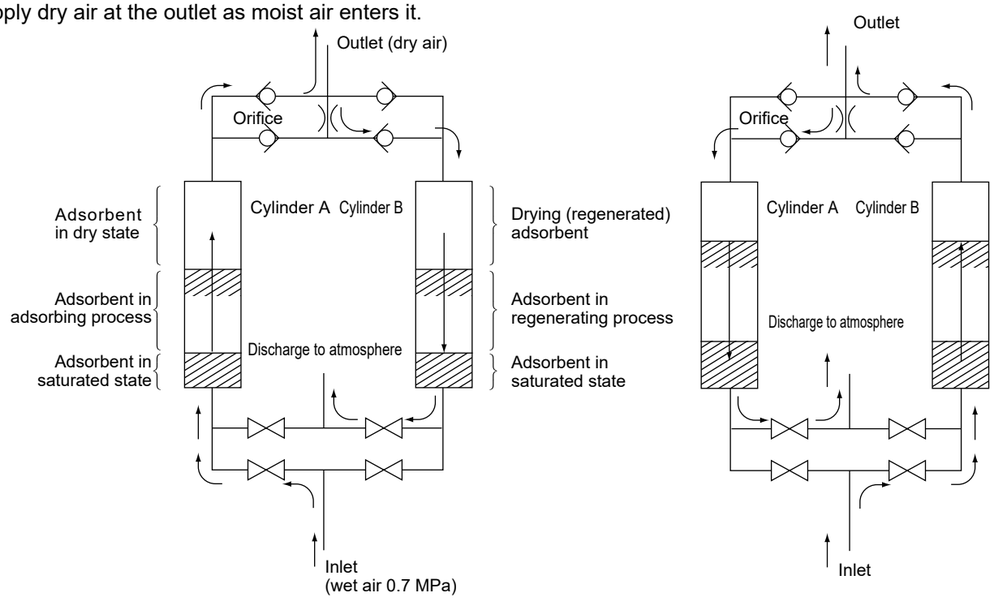
Suction Principles and Circuit Diagram

The heatless dryer is a system that utilizes the characteristics of an adsorbent (desiccant) which constantly tries to create a state of equilibrium with the vapor concentration of the ambient air. The unit has 2 cylinders, repeatedly switching between the one for the process of suctioning the water vapor from the air, and the other for the regeneration process of releasing the suctioned moisture with the dry air created. This device will constantly supply dry air at the outlet as moist air enters it.



Moist air coming in from the inlet will enter cylinder A, have its moisture removed due to the adsorbent, and then leave from the outlet as dry air. Part of the dry air coming out of cylinder A will flow through the orifice, be reduced in pressure to an atmospheric pressure, enter cylinder B, remove moisture from the moist adsorbent, and be exhausted into the air. By using a part of the air dried under pressure, when it is reduced in pressure by the atmosphere to regenerate the desiccant, the drying efficiency will increase and improve regeneration efficiency. For example, when dry air of 0.7 MPa is reduced in pressure to the atmospheric pressure, the volume of air expands to approximately 8 times as much and the relative humidity per unit of volume becomes approximately 1/8. Accordingly, the adsorbent releases a greater amount of moisture in trying to create a state of equilibrium with that air. After a certain amount of time, the flow of air is reversed with a timing motor for adsorption to take place in the cylinder B while regeneration will take place in the cylinder A. Repeat this operation.

Heatless Dryer System

1. Purge flow rate

The heatless dryer uses some of the dry air created by the dryer for the regeneration of the adsorbent that has absorbed moisture. The air used in this regeneration is referred to as the purge air, and in principle the minimum amount required is fixed.

$$\text{Theoretical purge rate} = \frac{1}{\text{Air pressure during adsorption (absolute pressure)}}$$

For example, at 0.7 MPa, the theoretical purge rate is approximately 12.5% (at 100% load).

In reality, 15 to 23% is configured in consideration of the absorbing/releasing efficiency of the desiccant and the efficiency of the device. Therefore, if the operating conditions differ, the purge rate will differ and so will the processing air rate and purge volume. Be sure to review the catalog to make sure that the operating conditions of use and necessary outlet dew point will be satisfied. In addition, ideal purge volumes can be set at the plant to suit the specifications of customers(Contact CKD for Special-order products). As it will be necessary to reconfigure the unit when working conditions are changed due to relocation, etc., consult with CKD.

2. Oil removal

In the case of desiccant air dryers, if the desiccant adsorbs oil, the adsorption of moisture will be obstructed and the outlet dew point may become lower and the life of the desiccant may become shorter. Accordingly, when installing a desiccant air dryer in an air line using a lubrication air compressor, be sure to install an oil removing filter (M-type filter) on the primary side of the dryer.

3. Installation of filter on the secondary side of the dryer

In the case of desiccant air dryers, as desiccant powder may flow out to the secondary side of the dryer, depending on the air purpose (required air quality), install a filter (a P-, S-, or M-type filter or a combination thereof) on the secondary side of the dryer.

4. Silencer Replacement

When switching the adsorbing side of the desiccant cylinder, as the cylinder (in a pressurized state) that had until then been adsorbing is suddenly reduced in pressure, a loud exhaust noise will be generated every time the switching takes place. A silencer is provided to reduce this exhaust noise, but after prolonged use, desiccant powder builds up and clogs the silencer. If left unchecked, this can affect the desiccant's regenerative performance and prevent it from producing the prescribed dew point performance. In addition, if the clogging becomes worse, the silencer may become damaged by the pressure during exhaust. As a guideline, replacement should be made when the pressure on the regenerator side exceeds 0.05 MPa or after one year.

5. Pressure fluctuation on dryer secondary side

Pressure fluctuates around the switching process (suction/release) for the desiccant cylinder, as air flow rate fluctuation other than the user's is caused by temporary purge stop and the pressurized filling process of the atmospheric pressure cylinder (regeneration cylinder), etc. The range of fluctuation is greatly affected by the piping conditions in which the dryer is installed and can be as high as 0.1 MPa in large cases. In cases when this pressure fluctuation may impact factory operation, consider setting the source pressure higher or installing an air tank on the secondary side.

6. Bypass circuit

In most cases with dryers, a bypass circuit which bypasses the dryer is provided for emergency air supply. The valve is opened when the air supply must be continued even if the dryer malfunctions, or when the dryer is repaired with air flowing as a temporary measure. However, moist air from which moisture has not been removed will be supplied within the factory. Most heatless dryers are selected for the air supply with high degree of dryness. Use extreme caution when opening the bypass circuit since opening it will cause moisture to enter all the air pipes past the dryer, creating a great amount of work to recover from this state. Therefore, it is recommended that a spare unit be installed.

7. Dew Point Indication

By convention, performance has been indicated by pressure dew point for refrigeration dryers and by atmospheric pressure dew point for heatless dryers and membrane dryers (see page 68 for terminology), but with the establishment of JISB8392-1, there is a trend toward unification of pressure dew point indication. At CKD, performance will be displayed with the pressure dew point from the super heatless dryer SHD3000 Series. Note that depending on the model or manufacturer, the display signals may become mixed.

Series Variation

Desiccant Air Dryers (Heatless dryer)

Series	Compact			Large		
	HD Series			**Super Heatless SHD Series**		
Installation Application	Factory end installation, built-in type					
Features / kW	Inlet air temperature 21°C			Inlet air temperature 35°C		
	Atmospheric dew point -17.5°C	Atmospheric dew point -40°C	Atmospheric dew point -72°C	**Pressure dew point -20°C (-40°C) *2**	**Pressure dew point -40°C (-57°C) *2**	**Pressure dew point -60°C (-74°C) *2**
0.4			●(HD-0.5)			
0.75	●(HD-0.5)	●(HD-0.5)	●(HD-1)			
1.5	●(HD-1)	●(HD-1)	●(HD-1.5)			
2.2	●(HD-1.5)	●(HD-1.5, -2)	●(HD-2)			
3.7	●(HD-2)	●(HD-4)	●(HD-4)			
5.5	●(HD-4)		●(HD-6)			
7.5	●(HD-6)	●(HD-6)	●(HD-9)			
11	●(HD-9)	●(HD-9)				
15	▲(HD-9)			●(SHD3025-G/M)	●(SHD3025-G/M)	●(SHD3025-M)
22				●(SHD3045-G/M)	●(SHD3045-G/M)	●(SHD3045-M)
37				●(SHD3075-G/M)	●(SHD3075-G/M)	●(SHD3075-M)
55				●(SHD3100-G/M)	●(SHD3100-G/M)	●(SHD3100-M)
75				●(SHD3125-G/M) ●(SHD3150-G/M)	●(SHD3125-G/M) ●(SHD3150-G/M)	●(SHD3125-M) ●(SHD3150-M)
95				●(SHD3200-G/M)	●(SHD3200-G/M)	●(SHD3200-M)
120				●(SHD3240-G/M)	●(SHD3240-G/M)	●(SHD3240-M)
150						
200						
250						
300						
400						
480						
710						
960						
1450						
Dew point monitor	×	×	×	● Standard Equipment	● Standard Equipment	● Standard Equipment
Energy-saving device equipped	×	×	×	● Standard Equipment	● Standard Equipment	● Standard Equipment
Different voltages supported	● Option	● Option	● Option	● Option	● Option	● Option
Paint color designation	▲ Special-order product	▲ Special-order product	▲ Special-order product	▲ Special-order product	▲ Special-order product	▲ Special-order product
Remote control, external signals	▲ Special-order product	▲ Special-order product	▲ Special-order product	● Standard Equipment	● Standard Equipment	● Standard Equipment
Outdoor specifications	×	×	×	×	×	×
Anchor bolt	×	×	×	● Option	● Option	● Option
Stainless steel nameplate	● Option	● Option	● Option	▲ Special-order product	▲ Special-order product	▲ Special-order product
Export specifications	● Option	● Option	● Option	● Option	● Option	● Option
Export packing	▲ Special-order product	▲ Special-order product	▲ Special-order product	▲ Special-order product	▲ Special-order product	▲ Special-order product
Product photo	● Option	● Option	● Option	▲ Special-order product	▲ Special-order product	▲ Special-order product
Appearance						
Listed page	144			154		

*1: This table has been prepared based on the conditions listed below; correction of models will be necessary depending on multiplier calculations in cases when the conditions are different.
Inlet air pressure: 0.7 MPa,
Inlet air temperature: in accordance with the rating of each series.

*2: The value in ( ) is the atmospheric dew point converted value.

*3: Please contact our sales staff for information on delivery dates and prices of special-order products.

Properties and handling of desiccant

1. Desiccant disposal methods

The desiccant is an adsorbent and there is a possibility that various substances other than moisture contained in the compressed air have been suctioned. Please be sure to appropriately process used desiccant as industrial waste.

2. Inlet air temperature and suction performance

The adsorption performance of the desiccant is greatly dependent on the temperature, and the adsorption performance will suddenly decrease when exceeding a temperature of 55°C. (This is why the inlet air temperature range of the heatless dryer is rated up to 50°C.) In general, as the lower the temperature, the higher the suction performance, efficient operation is made possible by installing the heatless dryer in a position where the lowest possible inlet air temperature can be realized.

3. Oil removal

Unlike the heated type, instead of fully adsorbing moisture with the desiccant, heatless dryers repeat the process of adsorbing a little moisture on the surface and quickly removing this moisture (regenerating). Accordingly, the surface of the desiccant must be kept clean and in a state where it is easy for the moisture to be suctioned.
The desiccant will adsorb oil as well if the compressed air contains oil. However, oil is not removed as easily as moisture and will infiltrate the desiccant and cause interference with the adsorption of moisture.
Accordingly, when installing the product in a lubrication air line, be sure to install an oil removing filter (M-type) on the primary side of the heatless dryer.

4. Desiccant replacement period

Replace the desiccant every 2 years.