Generation of linear temperature ramps
- Up to 50 program steps are programmable
- Standard interface RS 232 C and IEEE-488
- Data from two sensors can be displayed
- Analogue temperature outputs for both channels
- Can be used in three operating modes
  - Manual
  - Program
  - External computer control

Typical Applications

- Temperature control at refrigerator cryostats

Technical Data		Modell 9700
Mains connection, 50/60 Hz	V AC	85 to 240
Power consumption, max.	W	150
Entry of data		3 x 4 membrane key pad
Data memory		EPROM
Display		Two line, 20 digit LED digital display
Temperature measurement Sensors		2 x silicon diodes type D or 2 x silicon diodes with standard temperature resistance characteristics
Measurement current	µA	10
Measurement range	K	1.5 to 450
Measurement range of the silicon diode type D	K	1.4 to 325 K
Number of channels		2
Resolution		Simultaneous display of both channels
A/D converter resolution	bit	24
Switching outputs		2 relays (n.o. and n.c. contacts)
Temperature resolution	K	0.1
Temperature control		PID controller
Heating power, max.	W	50
Heating current, max.	A	1
Heating voltage, max.	V DC	0 to 50
Computer interface		RS 232 C and IEEE-488
Permissible ambient temperature	°C	+10 to +30
Mechanical design/cabinet		Table-top unit (8.5" x 3.5" x 12")
Dimensions (W x H x D) [high H without feet]	mm (in.)	215.9 x 88 x 304.8 (8.5 x 3.5 x 12.0)
Weight	kg (lbs)	2.3 (5)
Dimensions of the packaging (W x H x D)	mm (in.)	360 x 230 x 450 (14.17 x 9.06 x 17.72)
Weight (inc. packaging, approx.)	kg (lbs)	4.2 (9.3)
Length of mains cord	m (ft)	2.5 (8.75)

Ordering Information	Modell 9700
Low temperature controller Modell 9700	**Part No. 842 400**
Sensor cable, 3 m (10.5 ft) long	**Part No. 842 401**
Silicon diode type D with connection cable and miniature plugs	**Part No. 890 89**

Low Temperature Measuring Instrument MODEL 211S

Low temperature measuring instrument MODEL 211S

Advantages to the User

- Supports one silicon diode
- 3-digit LED display
- Temperature readout between 1 and 450 Kelvin
- Two trigger thresholds
- RS 232 C interface

Typical Applications

- Temperature measurements on cryostats
- Temperature measurements on cryopumps for monitoring their operation and to control pump systems

Technical Data

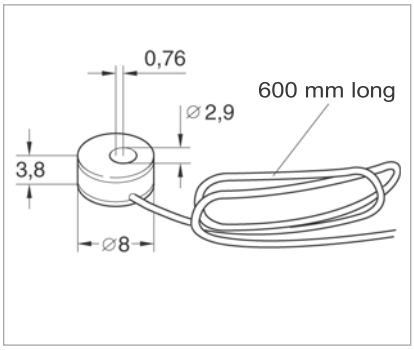
		MODEL 211S
Measurement current	µA	10
Display		LED, 5-digits
Temperature range	K	1.4 to 475
Resolution		0.001 K from 1.4 to 99.9 K 0.01 K from 100 to 475 K
Accuracy		±0.05 K from 1.5 to 99.9 K ±0.05 K from 100 to 475 K
Power supply voltage		5 V DC at 1 A through the supplied 100-240 V AC power adaptor
Trigger thresholds		2
Switched output		2 relays (n.c. and n.o.) 30 V DC at 1 A
Analog output Voltage Current	 V mA	 0 to 10 4 to 20
RS 232 C interface		a) Temperature output b) External adjustment of switching thresholds
Admissible ambient temperature	°C	+15 to +35
Mechanical design/housing		Benchtop unit
Dimensions (W x H x D)	mm (in.)	96 x 48 x 166 (3.78 x 1.89 x 6.54)
Weight (including packaging), approx.	kg (lbs)	0.45 (1.0)

Ordering Information

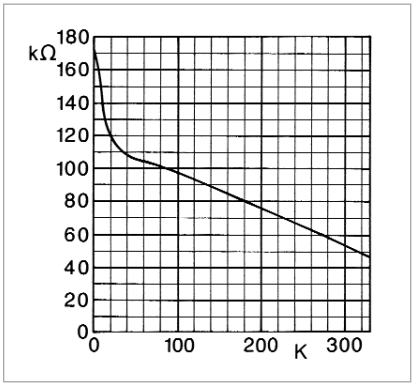
	MODEL 211S
Low temperature measuring instrument MODEL 211S	**Part No. 844 110**
HV cable 2 way with plug, 10 m (35.0 ft) long [1)]	**Part No. 844 112**
HV cable 4 way with plug, 10 m (35.0 ft) long [1)]	**Part No. 844 113**
UHV cable 4 way with plug, 10 m (35.0 ft) long [1)]	**Part No. 844 114**
Silicon diode, type D, with connecting cable and micro plugs - without current feedthrough	**Part No. 890 89**
HV current feedthrough on a flange DN 25 KF, 2 way	**Part No. 200 19 256**
UHV current feedthrough on a flange DN 16 CF, 4 way	**Part No. 500 217**

[1)] For COOLPOWER and COOLVAC pumps

Temperature Sensor



Dimensional drawing for the silicon diode, type D



Standard characteristic of the silicon diode

In contrast to vapor pressure thermometers, electric temperature sensors can be used for continuous measurements within a wide range of temperatures.

Silicon diodes offer a negative temperature coefficient of resistance, i.e. their resistance drops as the temperature increases. The slope of the temperature/resistance characteristic and the absolute resistance are decisive regarding the suitability of these diodes. The slope determines the sensitivity of the sensor and a high electrical resistance permits accurate measurements while keeping the thermal load small (microwatts).

In systems which are degassed at high temperatures, silicon diodes can only be fitted after degassing has been completed.

The silicon diode type D matches the low temperature display unit and the low temperature control unit Modell 9700.

Technical Data

Silicon Diode Type D

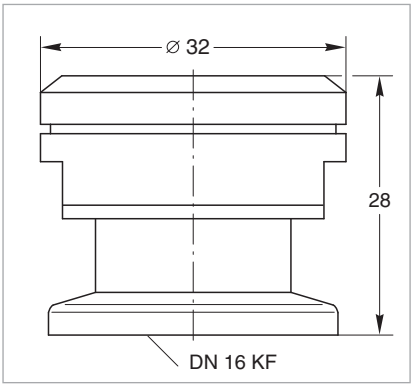
Temperature range	K	1.4 to 325
Temperature coefficient (dR/dT) qualitative quantitative	 Ω/K	 Negative in the entire temperature range Non-linear characteristic
Measurement current	µA	10
Bakeable to	°C	+60

Ordering Information

Silicon Diode Type D

Temperature sensor	**Part No. 890 89**
Silicon diode with 4way electrical feedthrough	**Part No. 200 20 694**
Flange DN 16 ISO-KF	**Part No. 200 20 616**

Safety Valve



Dimensional drawing for the safety valve

Typical Applications

- Protecting sealed vacuum systems like cryopumps, cryostats, lifting devices, for example against internal overpressures
- Mandatory for systems which are separated when cold, as a means of protection against overpressures

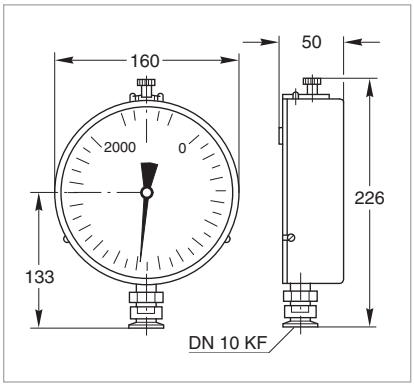
Technical Data

	Safety Valve
Responding pressure mbar	150 ± 40, over-pressure
Flow at 140 mbar l x h^{-1}	500
Valve disk	Spring loaded, with O-ring seal
Leak rate in the closed state mbar x l x s^{-1} (Torr x l x s^{-1})	< 1 x 10^{-8} (< 0.75 x 10^{-8})
Connection DN	16 KF
Diameter mm (in.)	32 (1.26)
Material	Steel 1.4305
Overall height mm (in.)	28 (1.10)
Weight kg (lbs)	0.3 (0.7)

Ordering Information

	Safety Valve
Safety valve on DN 16 KF flange	**Part No. 890 39**

Precision Manometer



Dimensional drawing for the precision manometer

Typical Applications

- Pressure readout for vapor pressure thermometers

Technical Information

For operation and measurements at pressures exceeding 1013 mbar (760 Torr) the small flange seal must be equipped with an outer centering ring Part No. 183 53.

Technical Data — Precision Manometer

Connection	DN	10 KF
Measurement range	mbar (Torr)	0 to 2000 (0 to 1500)
Accuracy		1 % of full scale
Diameter	mm (in.)	160 (6.3)
Length of the dial	mm (in.)	320 (12.6)
Internal volume, approx.	cm^3	20
Overall height	mm (in.)	226 (8.9)
Weight	kg (lbs)	1.4 (3.1)

Ordering Information — Precision Manometer

Precision manometer	**Part No. 890 50**

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