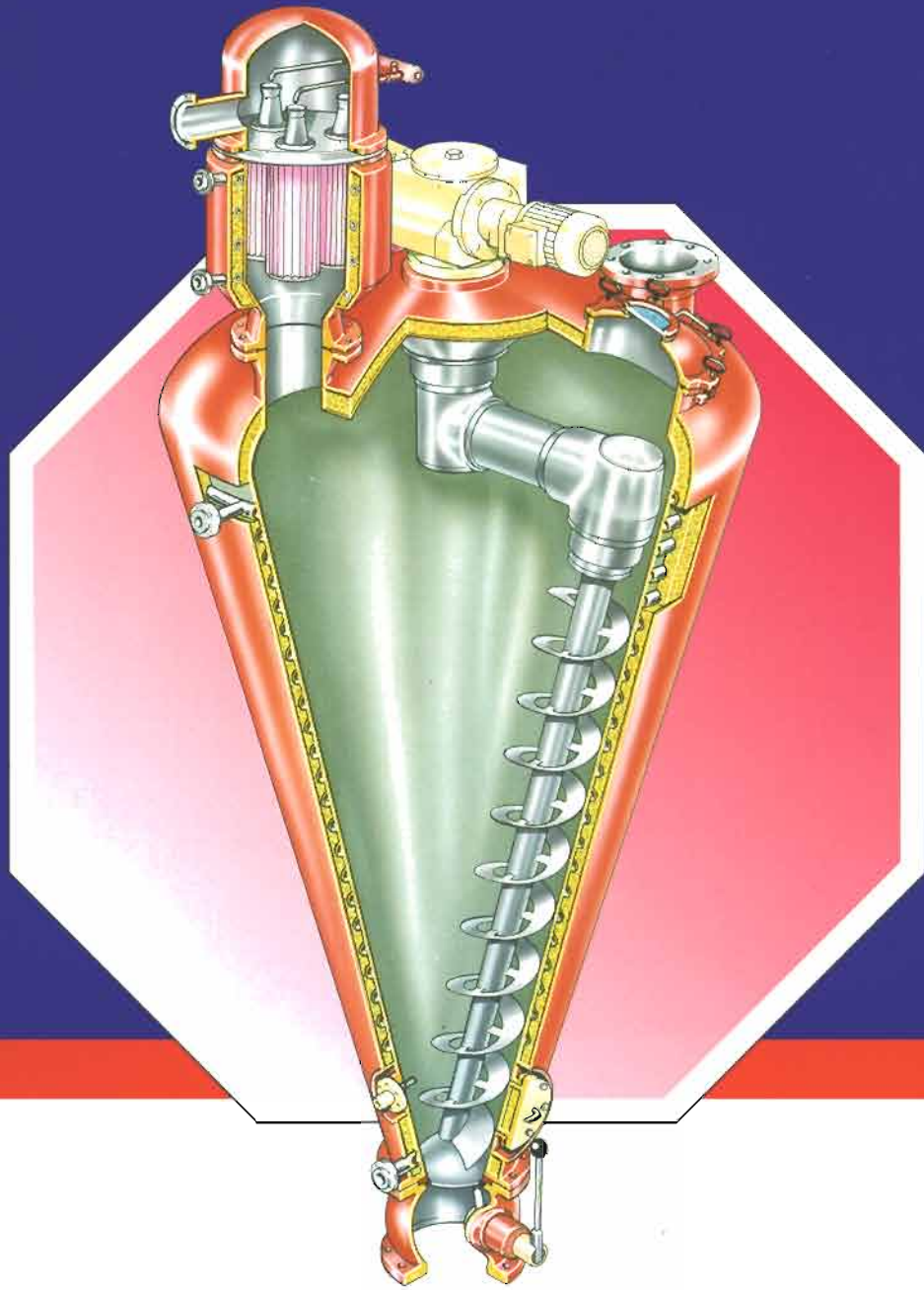


VRIECO-NAUTA® VACUUM DRYING TECHNOLOGY



HOSOKAWA MICRON B.V.

Leaders in powder processing technology

BEPEX • MICRON • STOTT • VRIECO-NAUTA®

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Principle of operation

The Vrieco-Nauta® conical mixer can be operated easily as a contact dryer making this advanced machine very suitable for drying and allied processes.

Heat energy is basically transferred into the product through a jacketed vessel wall causing solvents or moisture residues to evaporate. A rotating screw orbits along the vessel wall and helps the vapors to escape to the surface providing at the same time a frequent exchange of particles in contact with the heated surface.

A vacuum system keeps the vessel under constant vacuum and removes the vapors from the vessel, having separated dust particles from the vapors first in a dustfilter on top of the vessel.

The vacuum conditions within the vessel also reduce the saturated vapor pressure of the solvent and this makes drying at much lower temperatures possible.

For recovery of solvents a condenser can be installed together with a collection vessel.

Drying time and progress of the drying process are dependant on heat conduction of solid particles and solvents, pressure and temperature conditions as well as speeds of screw and arm.

Features

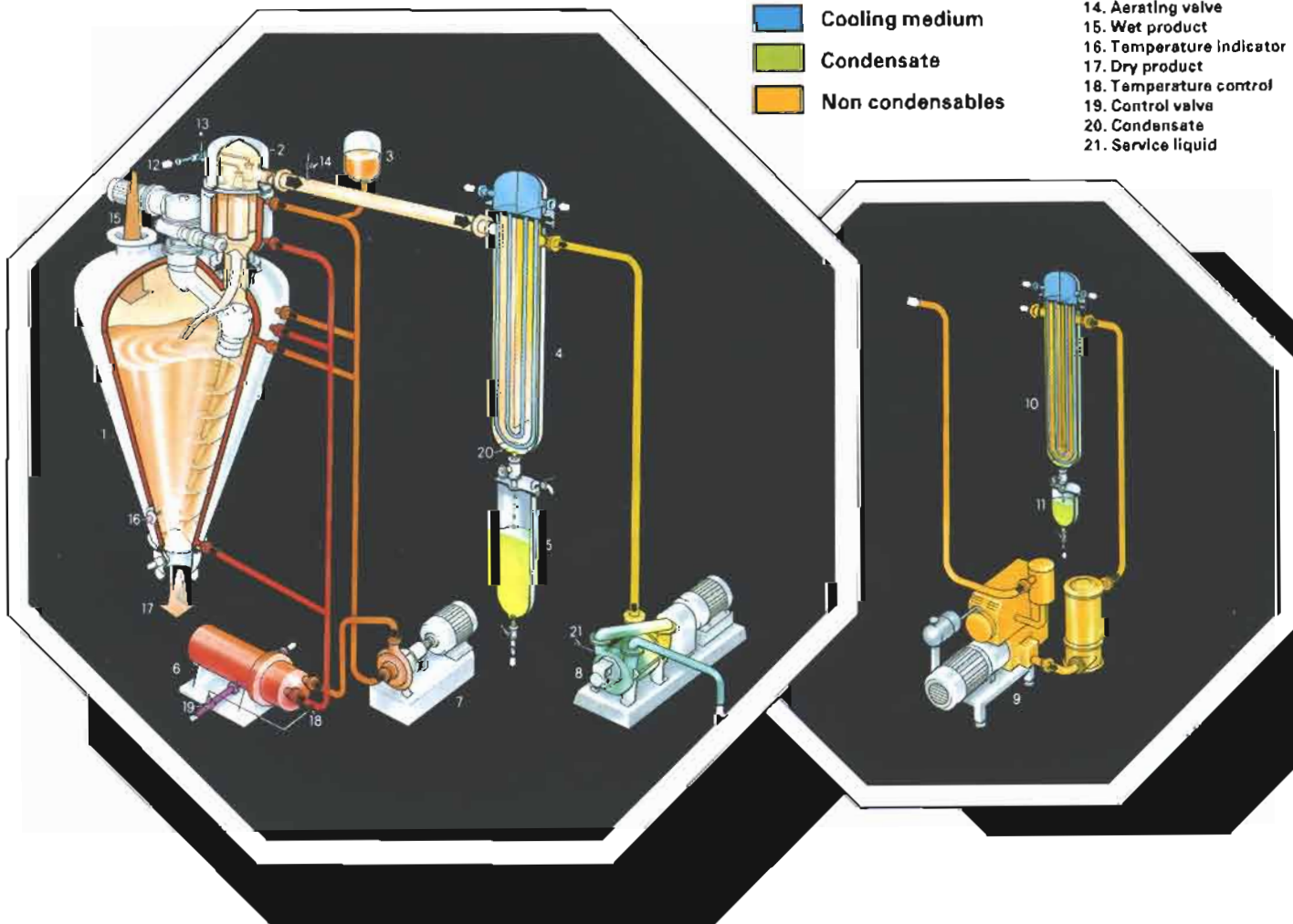
Vrieco-Nauta® dryers are built as totally enclosed systems and when operated under full vacuum they offer the following advantages:

- Fast drying times.
 - The mixing screw circulates the product continuously from bottom to top of vessel improving heat transfer conditions considerably.
- Final moisture after drying, is possible down to 0 %
- Low energy consumption.
- Gentle to product.
- Low temperature drying as vacuum conditions reduce the saturated vapor pressure of solvents.
- Temperature of the product is set by conditions of vacuum due to physical equilibrium of pressure and temperature.
- Quick and efficient removal of vapors.
- Recovery of pure solvents is possible.
- Dried solids suitable for direct use.

The design of the Vrieco-Nauta® vacuum dryers is such that static pockets are not present within the product area and therefore they are easy to clean.

Processing systems

Micron Powder Systems has available a wide range of powder processing equipment and offers complete services for design, engineering, manufacture and supply of systems in the field of mixing, grinding, pulverizing, classifying, conveying, metering, dust control and fluid bed technologies.



- Product
- Vapor
- Heating medium
- Cooling medium
- Condensate
- Non condensables

- Legend
1. Vacuum dryer
 2. Vacuum filter
 3. Expansion tank
 4. Condenser
 5. Receptacle
 6. Heat exchanger
 7. Circulation pump
 8. Watering pump
 9. Rotating vacuum pump
 10. Final condenser
 11. Receptacle
 12. Filter cleaning
 13. Timer controlled valve
 14. Aerating valve
 15. Wet product
 16. Temperature indicator
 17. Dry product
 18. Temperature control
 19. Control valve
 20. Condensate
 21. Service liquid

Applications

Vrieco-Nauta[®] vacuum dryers are very suitable for final drying of products such as powders, granules, pastes and slurries especially when they are brittle and temperature sensitive.

Such conditions are often present when producing semi- or endproducts in the Pharmaceutical, Cosmetic, Chemical and Food industries.

The design of the Vrieco-Nauta[®] drying system is based on experience, over a period of 30 years. Complete systems have been supplied worldwide for the following processes:

- Drying
- Extraction
- Alkalinization
- Crystallization
- Reaction
- Granulation
- Agglomeration
- Dispersion
- Homogenizing
- Emulsifying

It is also possible to combine several processes in the one vessel offering tremendous savings in terms of investment, labor and space.

Conditions for these processes are usually dependant on the physical specification of initial and final product desired and can be determined in our test laboratory by experiment.

Construction

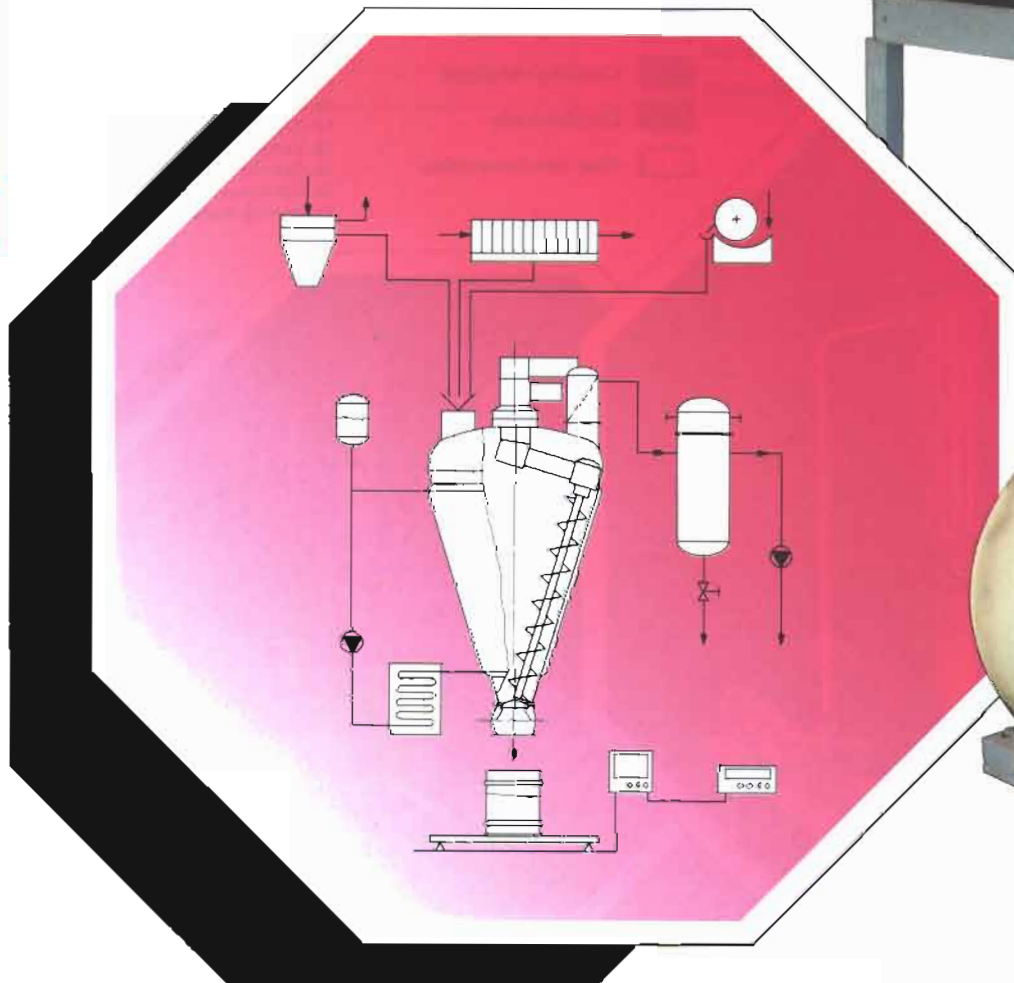
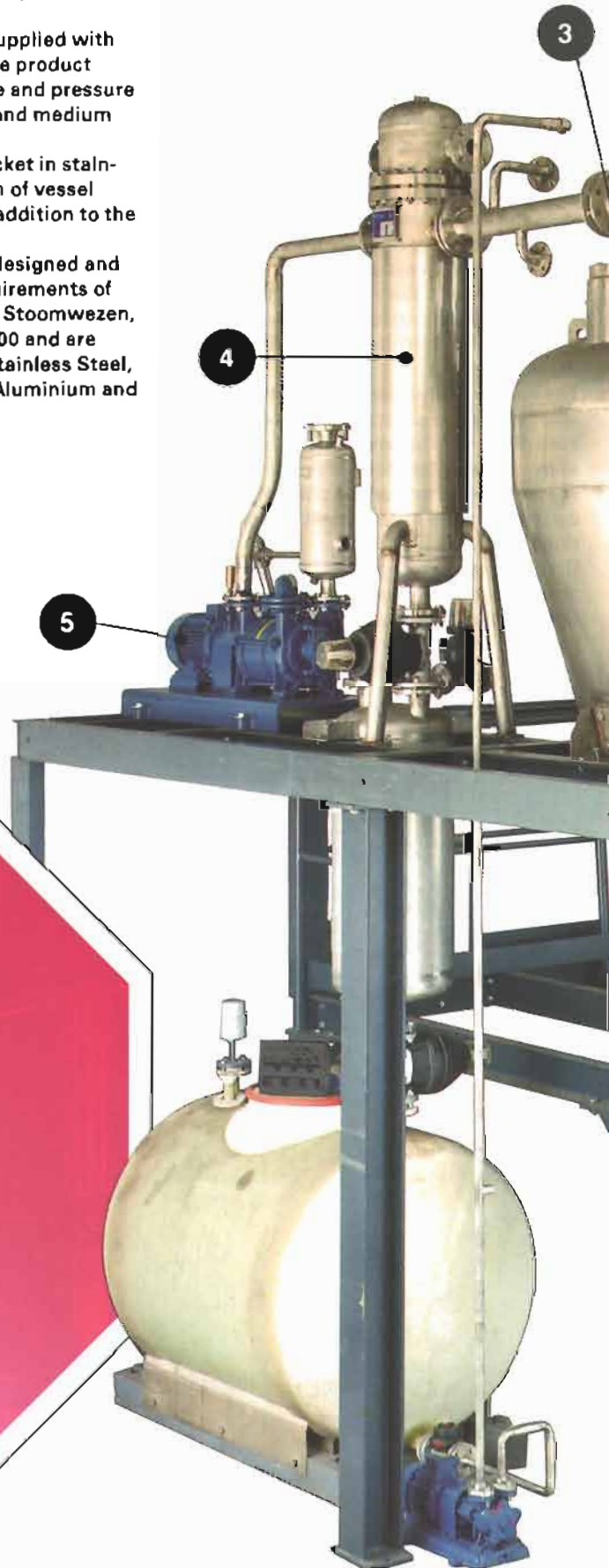
For process conditions of vacuum or pressure a domed cover is welded on top of the vessel.

Vessel and cover can be designed to withstand bursting pressures of up to 150 psi often required when processing hazardous products.

The vessel is jacketed or supplied with halfpipe coil for heating the product dependant on temperature and pressure conditions of the heating and medium used.

An all welded insulated jacket in stainless steel for full insulation of vessel and cover can be fitted in addition to the heating jacket.

Vrieco-Nauta[®] dryers are designed and built according to the requirements of various coding authorities Stoomwezen, TÜV, Lloyds, ASME, BS 5500 and are available in all grades of Stainless Steel, Monel, Nickel, Hastelloy, Aluminium and Carbon Steels.



Vrieco-Nauta[®] vacuum drying systems are designed to measure-based on quality and experience.



- 1** **Dryer**
Process vessel with orbiting screw handles products gently and efficient.
- 2** **Drive unit**
Available in various designs with or without variable speed control for optimum results.
- 3** **Vacuumfilter**
Prevents pollution of solvents and clogging of system.
- 4** **Condenser**
Condenses evacuated vapours and recovers condensate in collection vessel.
- 5** **Vacuum pump**
Creates the required vacuum conditions for fast evaporation of solvents.
- 6** **Heater**
Electric or steam powered heat generators provide heated water or thermal oil in the jackets. Direct heating of vessel with saturated steam is also possible.
- 7** **Moistening**
Liquids can be added to the product through the hollow drive shaft for production of granules and pastes etc.

Vrieco-Nauta[®] vacuumdryers with cantilevered mixing screw

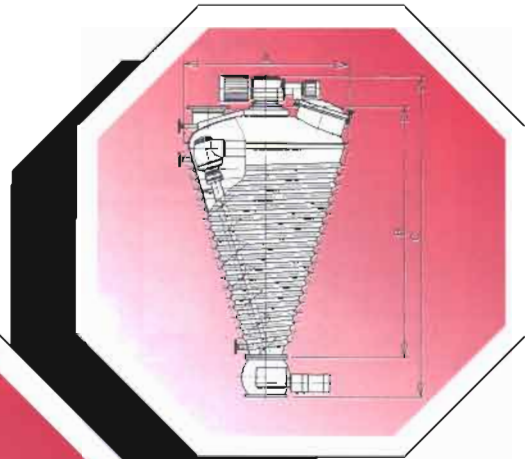
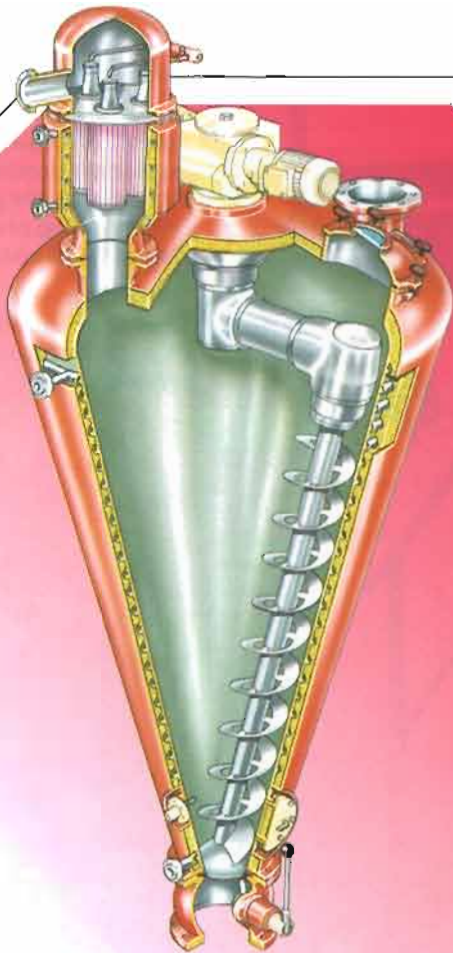
The heavy duty drive units for this range of dryers are designed to take full radial and axial loads from the mixing screw eliminating additional support methods for the screw in the bottom of the vessel. Advantages of this design are:

- No bearing or seals are in direct contact with product.
- No degradation.
- No segregation.
- No generation of heat.
- Bottom of vessel suitable for installation of inspection door or outlet valve for total emptying.

When pharmaceutical or other high value products have to be processed in these vessels special drive units are

available to meet the standards usually required in these industries. Special constructions of seals and other design precautions practically eliminate the risk of product contamination from lubricants. Vessel finishes and construction of drive units fully comply with F.D.A. standards applicable in this area. Process vessels which have to meet special process conditions are also available on request.

TYPE	Volumes in litres		A MM	B MM	C MM
	HOR.	EFF.			
0.4-VDC-41	40	34	740	1045	1580
0.8-VDC-41	80	68	850	1265	1800
1.2-VDC-41	120	100	940	1415	1950
2-VDC-22	200	160	1025	1615	2310
3-VDC-22	300	240	1130	1795	2490
5-VDC-43	500	430	1466	2135	2848
8-VDC-43	800	680	1620	2414	3127
10-VDC-43	1000	840	1716	2564	3277
12-VDC-43	1200	1000	1786	2698	3411
15-VDC-43	1500	1270	1890	2891	3604
20-VDC-43	2000	1700	2066	3214	3927
10-VDC-44	1000	840	1778	2697	3511
12-VDC-44	1200	1000	1890	2836	3650
15-VDC-44	1500	1270	1970	3012	3826
20-VDC-44	2000	1700	2090	3251	4065
25-VDC-44	2500	2150	2230	3500	4314
30-VDC-44	3000	2625	2344	3712	4526
35-VDC-44	3500	3125	2484	3965	4779
40-VDC-44	4000	3600	2574	4136	4950
30-VDC-45	3000	2625	2380	3777	4787
35-VDC-45	3500	3125	2480	3962	4972
40-VDC-45	4000	3600	2570	4130	5140
50-VDC-45	5000	4500	2710	4387	5397
60-VDC-45	6000	5400	2860	4657	5667



Vrieco-Nauta[®] vacuumdryers with supported mixing screw in vessel bottom

Radial bottom locator ①

Especially designed for dryers of larger volumes and for the processing of products which require a high input of energy.

The orbital arm and drive unit of this range of dryers are designed to take full axial load from the screw and the remaining radial load is taken by a special pin and ring locator fitted in the bottom of the vessel.

The minimum load resulting and the application of special materials for pin and ring reduce wear and generation of heat.

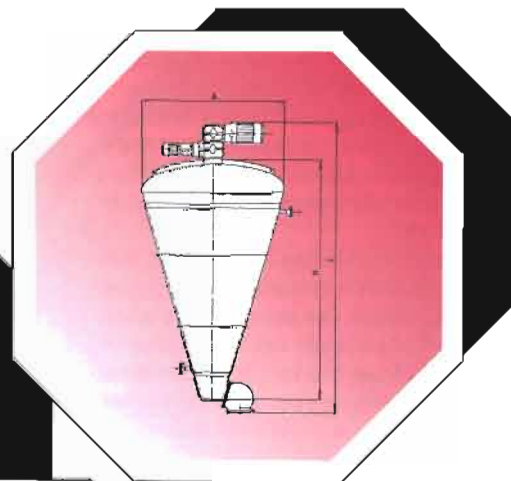
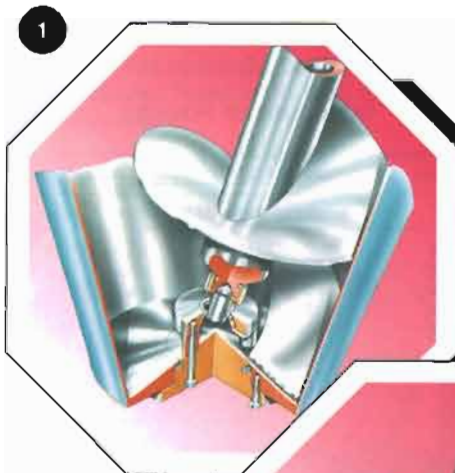
This unique design also eliminates degradation and segregation of the product in the vessel bottom.

Pintle bearing ②

A cup located at the bottom of the screw running on a pintle fitted in the bottom of the vessel actively supports the screw in both axial and radial directions.

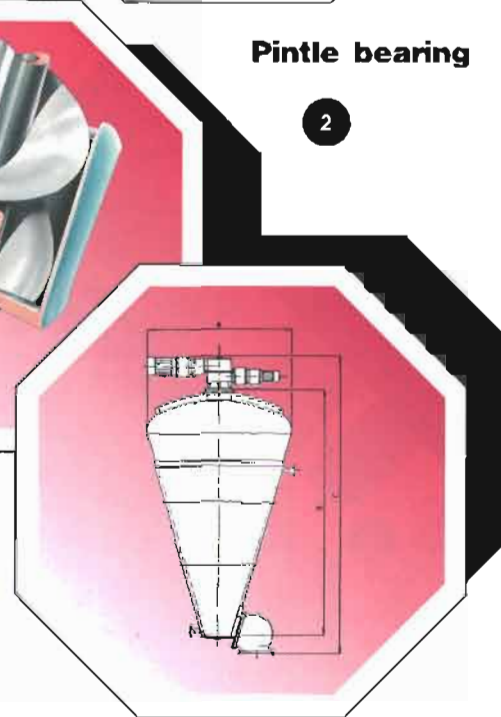
The pintle bearing is specially designed for this application and largely relieves the drive unit from mixing screw loads. Therefore this design generally offers cost savings as drive units of lighter design can be used.

Several designs of pintle bearing are available to suit different applications of dryers.



Pintle bearing

2



Radial bottom locator

TYPE	Volumes In litres		A MM	B MM	C MM
	HOR.	EFF.			
15-VDR-43	1500	1270	1890	2871	3584
20-VDR-43	2000	1700	2066	3194	3907
25-VDR-44	2500	2150	2230	3480	4294
30-VDR-44	3000	2625	2344	3692	4506
35-VDR-44	3500	3125	2484	3945	4759
40-VDR-44	4000	3600	2574	4116	4930

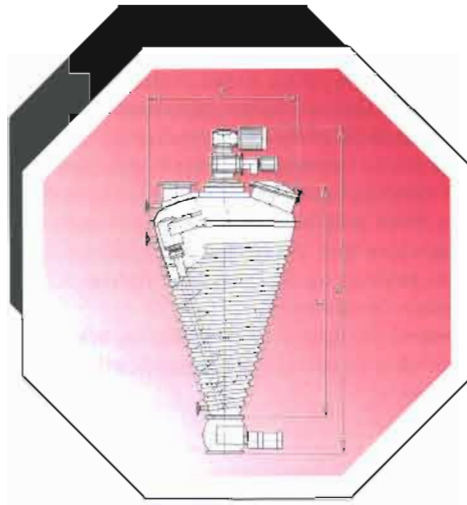
TYPE	Volumes in litres		A MM	B MM	C MM
	HOR.	EFF.			
15-VDP-43	1500	1270	1890	2871	3584
20-VDP-43	2000	1700	2066	3194	3907
25-VDP-44	2500	2150	2230	3480	4294
30-VDP-44	3000	2625	2344	3692	4506
35-VDP-44	3500	3125	2484	3945	4759
40-VDP-44	4000	3600	2574	4116	4930

Vrieco-Nauta[®] pharmavacuum dryers with cantilevered screw and non lubricated orbital arm

A totally new concept of drive unit has been introduced for use in conjunction with Vrieco-Nauta[®] vacuum dryers. The bevel gears inside the orbital arm for the drive power transmission of the mixing screw have been replaced by a set of non lubricated pulleys and a timing belt.

The great advantage achieved by this design is that lubricants are no longer present within the processing vessel. The risk of possible contamination of products from lubricants is fully eliminated making this range of dryers very suitable when sanitary conditions are applicable.

Drive units with timing belt transmission do not require frequent maintenance, and cleaning or inspection of seals is easy and simple to achieve. Vessel finish and construction of drive unit fully comply with F.D.A. standards.



SCHEDULE OF POWERS

Nett Volume in litres	* Nominal drive power in kW		Heated sur- face in m ²	
	Screw	Arm	Vessel	Screw
840	3/15	0.25/1.5	6.7	0.7
1700	3/15	0.25/1.5	10.3	0.9
2625	3/22	0.25/2.2	13.1	1.3
3600	7.5/22	0.75/2.2	15.4	1.5
4500	7.5/22	0.75/2.2	17.8	1.6

* Drive power required is dependent on product.

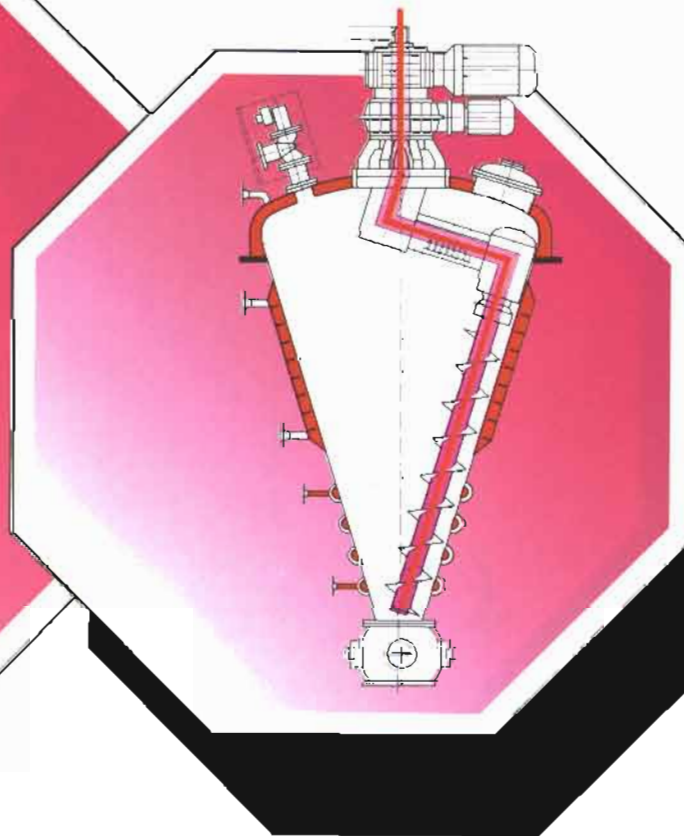
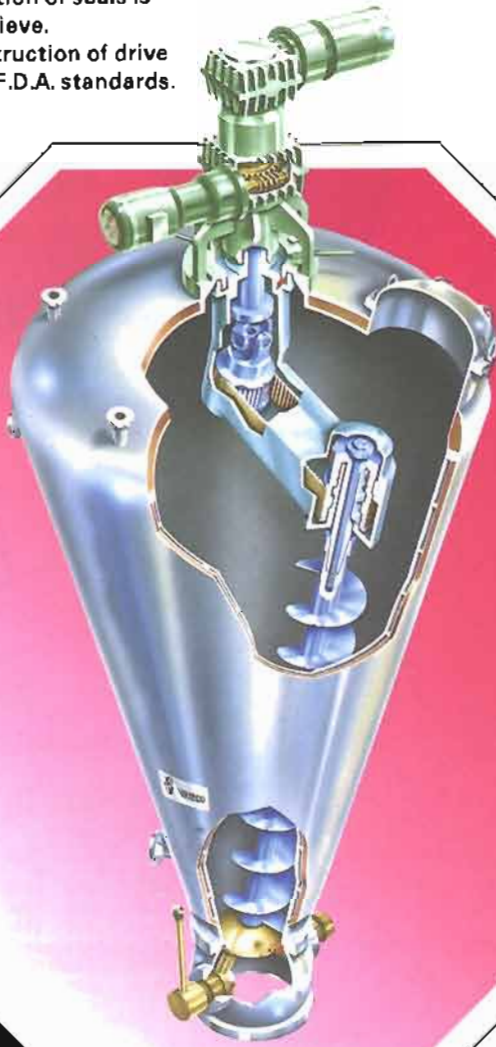
TYPE	Volumes in litres		A	B	C
	HOR.	EFF.	MM	MM	MM
5-VDC-53	500	430	1486	3191	2123
8-VDC-53	800	680	1626	3478	2410
10-VDC-53	1000	840	1740	3670	2602
15-VDC-53	1500	1270	1940	4029	2961
10-VDC-54	1000	840	1778	3864	2680
15-VDC-54	1500	1270	1980	4224	3039
20-VDC-54	2000	1700	2114	4483	3278
25-VDC-54	2500	2150	2240	4700	3515
30-VDC-54	3000	2625	2354	4914	3716
35-VDC-54	3500	3125	2444	5062	3877
25-VDC-55	2500	2150	2230	4765	3474
30-VDC-55	3000	2625	2438	5145	3854
35-VDC-55	3500	3125	2484	5255	3956
40-VDC-55	4000	3600	2603	5483	4184
50-VDC-55	5000	4500	2774	5763	4472

Heated mixing screw

The Vrieco-Nauta[®] vacuum dryer with timing belt transmission can easily be fitted with a heating system for the screw.

The heating medium of this system is fed and returned to the screw through the hollow drive shaft of the gearboxes outside the vessel and a rotary joint on the drive shaft of the screw, all fully integrated into the orbital arm.

The design of this rotary joint is such that possible leakage of medium will be removed with the returned medium. Elimination of lubricants inside the orbital arm is of great importance when a heating system for the screw is required.



Accessories

1 Vacuum filters

A range of vacuum filters is available which are specially designed to operate in conjunction with Vrieco-Nauta® vacuum dryers.

Size and specification are dependant on product, solvent and volume of vapors to be handled.

Automatic reverse jet cleaning systems are standard and filterbody and cover are jacketed to avoid condensation of the vapors passing through the filter.

2 Outlets

A ball segment valve of special design is fitted to the bottom or in the wall of the vessel.

Special features are:

- Closure against flow of product is possible.
- Sanitary design with inner surfaces polished if required.
- Suitable to operate under full vacuum and pressure conditions up to 6 bar.
- Easy to clean.
- Minimum product retention.

3 Sampling device

For installation into the vessel wall enabling product samples to be taken when the vessel is under full operating conditions.

4 Lumpbreaker

For the elimination of agglomerates and lumps which can occur in certain phases of a process, a lumpbreaker can be installed in the wall of the vessel.

5 Liquid addition

For addition of liquids to powders or moistening of dry solids, spray nozzles can be installed inside the vessel.

The liquid is fed to the nozzle through the hollow shaft of the drive assembly for direct spraying on to the surface of the product.

The rotary joint is outside the product area to prevent any harm to the drive assembly or product in case of a seal failure.

6 Cleaning

A bacteriologically clean vessel can be obtained when C.I.P. cleaning systems are used for the internal cleaning of the vessel.

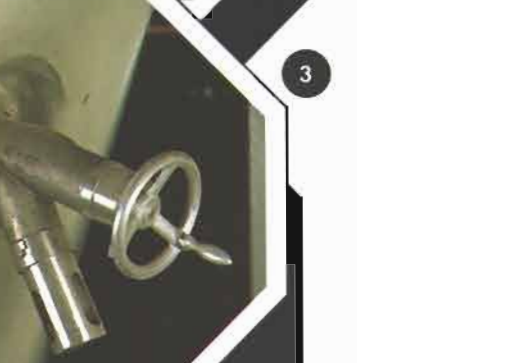
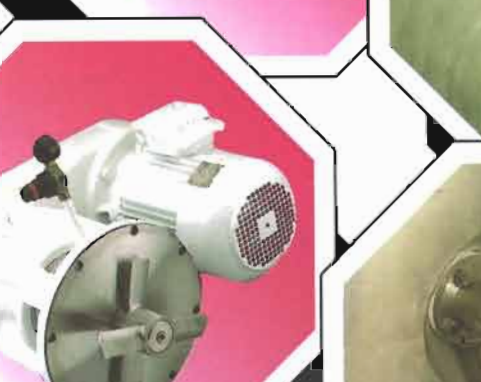
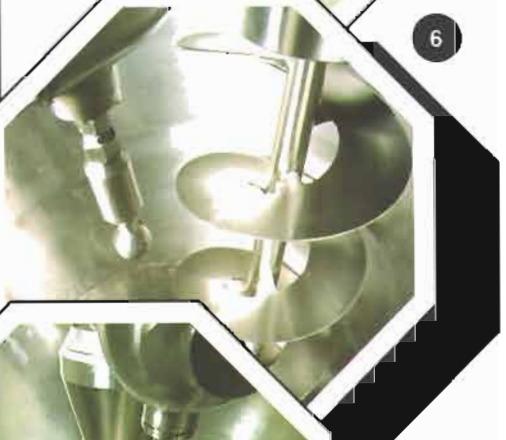
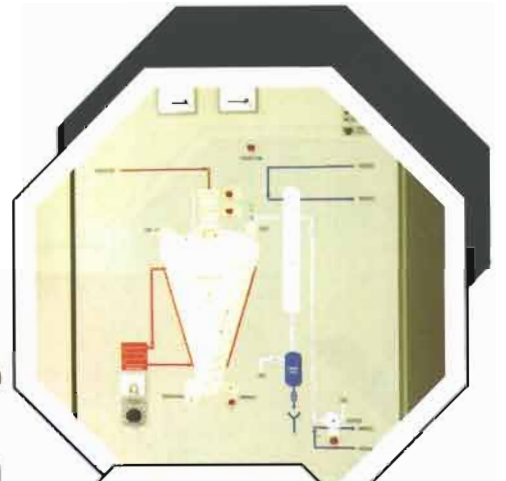
Available are troll balls, lances and/or spray nozzles fitted in the wall or cover of the vessel.

7 Process control

The electrical panel controls all process functions.

Available are semi-automatic panels, pushbutton controlled, or when required automatic PLC controlled systems with recorders.

For accurate measurement and control of product temperature and process conditions, pressureswitches and temperature probes are included as part of the drying system.



Drying process

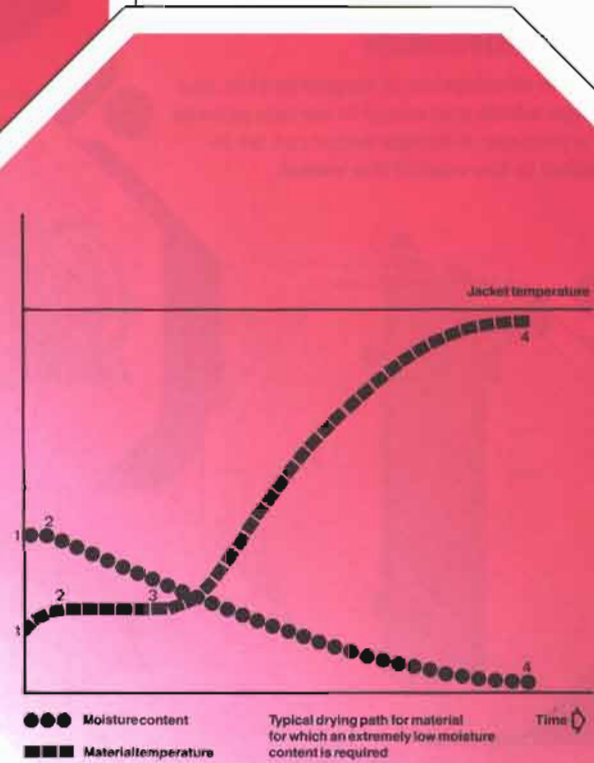
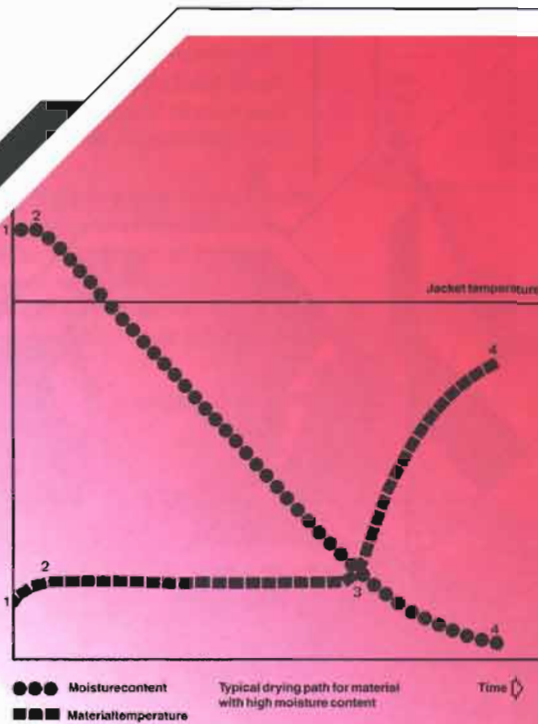
The drying process can be explained with a graph showing the path of the product temperature as a function of time. From this we can extrapolate three distinct periods:

From 1 to 2: The pre-heating stage.
During this period, the temperature of the wet material is raised to the evaporation temperature of the solvent.

From 2 to 3: Constant rate period.
During this stage, all the heat applied is utilized in evaporating the moisture. The material temperature is equal to, or slightly higher than, the boiling point of the solvent at the vessel pressure.

From 3 to 4: Falling rate period.
Now, the remaining moisture is within the particles, as all surface moisture has been removed. The drying rate slows and the material temperature increases, until the required final moisture content is reached.

The graph also shows the reduction in moisture content.



Research and Development

Hosokawa Micron offers an extensive test and development center where customers' products can be accurately tested prior to final design for determination of the most efficient process, system or plant.

Data collected over many years of testing various materials, provides the firm basis of our technological know how.

By utilizing the latest processing technologies a continuous update of knowledge is ensured.

Whether you require a single machine or a complete powder processing system, the same skilled and experienced staff are at your service to ensure that your requirements are met and the most suitable equipment will be offered.

Our research and development centers are backed up by the Hosokawa Micron Corporation. The Hosokawa Micromeritics Laboratory in Hirakata/Japan is sourcing technical developments in Europe, America, Australia and Asia. When you have problems in the field of powder processing we could be of help in solving them.

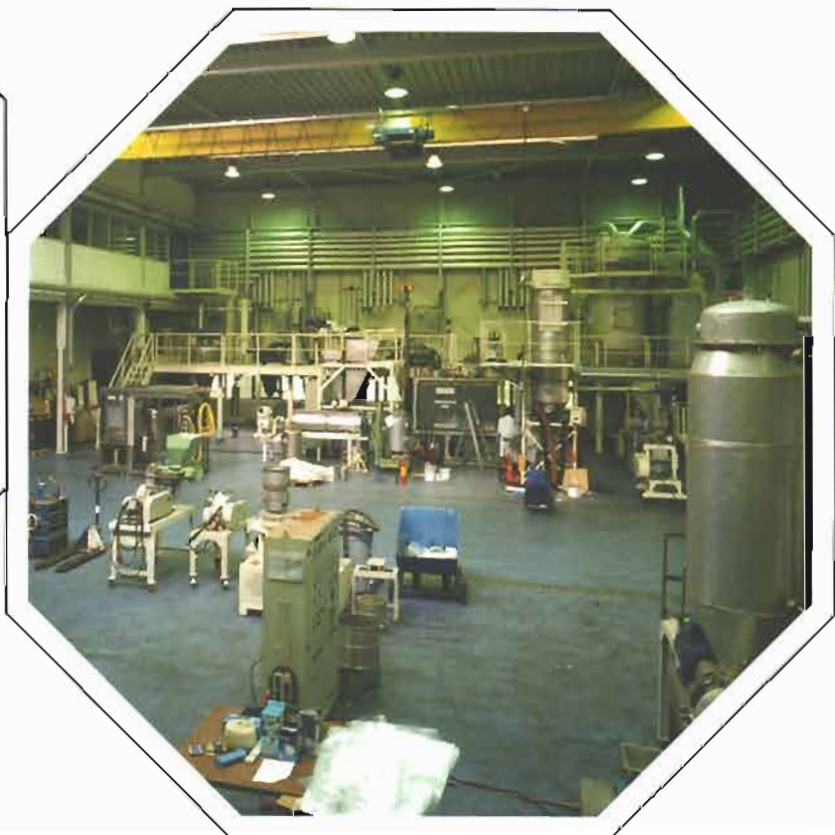
Hosokawa Micron test and development centers look forward to assisting you in finding solutions to solve your problems.

Service

Behind each Hosokawa Micron installation there is an effective and well trained service organization, carrying essential parts in stock. In the event of a breakdown, our customers can be back into production with minimum time loss and inconvenience.

Service engineers and parts can be on site at very short notice.

When purchasing Hosokawa Micron equipment you may rely on this fast and effective service. An additional service that we offer is that of periodical maintenance contracts to ensure that your installations operate efficiently.



Process engineers for: mixing-drying-grinding-separating-metering-weighing



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