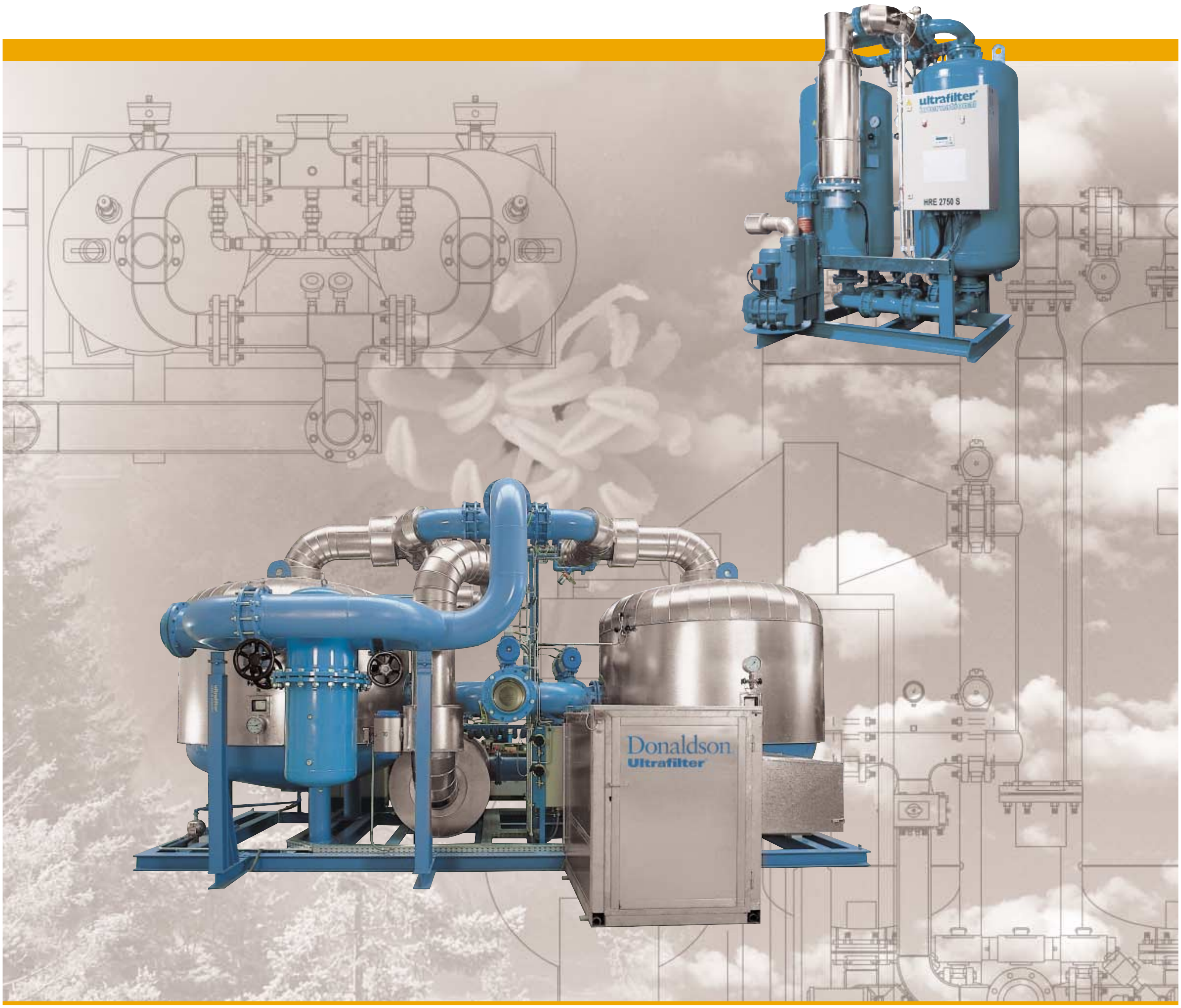
Donaldson.
Ultrafilter®

HRE/HRS-L

Heated Blower Purge Desiccant Compressed Air Dryers



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History

Ultrafilter International AG, whose world headquarters is in Haan, Germany, was established in 1972 as a trading company to buy and sell, into the German market, compressed air and gas purification equipment. In the 1980's, Ultrafilter established itself as a prime manufacturer of compressed air and gas dryers and filters, backed by numerous innovative patents, and has since grown to be among the largest such manufacturers in the world. Our product lines include, but are not limited to: air, gas and liquid filters for both process and industrial applications; refrigerated, membrane and regenerative desiccant compressed air and gas dryers; breathing air systems; condensate management systems; and process water chillers.

In 2002, Ultrafilter was acquired by Donaldson Company, Inc., headquartered in Minneapolis, Minnesota. Donaldson is a leading worldwide provider of filtration systems and replacement parts. Since 1915, Donaldson has perfected and leveraged its core strengths—innovative technology, strong customer relationships and broad geographic presence—to meet the diverse and changing needs of its customers.

The Need for Clean Dry Air

The Problem

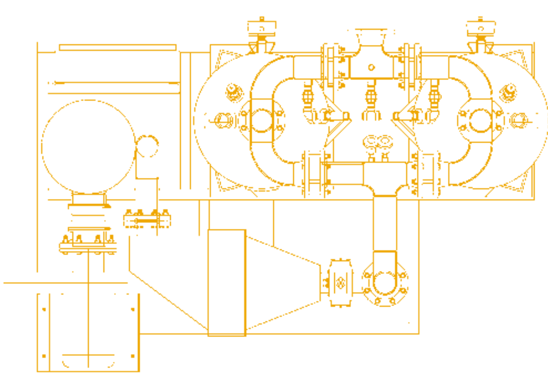
Corrosion, erosion, product defects, line freeze-ups

The Cause

Solids, liquids, vapors, gases

The Solution

High quality and energy efficient air and gas purification systems



The Result

Energy savings, increased productivity, longer lasting tools, and reduced system maintenance.

Any contaminants present in the atmosphere surrounding an air compressor will be entrained and concentrated in the process air as it enters the compressor. These contaminants can be in the form of liquids (e.g. water and oil), vapors (e.g. hydrocarbons), gases (e.g. carbon dioxide, hydrogen chloride and sulfur dioxide) and solids (e.g. sand, dust and soot). If not removed, such contaminants can lead to serious damage of process equipment and/or degradation of the final product itself through corrosion, erosion, freeze-ups, biological growth and product spoilage from contact with contaminated air. Donaldson Ultrafilter products are designed to address these problems efficiently and economically.

Air Quality Classifications

The quality of compressed air you need depends a great deal on the application. The quality of compressed air you can achieve depends a great deal on the purification equipment selected. Refrigerated air dryers, for example, will provide air at a pressure dew point (pdp) of 38º F (ISO Class 5), while regenerative desiccant air dryers are required for ISO Class 2 (-40º F) or ISO Class 1 (-94º F pdp). A number of organizations have developed standards and classifications of compressed air specific to given applications. Examples include:

Quality Standard for Instrument Air—American National Standards Institute/International Standards Association (ANSI/ISA-S7.0.01-1996)
Plant Breathing Air—Compressed Gas Association (CGA, G-7.1, Grade D)
Medical Air for Hospitals—National Fire Protection Agency (NFPA-99)

The International Standards Organization (ISO) has established the following air quality classifications relating to maximum size and concentration of particles, maximum pressure dew point and maximum oil content.

ISO 8573-1 Air Quality Classes

Class*	Particles		Max. pdp (ºF)	Max. Oil Content (mg/m3)
	Max. Size (microns)	Max. Concentration (mg/m3)		
1	0.1	0.1	-94	0.01
2	1	1	-40	0.1
3	5	5	-4	1
4	15	8	+37.4	5
5	40	10	+44.6	25

*Reported as ISO Class #,#,# (Particle, PDP, Oil). E.g. ISO Class 2,4,2.

Externally Heated Blower Purge Compressed Air Dryers

Atmospheric air, heated externally, reduces purge air losses to 2% or less.

While refrigerated compressed air dryers will achieve ISO Class 4 or 5 dew points, regenerative desiccant dryers are required to achieve ISO Class 1 and 2 dew point levels. Desiccant dryers are generally referred to as either "heatless" or "heated." Heatless dryers are so-named as they do not use any source of heat for regeneration other than that given off during the drying, or adsorption, cycle. This is referred to as "the heat of adsorption." However, heatless dryers will consume up to 15% of the process air they are drying during the regeneration cycle. Heated dryers, on the other hand, utilize an external source of heat for regeneration and require little or no process air.

Donaldson Ultrafilter HRE and HRS-L heated blower purge dryers utilize atmospheric air for regeneration of the desiccant bed. No process air is used during this phase of the overall dryer cycle. Process air is only consumed during depressurization and repressurization of the off-line vessel and, in the case of the HRE, during cool-down of the regenerated bed. This amounts to approximately 2% of the rated capacity of the dryer. The HRS-L dryer further reduces purge air consumption by utilizing ambient air for cool-down of the regenerated bed.

HRE/HRS-L Heated Blower Purge Desiccant Compressed Air Dryers

HRE and HRS-L heated desiccant compressed air dryers benefit from decades of design and fabrication experience by Donaldson Ultrafilter. Our dryers are designed to consistently provide quality air with high energy efficiency in a flow range from 600 to 5,000 scfm.

Major Components

DESICCANT

Beaded activated alumina is used as the adsorption media in heated desiccant dryers. The beads exhibit a very high internal surface area and high moisture separation efficiency. Each lot of desiccant is thoroughly tested for density, moisture content, abrasion resistance, surface area, mesh size and granule strength to assure that it meets our strict design requirements.

ASME VESSELS

HRE and HRS-L desiccant vessels have been designed with a wide diameter for a large cross-sectional flow area. This results in a low flow velocity which minimizes both pressure drop across the bed and attrition of the desiccant itself. The vessels incorporate the following additional features:

- Stainless steel inlet and outlet air diffusers for even flow distribution
- Stainless steel bed support on units above 3,000 scfm
- Desiccant fill and drain ports
- 1/16" corrosion allowance
- Operating pressure gauge on each vessel
- Pressure relief valve on each vessel

VALVES


Butterfly Valve

Dryer operation is controlled by a combination of butterfly, check and globe valves, providing optimum control and maximum reliability at minimum cost. Butterfly valves are used at the dryer inlet and purge exhaust outlet. These valves are designed with a unique continuous annular raised land on the disc that provides a sure seal around the valve stem. In addition, the butterfly valves offer these features:

- High flow stainless steel disc design minimizes obstruction in flow path
- Double o-ring seal at valve stem
- Bronze stem bearings to eliminate stem seizures, provide reliable load support and minimize torque
- Hard-backed cartridge seat providing superior disc sealing integrity and easier replacement due to slip-fit into valve body; also eliminates high torque and premature failure caused by elastomer distortion found in other seat designs
- Integral flange seal eliminates need for gaskets or o-rings
- Position indicators
- Dual-acting worm-driven actuators

CHECK VALVES


Check Valve

Check valves are used at the dryer outlet and on the hot air regeneration lines. They are designed with large ports to minimize pressure loss. Outlet check valves incorporate a stainless steel disc and Viton® o-rings while hot air regeneration valves utilize a metal-to-metal seal to withstand the elevated temperatures.

(Viton is a registered trademark of DuPont Dow Elastomers)

GLOBE VALVES


Globe Valve

Angle-seated globe valves are used to control depressurization of the regenerating vessel and to control the dry purge air flow during the cooling phase of the process. Angle-seat globe valves offer high flow rates and long service life in compact, economical packages.

BLOWER

A direct drive radial-bladed centrifugal blower is used to provide ambient air for themal regeneration of the off-stream bed. The blower wheel is constructed of heavy gauge high strength steel to assure long life and efficient operation. Wheels are dynamically balanced for smooth operation and the shaft is sealed with a Teflon® seal. The blower/motor assembly is factory tested to assure low vibration levels.

HEATER

Ambient air from the centrifugal blower is directed through an electric resistance heater to elevate the temperature to 400º F for regeneration of the off-stream bed. Heaters are designed with a low watt density for low surface temperatures and long element life. The heating elements are contained within tubes which are themselves protected with direct-contact type “K” thermocouples.

ELECTRICAL CONTROLS

The entire drying/regeneration cycle is controlled by an Allen Bradley MicroLogix programmable logic controller (PLC), among the most reliable controllers available. The PLC is supplied with an Allen Bradley Microview display which, among other items, will provide the operator with the following information:

- Indicate alarm when a system fault is detected and identify the specific fault
- Indicate current status of each vessel (drying, regenerating or in standby)
- Indicate time remaining of each phase of the cycle

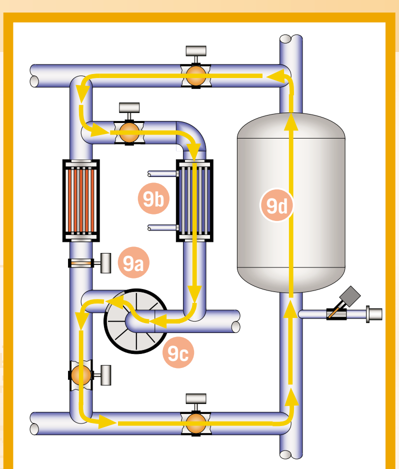
GENERAL DESIGN FEATURES

- Piping design and layout can have a significant impact on pressure loss through the entire system. HRE and HRS-L piping sections are conservatively sized to reduce system pressure loss and lower operating costs. Long radius elbows, which reduce pressure drop to about 67% of standard elbows, are used throughout the system.
- Back pressure during purge can cause the system to consume too much compressed air during this phase of the cycle. To minimize this back pressure, large diameter pipe and high flow mufflers have been incorporated into the design.
- Mufflers with a unique expansion chamber have been selected to allow the exhaust of purge air to atmosphere with minimal noise and free of contaminants. They are constructed of corrosion resistant materials, providing for long life and low maintenance requirements.
- All external surfaces are mechanically cleaned of loose particles, scale, rust, oil, grease and any other contaminant prior to painting. A primer coat is followed by two coats of Donaldson Ultrafilter blue for maximum protection against the elements.
- All components have been arranged to fit into the smallest footprint possible, saving valuable floor space.

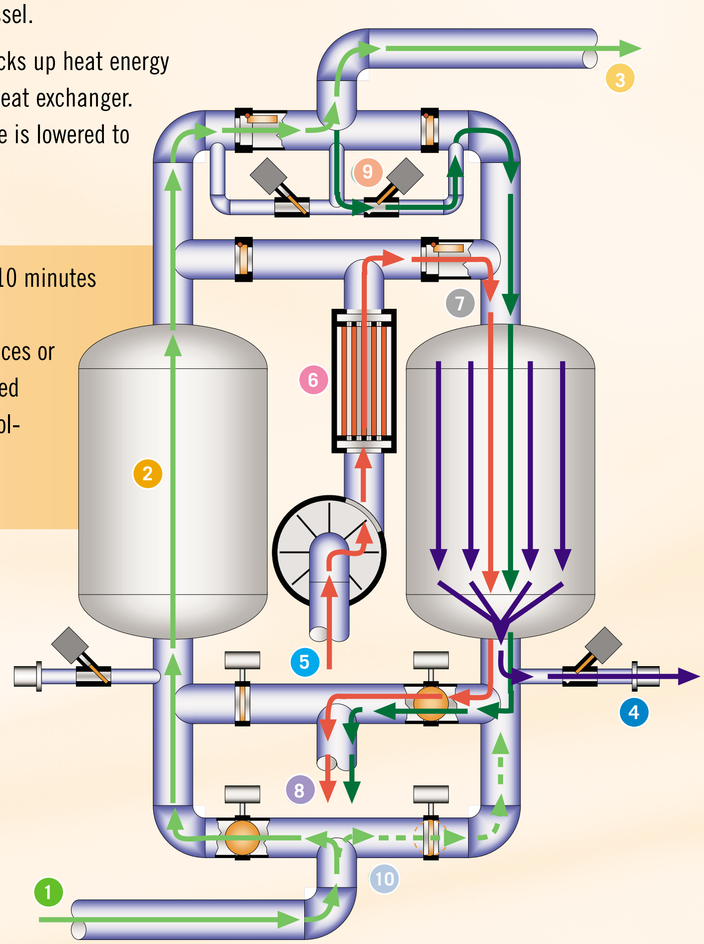
(Teflon is a registered trademark of the DuPont Company)

HRE and HRS-L Process Flow

1. Wet compressed air, controlled by butterfly valves, enters the base of the on-line vessel.
2. As the compressed air passes through the desiccant bed, moisture is removed, lowering the dew point to -40º F.
3. Dry compressed air exits the top of the vessel, passes through a check valve and flows downstream to the use point.
4. When the desiccant bed becomes saturated with moisture, it goes off-line and depressurizes to ambient through an angle-seat globe valve. A muffler attenuates the noise of depressurization.
5. After the off-line vessel has depressurized, a centrifugal blower draws in ambient air for regeneration.
6. The ambient air is heated to 400º F, giving it the energy required to initiate and accomplish desorption, after which it passes through a check valve and enters the top of the regenerating vessel.
7. As the hot ambient air passes through the desiccant bed, water molecules are released from the surface of the desiccant and enter the air stream.
8. Hot regeneration air passes through a butterfly valve and exits to atmosphere.
9. At the end of the heating phase of the cycle, the desiccant bed, although regenerated, remains hot. The temperature of the bed must be lowered to minimize dew point and temperature spikes in the process air when the bed goes back on-line. This is accomplished by allowing a slipstream of dry process air, controlled by an angle-seat globe valve, to flow from the on-line vessel into the off-line vessel. This slipstream is also used to repressurize the off-line vessel after it has been cooled.
   a. The HRS-L heated blower purge dryer incorporates a water-cooled heat exchanger which eliminates the need for purge air during the cool-down period. At the end of the heat cycle, a series of valves open or close creating a closed-loop between the air blower and vessel.
   b. The hot air bypasses the heater and is directed through a water-cooled heat exchanger.
   c. The blower circulates the cooled air back through the vessel.
   d. As the cooled air passes through the desiccant bed, it picks up heat energy which is removed from the system via the water-cooled heat exchanger. The closed-loop cycle continues until the bed temperature is lowered to its operation point without the use of purge air.
10. Unique to the Donaldson Ultrafilter HRE is our parallel running period 10 minutes prior to vessel switchover. During this period, the incoming flow of wet compressed air is directed through both vessels. This step further reduces or eliminates the dew point and temperature spikes associated with heated dryers while minimizing the loss of purge air used during the initial cool-down. This step is not required with HRS-L dryers.



HRS-L Process Flow



HRE Process Flow

Built-in Energy Management

Compressed air systems do not necessarily operate at full capacity 24 hours a day. When a heated dryer routinely operates at less than its full design capacity, excess energy is consumed in the form of unnecessary heat cycles and wasted purge air.

Many adsorption dryers operate on a fixed cycle regardless of demand and require the addition of optional equipment to gain any benefit from operation at less than design capacity. Donaldson Ultrafilter HRE/HRS-L dryers incorporate built-in, standard energy management features.

Thermocouples located in the purge air exhaust and cooling air outlet streams continuously monitor the temperature of the purge for both high and low set points. During the desorption phase of regeneration, the external heater adds energy required to remove adsorbed moisture from the desiccant bed. Once desorption is complete, the temperature of the purge exhaust will rise as the heat energy is no longer being consumed by the desiccant bed. This rise in temperature signals the completion of desorption and shuts down the heater. Whenever the moisture load on the dryer is anything less than design capacity in a given adsorption cycle, energy is conserved and operating costs are reduced by early termination of heating.

At this stage, the thermocouple in the cooling air outlet begins to track the decrease in bed temperature during the cool-down purge cycle. At a given set point, the temperature at the cool-down purge air outlet indicates that the bed has been lowered back down to the adsorption operating temperature. Any further reduction in bed temperature results in wasted purge air. The cooling phase is terminated at this point.

Rather than operating on fixed heating and cooling cycles, which consume both electrical energy and compressed air based on the design capacity of the dryer, these built-in energy management features reduce operating costs without the addition of special equipment whenever the demand on the dryer is less than 100% of its capacity.

Ultraconomy Energy Management System

Additional savings can be achieved with the use of the optional Ultraconomy energy management system. While the built-in energy management features provide early termination of heating and cool-down, the dryer continues to operate on a fixed-time adsorption cycle. Switchover will occur regardless of the moisture content of the on-line bed. When operating at less than full capacity, the dryer will experience unnecessary cycling of its valves, unnecessary compressed air losses through depressurization and repressurization cycles, and wasted heater operation.

When operating in Ultraconomy mode, the dew point of the process air is monitored at the dryer outlet to determine whether or not regeneration should be initiated. The drying stage will be extended until the dew point rises above a given set point. Only then will switchover to the standby vessel occur and the regeneration cycle begin, reducing wear-and-tear on the overall system and conserving electrical power and compressed purge air.

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HRE/HRS-L Heated Blower Purge Desiccant Compressed Air Dryers

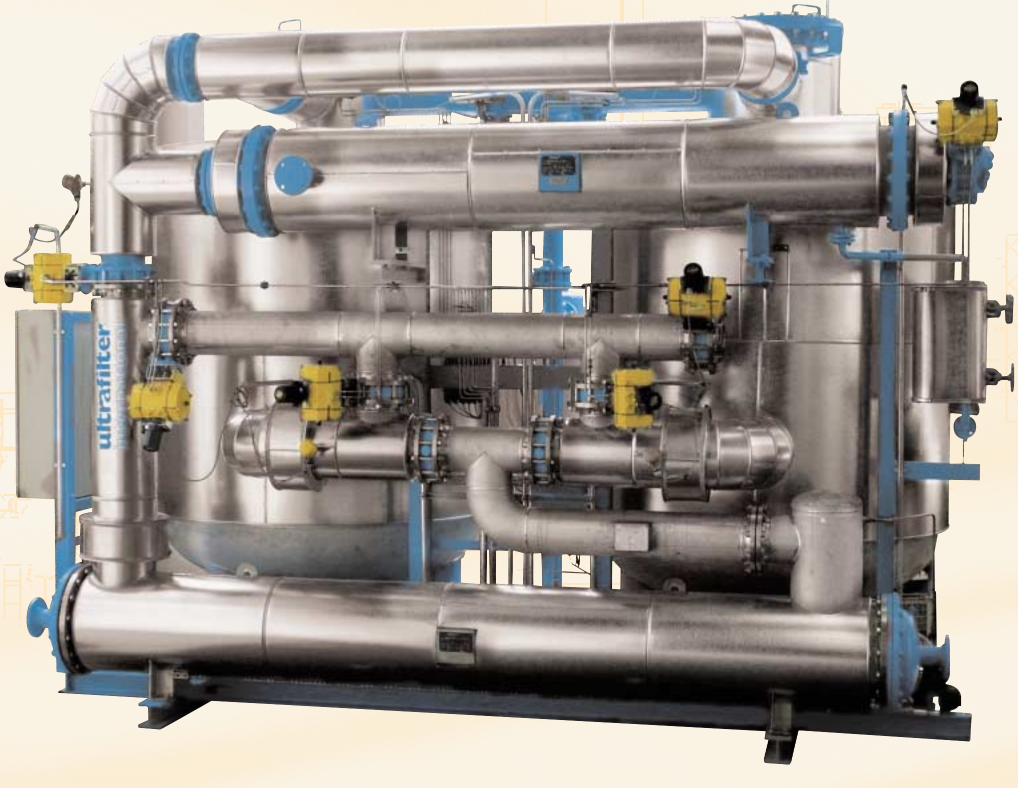
HRE and HRS-L dryers are designed to provide high drying efficiency in a flow range from 600 to 5,000 scfm. By utilizing an external source of heat for regeneration, HRE/HRS-L dryers significantly reduce or eliminate the use of compressed purge air for regeneration resulting in an overall reduction in the cost of operation.

Key Features and Benefits

- Purge air consumption of only 2% or less
- Built-in standard energy management controls
- Low pressure drop design for energy savings
- High quality components for reliable service and long life
- Unique HRE parallel flow to reduce or eliminate dew point and temperature spikes
- Small footprint saves valuable floor space
- NEMA 4 electrical enclosures
- Corrosion resistant finish

Available Options (partial list)

- Ultraconomy energy management system
- Single and dual prefilter and afterfilter systems
- 3 valve bypass system
- Vessel/piping insulation
- Steam-based desorption system
- Dew point monitor and alarm
- Stainless steel instrument air tubing



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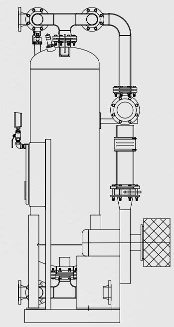
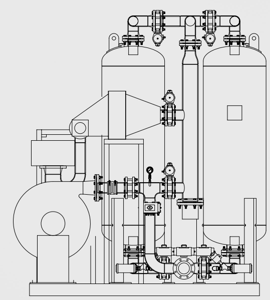
HRE Blower Purge Desiccant Dryer

Model Number	Capacity[1] (scfm)	Connection (in.) ANSI Flange	Dimensions (in.) Height	Width	Depth	Blower Motor HP	Installed Heater kW	Total Average kW	Approx. Weight (lbs.)
0600-60	600	3	103	85	50	5.0	16.0	11.6	2,660
0800-60	800	3	103	90	50	7.5	24.0	17.9	3,260
1000-60	1000	3	120	95	50	7.5	27.0	19.1	3,940
1200-60	1200	4	120	100	50	10.0	32.5	21.6	4,800
1400-60	1400	4	115	100	55	10.0	37.0	24.4	5,200
1600-60	1600	4	120	110	60	10.0	45.0	29.3	5,900
2000-60	2000	4	120	115	65	10.0	52.0	33.7	7,000
2400-60	2400	6	130	125	70	15.0	64.0	41.1	8,750
3000-60	3000	6	130	125	70	15.0	78.0	49.9	10,600
3500-60	3500	6	125	150	80	15.0	90.0	57.0	11,900
4000-60	4000	6	130	155	85	20.0	100.0	63.9	13,650
5000-60	5000	6	135	182	90	20.0	120.0	76.6	17,600



HRS-L Zero Purge Air Blower Purge Desiccant Dryer

Model Number	Capacity[1] (scfm)	Connection (in.) ANSI Flange	Dimensions (in.) Height	Width	Depth	Blower Motor HP	Installed Heater kW	Total Average kW	Approx. Weight (lbs.)
0600-60	600	3	103	118	68	5.0	16.0	12.8	4,250
0800-60	800	3	103	118	68	7.5	24.0	20.0	4,850
1000-60	1000	3	120	120	70	7.5	27.0	20.9	5,640
1200-60	1200	4	120	124	72	10.0	32.5	22.9	6,520
1400-60	1400	4	115	140	80	10.0	37.0	25.9	6,950
1600-60	1600	4	120	146	83	10.0	45.0	30.9	7,700
2000-60	2000	4	120	150	90	10.0	52.0	35.6	8,800
2400-60	2400	6	130	180	106	15.0	64.0	43.2	10,500
3000-60	3000	6	130	180	106	15.0	78.0	52.3	12,500
3500-60	3500	6	125	188	112	15.0	90.0	59.4	13,800
4000-60	4000	6	130	200	118	20.0	100.0	66.8	15,500
5000-60	5000	6	135	225	125	20.0	120.0	80.1	19,900



Capacity Correction Factors

Operating Temperature	Operating Pressure (psig) 70	80	90	100	115	130	150
90° F	0.96	1.08	1.19	1.25	1.30	1.39	1.50
95° F	0.77	0.91	1.06	1.16	1.30	1.39	1.50
100° F	0.63	0.75	0.87	1.00	1.13	1.26	1.44
105° F	0.50	0.60	0.70	0.80	0.95	1.08	1.26
110° F	0.37	0.45	0.55	0.63	0.74	0.87	1.04

[1] Capacity based on -40˚ F pdp, 100 psig inlet pressure, 100˚ F inlet temperature and 100˚ F ambient according to DIN ISO 7183.

Pressure dew point: -40° F standard; pdp down to -100° F available as option.
Operating pressure: Minimum 70 psig; Maximum 150 psig.
Operating temperature: Minimum 40° F; Maximum 110° F.
Ambient temperature: Minimum 40° F; Maximum 110° F.
Electrical connection 460V/3PH/60Hz.
Cooling:
HRE by means of dried air (average 2% of process flow).
HRS-L by means of blower air in a closed loop cooling system with air/water heat exchanger.

Installation of prefilter and afterfilter is recommended.
PLC control including indicator and dry contact for common alarm.
NEMA 4 control box standard.
Failure-to-switch alarm standard.
Regeneration cycles: standard 2 by 4 hours.
Maximum fan suction condition: 95° F, 90% RH (tropical).

Ordering information:
Specify "Type" "Model Number"
Example: "HRS-L3500-60"

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