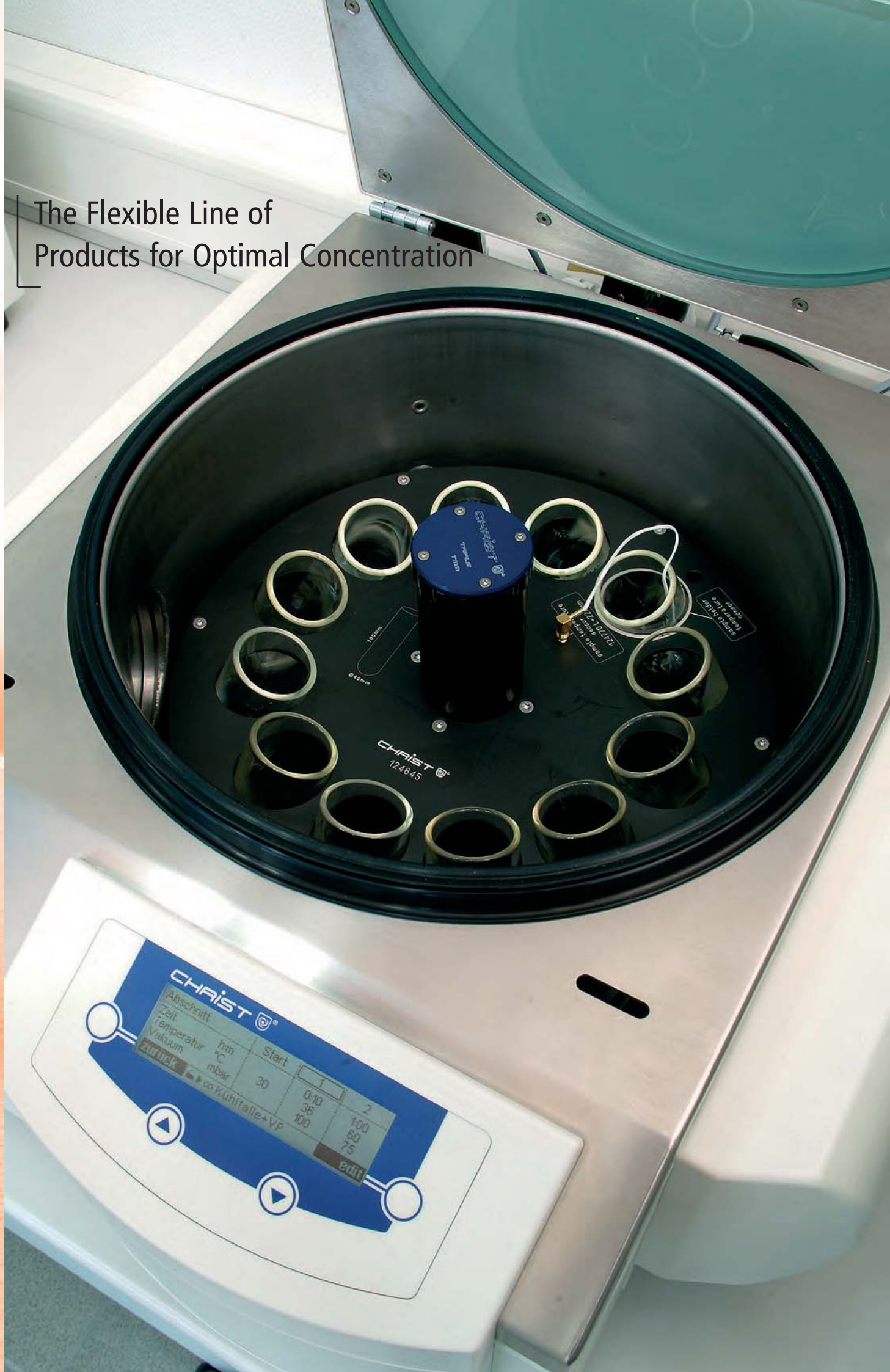




*SpeedDry*  
Rotational Vacuum Concentrators

**CHRIST** ®

The Flexible Line of  
Products for Optimal Concentration



# Rotational Vacuum Concentrators: Evaporation of Temperature Sensitive Samples with Care

## The Process

This process is used for the evaporation, drying, purification and concentration of samples. This method is an alternative to the following processes:

- Distillation systems and rotational evaporators use high temperatures and are working next to normal pressure.
- Freeze-drying systems operate at very low temperatures and high vacuum levels. Although sublimation (the direct transformation from frozen solid to steam) protects the sample, it is time consuming.

Rotation vacuum concentrators provide a method between the two above processes. The sample solvent evaporates at room temperature, at low pressure and without having to be frozen. This occurs relatively quickly. There is no thermal strain on the sample which is important when working with thermally sensitive biological or clinical substances. The material is rotated at a moderate centrifugal speed of 1.350 to 1.750  $\text{min}^{-1}$ . The resulting gravitational force prevents the product from spitting and bumping. The solvent is collected in traps and can be reused or discarded.

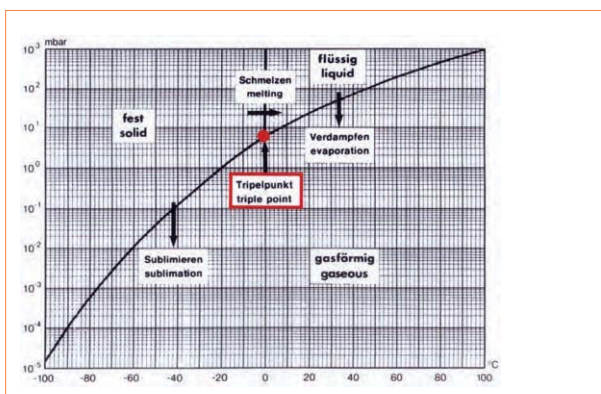
## The economically efficient Rotational Vacuum Concentrator

- no sample foaming, minimal sample loss
- simultaneous, multiple sample drying
- concentration of sample on tube bottom (other than in vortex-shaker), an advantage when using small volumes of thin solutions
- suitable for drying of water and solvent-containing substances for volumes of less than 1 ml up to 3 liters
- reproducible drying processes through control of process parameters such as rotor chamber temperature (energy input for evaporation) and vacuum (including the automatic setting of optimal pressure, depending on pump system)
- safe and simple solvent recovery

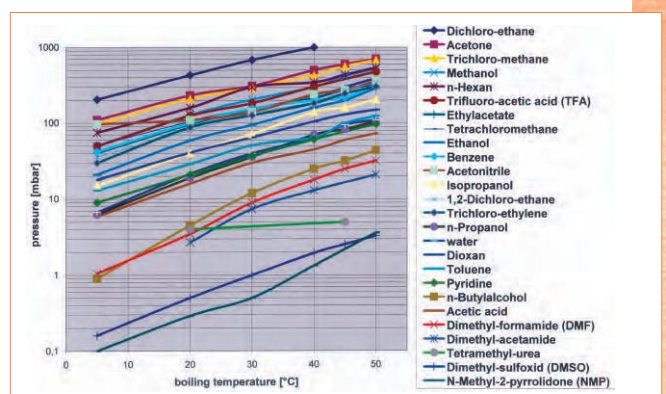
## Possible uses

- DNA/RNA (solvents mainly water, ethanol, methanol)
- oligo-synthesis, peptides
- PCR (polymer chain reaction)
- HPLC (solvent mainly water/acetonitril)
- isolation/synthesis of organic substances
- storing and handling of substances (substance libraries)
- combinational chemistry
- high-throughput-screening (HTS)
- analysis of food and environmental samples
- toxicology, forensic
- general laboratory evaporation

vapour-pressure curve for  $\text{H}_2\text{O}$



vapour-pressure curves for commonly used organic solvents



## SpeedDry Vacuum Concentrators: Performance that Speaks for itself



- **Magnetic drive with speed control:** centrifugal force eliminates bumping and foaming, no rotating parts outside of the rotor-chamber, the chemicals remain within sample chamber.
- **Simple interface with the push of a button:** Concentrator Display (CD) interface\*, automatic sequence for start and stop, vacuum on and off depending on rotor speed, automatic aeration, sample is prevented from spitting.
- **Fast evaporation:** high input of energy through electrical heating of rotor chamber, can be set in 1°C intervals from 30°C to 80°C (except of RVC 2-18 = 60°C), cooling traps reduce evaporation time for larger sample volumes.
- **Useful for water or solvent containing samples:** Basic Speed Dry systems with durable glass cover (is optional with the RVC 2-25), stainless steel rotor chamber, chemically resistant seals, anodized rotors. RVC 2-18 CD also available in HCL-resistant version.



\* for RVC 2-18 resp. CDplus for models RVC 2-25, 2-33 and 2-33 IR



### Concentrator Display (CD) Interface

- microprocessor system with LCD display
- speed control
- rotor chamber heating can be set in 1°C intervals from 30°C to 60°C (80°C)
- pre-set time from 5 minutes to 12 hours
- LC display shows important process and system parameters:
  - rotor temperature
  - time
  - open/close of cover
  - rotor speed
  - state of vacuum ("evacuated / aerated")
  - visual alarm with error code
  - optional data-interface

additional with CDplus:

- vacuum measurement and -control
- ramp programming function for pressure and temperature
- determination of the end of the drying process (pressure increase test) for automatic operation

- **No limits to your applications:** system components can be individually combined, cooling traps range from 2-4 liters and temperatures of -50/-60/-90 and -105°C, chemical resistant diaphragm vacuum pumps from 10 mbar to 2 mbar final vacuum or chemical hybrid pumps with < 0.1 mbar final vacuum (also for solvents with high boiling points).
- **Combination possibilities with your freeze-drying system:** easy connection via rubber valve, especially suited for substances with high boiling points (e.g. DMSO, NMP)
- **Broadest range of rotors:** from standard tubes to special flasks - our own rotor manufacturing covers almost every need.
- **Made in Germany:** ISO 9001- certified series production, qualified technical and application service.

## SpeedDry Product Range for Vacuum Concentrators

### Basic Appliances in Three Different Sizes



#### RVC 2-18 CD

- the **mini** concentrator: inexpensive and compact table-top concentrator suited for smaller sample volumes
- special DNA and HCL systems available
- chemical resistant diaphragm pumps (2m<sup>3</sup>/h suction capacity, 7 mbar final vacuum), standard, vacuum system with lower vacuum and vacuum controls, optional
- normally used without cooling traps



#### System solutions for special processes

The complete **RVC 2-18 DNA** system is designed for the concentration of DNA / RNA in ethanol/methanol / water solutions in up to 72 samples of 1.5 ml / 2.2 ml tubes. A special **RVC 2-18 HCl** (see photo left) version exists for material containing in hydrochloric acid. For other applications the systems can be configured according to need – please contact our application specialists for assistance.



#### RVC 2-25 CDplus

- the **mid-size** concentrator: all-purpose table-top concentrator for the routine concentration of larger sample volumes
- rotor capacity 108 x 1.5/2.2 ml tubes up to 2 x microtiter plates
- stainless steel/glass compound cover with window (corrosion proof, e.g. for DCM/ACN)
- chemical resistant diaphragm pumps (2m<sup>3</sup>/h suction, 7 mbar final vacuum), standard, vacuum system with lower vacuum and vacuum controls, optional
- optional combination with cooling traps (2 or 4 Liters) for increased evaporation

## RVC 2-33 CDplus

- The **maxi** concentrator: a multipurpose system for large sample volumes with practically all types of solvents
- rotor capacity 216 x 1.5/2.2 ml tubes up to 12 x microtiter plates or 4 x deep-well plates
- stainless steel/glass compound cover with window (corrosion proof)
- high-performance drive system, 1.550 min<sup>-1</sup> (500xg f. micro tubes) prevents bumping and foaming (e.g. with DCM)
- practically tolerant to imbalance (> 50 g)
- chemical resistant diaphragm pumps (2m<sup>3</sup>/h suction, 9 mbar final vacuum), standard, vacuum system with lower vacuum and vacuum controls, optional, chemical hybrid-pump for solvents with high boiling points (e.g. DMSO)
- recommended use with 4 liter cooling traps due to high volume evaporation (-50°C, -60°C, -90°C or -105°C)
- flexible use as vacuum drying chamber through easy dismantling of rotor shaft



## Rotational-Vacuum-Concentrator SpeedDry 2-33IR Fastest possible Sample Concentration and Drying

This newly developed CHRIST-vacuum concentrator SpeedDry 2-33IR is particularly suitable for gentle concentration of DNA/RNA, proteins and similar analysis preparations at the workplace. The versatile rotor program provides a high sample capacity, e.g. from 216 x 1.5 ml reaction vials up to 12 x microtiter-plates or 4 x deep-well-plates. In addition, large sample volumes, e.g. 100-ml-tubes that are used for the screening of active substances can be quickly concentrated thanks to the efficient energy supply with halogen IR lamps.

The innovative drive system with its powerful external rotor motor, the contact-free, central rotary coupler, and direct power transmission all guarantee safe operation even in the event of high unbalance. The user-friendly CDplus control unit provides a quick overview of the current operating parameters. Heating temperatures between +30 °C and +80 °C and, of course, also the entire pressure range of the vacuum pump can be selected either manually or controlled by a program, also freeze drying possible.



## Features



- Particularly solvent-resistant unit with a stainless steel chamber, safety glass lid and magnetic drive without a shaft exit to the outside. Suitable for DMSO, ACN, TFA.
- CDplus control unit with a ramp programming function for pressure and temperature (16 programs max.).
- Halogen IR lamps provide optimal energy input for fastest possible evaporation.
- Control of the energy supply as a function of the sample vessel temperature, plus an additional measurement of the product temperature in order to avoid thermal damage.
- Robust, non-contact measurement data transfer (Triple TMM) from the rotor to the control unit.
- Precise vacuum control in both directions (air injection) for reproducible processes. High-performance vacuum pumps with final vacuum of <math><0.1\text{ mbar}</math> allow dual-step process "Evaporation and Freeze Drying".
- Determination of the end of the drying process (pressure increase test) for automatic operation.
- Variable speed for substance mixtures that tend towards a delay in boiling.
- Central control of the entire system consisting of the RVC, cooling trap (LDplus/LSC), and vacuum pump (including a warm-up/cool-down function).
- Multilingual user interface (German/English/French).
- All units are "Made in Germany" within our ISO 9001-certified series production. Not to mention that CHRIST provide a qualified technical and application service.

## More Choice for the Job at Hand- the RVC-Module System Adapts to Your Needs



### Rotors for virtually all sample-tubes

We profit from the vast know-how of our sister company Sigma Laboratory Centrifuges which produces all of the rotors for our vacuum concentrators. Our development engineers and specialists are experienced in the production of standard and custom-made rotors. They are manufactured using state-of-the-art CNC machines, are precisely balanced and laser marked and coded. Our aim is to produce rotors with flawless performance quality and high chemical resistance for a long period of use.

## Rotor-Table RVC

Nominal tube volume (ml)	Tube size diameter x length (mm)	RVC 2-18 CD	RVC 2-18 HCI CD	RVC 2-25 CDplus	RVC 2-33 CDplus	RVC 2-33 IR CDplus
0.2	6 x 20			3 x 72		
0.25 / 0.5	5.8 x 47	2 x 40	2 x 40			
0.6	6 x 38					
0.5 / 0.75	7.9 x 28	3 x 30		3 x 48		
1	5 x 100	18		48	72	72
1	7.2 x 40	3 x 36				
1.5 / 2.0	10.8 x 38	3 x 24	2 x 24	3 x 36	3 x 72	3 x 72
1.5	11–12 x 31–39				3 x 54	3 x 48
2	8 x 90		24			
2	10.7 x 72	12				
2	11.2 x 36	3 x 36	3 x 36			
2	12 x 36			3 x 36		
2	12.3 x 42			2 x 36		
2	16.1 x 56	2 x 18				
2.5	11.7 x 32	3 x 24		2 x 36		
2.5	12 x 36	3 x 24	2 x 24			
4	14.8 x 83	12				
4	12.7. x 46			2 x 36		
5	15 x 45	2 x 18	2 x 18	2 x 30		
5	15 x 50				2 x 72	
5.5	15.6 x 57	2 x 18				
5	16.5 x 35			3 x 24		
5	16.7 x 50.3–65				3 x 36	3 x 36
4 / 7	12.5 x 75–85			48	72	
4 / 7	12.5 x 70–100	18	18			
8 / 10	12–13 x 100–120		18	36	54	2 x 72
10	16–17 x 65–100					2 x 48
10	16 x 150	8				
10	20 x 62	12				
13	15.2 x 100			36		48
10 / 15	16.5 x 80–100	12	12	24	48	48
15 / 18	16.5 x 100–125 Falcon	6	6	24	48	48
15	18 x 100			36	48	48
15	18 x 120			27	48	48
16	19.1 x 107			12		
15	19 x 80–125				2 x 24	
18	20 x 70–80			18		
20 / 25	18–19.5 x 110–140					36
20	15.6–16.5 x 104–162					48
30	18 x 180				24	24
30	24–25 x 105–120	8		12	18	36
30	20–21.5 x 150–180				24	24
50	24–24.5 x 120–160					24
50	24–25 x 105–166					24
50	27–29 x 100–120 Falcon					18
50	27 x 140				20	
50	28.5 x 107	6	6			
50	29.5 x 117	6	6	8	18	24
50	34 x 100	6		8	12	12
50 / 80	28–30 x 120–150					24
70	24–25 x 144–203					20
70	44–45 x 120–140					12
100	45 x 100–120			6	8 / 12	12
340	56 x 200 flasks					6
500	105 x 175 flasks					6
MT-plate	86 x 128 x 20			2	4 x 3	4 x 3
DW-plate	86 x 128 x 40			2	4	4

## Chemical Resistant Diaphragm Vacuum Pumps / Hybrid Vacuum Pumps

### Chemical Resistant Diaphragm Vacuum Pumps / Hybrid Vacuum Pumps

Chemical membrane pumps are mechanical, oil free vacuum pumps. Final vacuum values of up to 2 mbar can be achieved depending on the type of pump used. They are particularly useful for solvents with low to medium level boiling points. The parts that come into contact with the substance are made of corrosion resistant materials and are resistant to chemically aggressive vapors and condensation. VARIO chemical pumping units allow for the automatic adjustment of the optimal working pressure for high evaporation rates.

The RC-6 chemical hybrid pump is the corrosion-proof combination of a two-staged rotary pump and a chemical resistant membrane pump. The end vacuum of up to  $2 \times 10^{-3}$  mbar makes this pump suitable for solvents with high boiling points.

### Features

- high chemical resistance (parts in contact with samples made of PTFE compounds), continuous oil cleaning within the chemically resistant hybride pump RC-6
- high suction performance, even at low values
- gas-ballast valve avoids condensing inside the pump
- virtually 100% solvent recovery with emission condenser
- self-finding working pressure in VARIO models, reducing process-time by 30%
- runs quietly, compact form



	MZ 2C NT	MD 4C NT	PC 3001 Vario	RC-6
suction power (m <sup>3</sup> /h)	2.0	3.4	1.7	6
final vacuum (mbar)	7	1.5	2	$2 \times 10^{-3}$
special features	<ul style="list-style-type: none"> <li>· with or without emissions condenser (solvent-recovery vessel)</li> </ul>	<ul style="list-style-type: none"> <li>· with emissions condenser</li> <li>· vacuum control</li> <li>· automatic mode: self-adapting vacuum for shorter process times</li> <li>· low end vacuum level suitable for solvents with high boiling point</li> </ul>	<ul style="list-style-type: none"> <li>· with emissions condenser</li> <li>· vacuum control</li> <li>· automatic mode: self-adapting vacuum for shorter process times</li> <li>· low end vacuum level suitable for solvents with high boiling point</li> </ul>	<ul style="list-style-type: none"> <li>· with or without emissions condenser</li> <li>· low end vacuum level suitable for solvents with high boiling point (DMSO, NMP, DMF)</li> <li>· connection with cooling trap recommended</li> </ul>

## Cooling Traps for Larger Volumes

The rate of evaporation is not only influenced by the energy input, but also by the suction capacity of the diaphragm pump. It is significantly more efficient to use a cooling trap (cryo-pump), instead of bigger vacuum pumps. Processes involving water solutions benefit from cooling traps, organic solutions are less critical due to their higher vapour density. The larger evaporation area surface sample is what causes the "bottle-neck" in the pump, not the volume and number of the vials.

### CT02-50 and CT 04-50

- 2 liters volume (CT02-50), 4 liters (CT04-50)
- condenser temperature  $-50^{\circ}\text{C}$
- easy solvent release drain valve
- LED display shows condenser temperature
- vacuum concentrator connection with chemical-resistant glass cover



### Alpha 1-2 LD, Alpha 2-4 LD and Beta 2-4 LT

- volume 2 liters (Alpha 1-2 LD), 4 liters (Alpha 2-4 LD and Beta 2-4 LT)
- condenser temperature  $-60^{\circ}\text{C}$  (Alpha 1-2 LD),  $-90^{\circ}\text{C}$  (Alpha 2-4 LD),  $-105^{\circ}\text{C}$  (Beta 2-4 LT)
- powerful ice condenser with internal condenser coils
- Lyo-Display (LD) system interface showing ice condenser temperature, vacuum display optional
- vacuum concentrator connection with chemical-resistant glass cover
- optional RS 232 data interface
- expandable into freeze-drying system



### connection to freeze-drying system

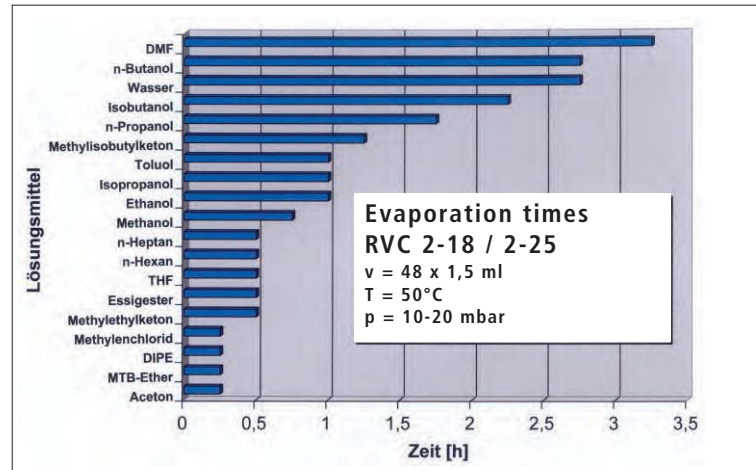
- for example: connection to Alpha systems (with LD or LSC interface) please see separate product information
- directly connected to the drying chamber of the freeze dryer with a rubber valve



## Examples for Evaporation Times

Evaporation time is dependent on the type of solvent used. As a rule, solvents with a low boiling point (i.e. DCM methylenchloride, chloroform, methanol, hexane) evaporate more easily and quickly than solvents with high boiling points (i.e. water, DMF, DMSO, NMP). Examples are shown in the table below.

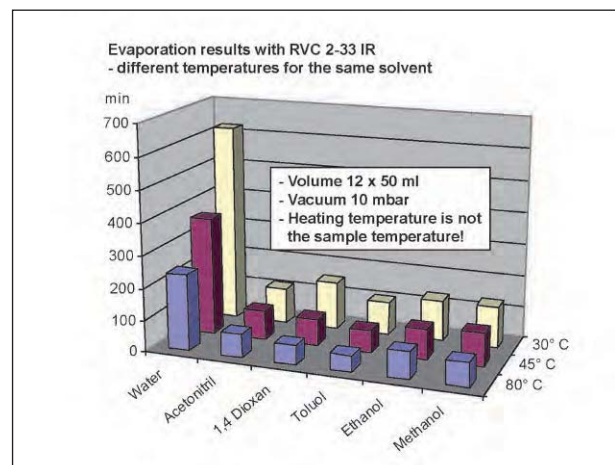
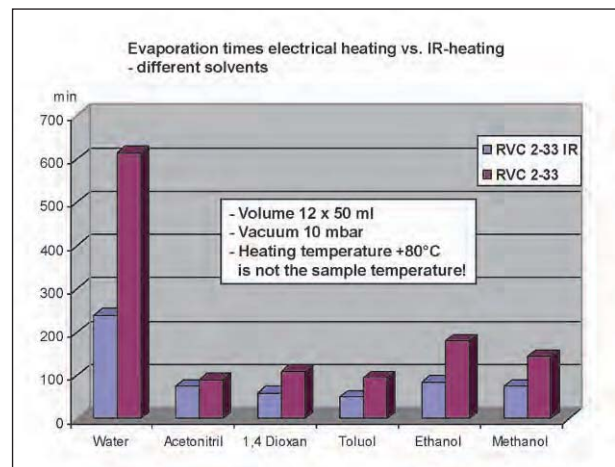
The energy input into the product through the heating of the rotor chamber also influences evaporation. Evaporation time is reduced through this source, particularly in solvents with high boiling points (also water-based substances). The remaining product stays cool as the solvent's temperature remains low through evaporation.



## Influence of energy input on evaporation times

The energy input to the sample is essential for the duration of the evaporation process. With standard vacuum-concentrators electrical heating of the rotor chamber is used while with the special High-Throughput-System SpeedDry 2-33IR IR-lamps provide a direct energy input to the samples. Results are reduced evaporation times – depending on used solvent up to factor 2-4 faster. The following figures show examples for different solvents.

System configuration: SpeedDry RVCV 2-33 Standard (with electrical heating of the rotor chamber) and RVC 2-33IR (with improved IR-heating), sample volumes 12 x 50 ml, p=10 mbar, with cold trap -50°C.



### Common Solvents for RVC – Application Data

Substance name	Ch. formula	Boiling point at 1013 mbar (hPa), in °C	Vapour pressure in mbar (hPa)						Freezing/Solid Point
			5°C	20°C	30°C	40°C	45°C	50°C	
Acetic acid	CH <sub>3</sub> COOH	118		16	26,5			77	+17
Aceton	CH <sub>3</sub> COCH <sub>3</sub>	56		246	360	560		814	-95,4
Acetonitrile	C <sub>2</sub> H <sub>3</sub> N	80,1		97	153			360	-45,7
Benzene	C <sub>6</sub> H <sub>6</sub>	80		100	155			365	+5,5
n-Butyl alcohol (1-Butanol)	C <sub>4</sub> H <sub>10</sub> O	117		6,7	13,3			50	-89,5
Trichloro-methane (Chloroform)	CHCl <sub>3</sub>	61		213	320			695	-63
1,2-Dichloro-ethane (Ethylenechloride)	C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub>	84		87	135	210	270	337	-35,5
Dichloro-methane (Methylenechloride)	CH <sub>2</sub> Cl <sub>2</sub>	40		470	689,5			1500	-95
Dimethyl-Acetamide (DMA)	C <sub>4</sub> H <sub>9</sub> NO	165,5		3,3	7,4			44	-20
Dimethyl- Formamide (DMF)	C <sub>3</sub> H <sub>7</sub> NO	153		3,77	6,5	13,4		23	-61
Dimethyl-Sulfoxid (DMSO)	C <sub>2</sub> H <sub>6</sub> OS	189		2,5	3,5			7,5	+18,5
Dioxan	C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>	101		38	68			159	+12
Ethylacetate	C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>	77		98	148			379	-83
Ethanol	C <sub>2</sub> H <sub>5</sub> OH	78		58	100			293	-114
n-Hexan	C <sub>6</sub> H <sub>14</sub>	69		162	248			540	-95

### Common Solvents for RVC – Application Data

Substance name	Ch. formula	Boiling point at 1013 mbar (hPa), in °C	Vapour pressure in mbar (hPa)						Freezing/Solid Point
			5°C	20°C	30°C	40°C	45°C	50°C	
Isopropanol (2-Propanol)	C <sub>3</sub> H <sub>7</sub> OH	82		43	76			229	-88
n-Propanol , propyl alcohol (1-Propanol)	C <sub>3</sub> H <sub>7</sub> OH	97		20	36			121	-126
Methanol (Methyl alcohol)	CH <sub>3</sub> OH	65		129	200	352		552	-98
N-Methyl-2- Pyrrolidone (NMP)	C <sub>5</sub> H <sub>9</sub> NO	203		0,32	0,67	1,33		2,5	-24
Tetrahydrofuran (THF)	C <sub>4</sub> H <sub>8</sub> O	64		173	280			586	-108
Toluene	C <sub>7</sub> H <sub>8</sub>	111		29	51			123	-95°C
Trichloro-acetic acid (TCA)	CCl <sub>3</sub> COOH	196		0,1	0,5			1,2	+59
Trichloro-ethylene	C <sub>2</sub> HCl <sub>3</sub>	87		78	124			284	-86
Trifluoro-acetic acid (TFA)	C <sub>2</sub> HF <sub>3</sub> O <sub>2</sub>	72		110	180				-15
water	H <sub>2</sub> O	100		23,37	42,41	74		123	0

Used for following solvents:

solvents low to middle  
boiling points

- acetonitril (ACN)
- acetone
- chloroform
- dioxin
- methylenchloride (DCM)
- ethanol (EtOH)
- hexane (Hex)
- methanol (MeOH)
- TFA
- water

solvents high boiling  
points (in conjunction with  
vacuum pumps and cooling traps)

- dimethylsulfoxide  
(DMSO)
- NMP
- dioxane
- t-butanol

special RVC 2-18 system

- hydrochloric acid (HCl)

## Technical Data

	RVC 2-18 CD	RVC 2-25 CDplus	RVC 2-33 CDplus	RVC 2-33 IR CDplus
Rotor speed (min <sup>-1</sup> ) (adjustable with controller CDplus)	1500	1550	1550	1750
Relative centrifugal force (rcf)	210	235	500	530
max. allowed imbalance (g)	20	30	50	50
Temperatur range (°C)	+ 30 bis + 60	+ 30 bis + 80	+ 30 bis + 80	+ 30 bis + 80
Process vacuum depending on pump system, max. (mbar)	< 0,1	< 0,1	< 0,1	< 0,1
Dimensions (mm, w x h x d)	240 x 240 x 325	315 x 255 x 460	390 x 315 x 406	390 x 315 x 406
Weight (kg)	14	24	44	48.5
Electrical connection (V/Hz) (other voltages available)	230/50–60	230/50–60	230/50–60	230/50-60
Max. power consumption (kVA)	0.5	0.9	1.4	1.4
Max. current (A)	2	3.5	5.8	5.8
Max. ambient temperature, climate category SN (°C) (higher temperatures upon request)	+ 10 bis + 25	+ 10 bis + 25	+ 10 bis + 25	+ 10 bis + 25
Sound emission acc. to DIN 45635 (dB/A)	40	44	49	49
Vacuum connection, small flange	DN 16 KF	DN 16 KF	DN 25 KF	DN 25 KF
Suggested vacuum pumps (other combinations possible)	MZ 2C MD 4C PC 3001 Vario	MZ 2C MD 4C PC 3001 Vario RC-6	MZ 2C MD 4C PC 3001 Vario RC-6	MZ 2C MD 4C PC 3001 Vario RC-6
suggested cooling traps (other combinations possible)	CT 02-50 directly to freeze dryer	CT 02/04-50 ALPHA 1-2 / 2-4 Beta 2-4 LT directly to freeze dryer	CT 04-50 ALPHA 2-4 Beta 2-4 LT	CT 04-50 ALPHA 2-4 Beta 2-4 LT
please note: cooling traps are not absolutely necessary when using chemical resistant diaphragm pumps, but are recommended with samples > 100 ml in order to decrease evaporation time				

We reserve the right to make technical changes without prior notice

## Product Spectrum

Our comprehensive product range of freeze dryers and vacuum concentrators for every application. Do not hesitate to contact us for an individual configuration of your system.

Freeze dryers for industrial production

Pilot systems for process development and optimization

Freeze dryers for research and development

Rotational vacuum concentrators, available in different sizes, covering the gamut from solving routine laboratory problems to the evaporation in high-end pharmaceutical research

Freeze dryers for routine laboratory use



**CHRIST** 



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