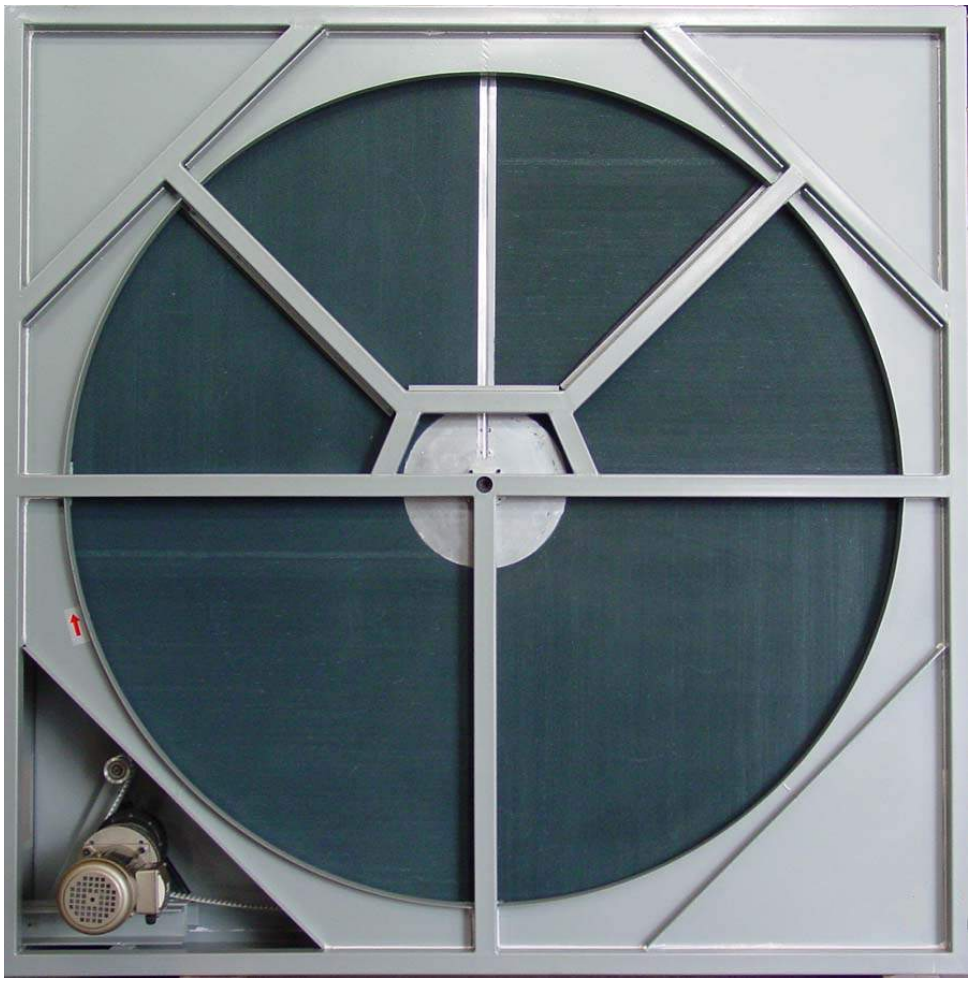
Desiccant Dehumidification Rotor and Cassette

Installation, Operation and Maintenance Manual



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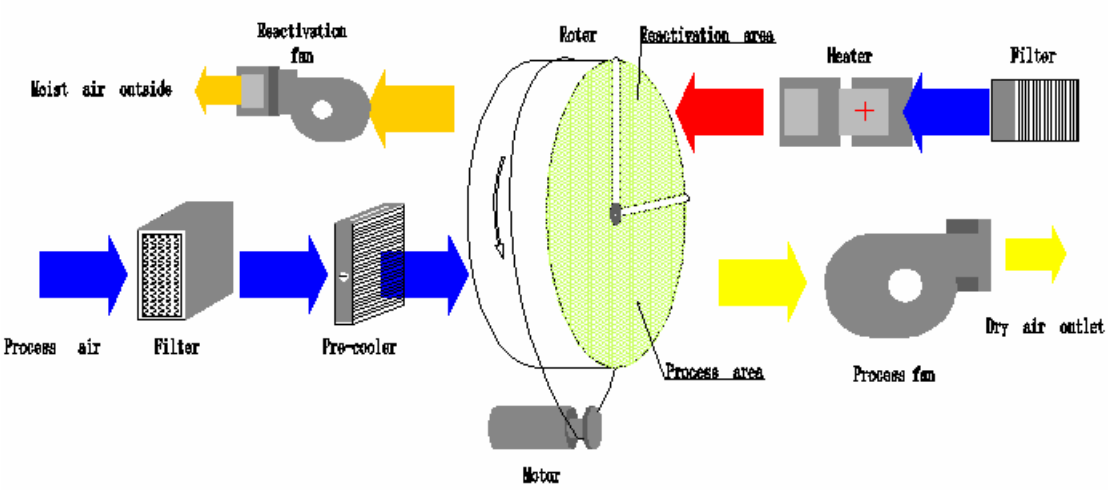
INTRODUCTION

Purpose

PPS Dehumidification rotors and PPSC Dehumidification rotor cassettes are used in heat reactivated desiccant dehumidification systems. Moisture is adsorbed by the desiccant material within the structure of the media of the rotor, and is then desorbed by the heat of reactivation. Two (2) air streams are used in conjunction with the rotor and cassette. The moisture in processing air is adsorbed and then be desorbed by reactivation hot air and be subsequently exhausted to an ambient location. The dry air therefore is created continuously with the rotating of the rotor (see the principle of operation).

Illustration of the dehumidification principle of operation

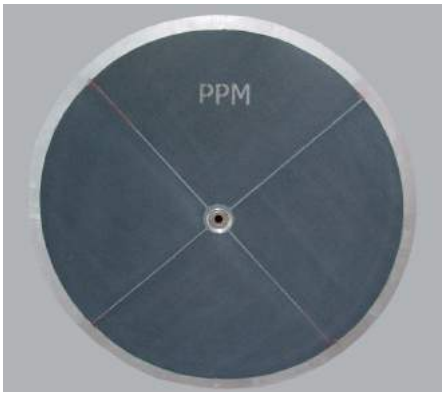


The rotors and rotor cassettes are designed for 10 years of continuous use with minimal required maintenance. Careful installation and performance of required maintenance items in accordance with this manual will ensure long life and top performance.

Components

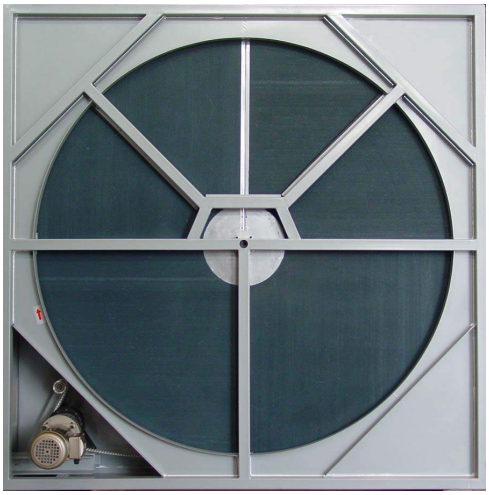
Desiccant Rotor

The desiccant rotor is a high capacity silica gel (PPS) and/or molecular sieve (PPM) desiccant media provide by PROFLUTE in Sweden captivated in a galvanized perimeter bands with radial central spokes. The spokes attach to a central hub with a couple of integral sealed ball bearings. The flange required by customer could be made with the perimeter band.



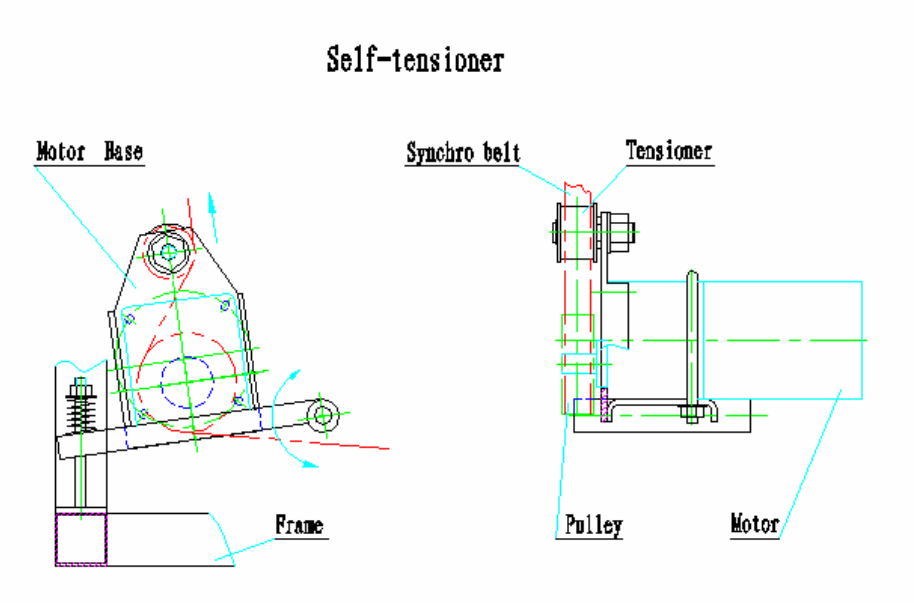
Desiccant Rotor Cassette

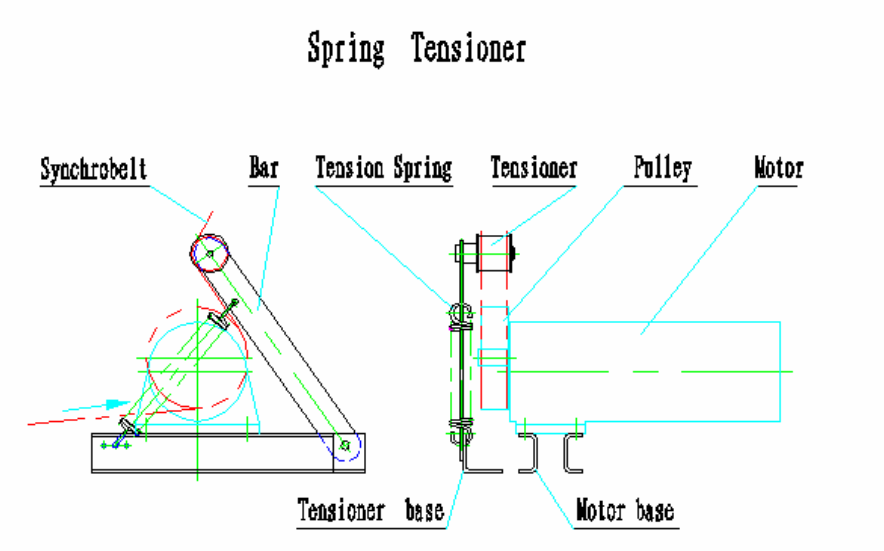
The cassette weld with the square tubes and steel plates has a rigid and stable construction; the anti-corrosion processing with galvanized plus plastic coating ensures a long working life. The rotor is assembled on a solid center shaft with spacer plates attached to the cassette structure with shoulder screws.
The basic structures of the cassette are “T” type and “Y” type accordance with the different position of the reactivation zone and it could be chosen by customers.



Rotor Drive System

The rotor drive system is consist of a gear motor (3 phases, 380v, 50 Hz), a sync-belt and a sync-pulley. For the rotor cassettes with a rotor size no more then 1220x200, its driving motor is fixed on a plate which can swing around a shaft so it has a self-tension function. For the rotor cassettes with a rotor size big then 1220x200, its driving motor is fasten on the bottom of cassette with a spring tension device.





Seals

The seals are made of high temperature, anti-wear and low friction material imported from abroad. The plate type of silicon rubber plus Teflon coating seal is used for the rotor perimeter seal and the “P” type of VITON seal is used for the dividing seal between the process and reactivation zone.

Installation

Location

PPS Dehumidification rotors should be located in the cassette similar to those provided by SAT. Customer manufactured cassettes should securely support the rotor, minimize rotor movement along the shaft, drive the rotor with minimum force exerted on the outer band of the rotor, and should provide well sealing in between process and reactivation air streams. PPSC Dehumidification rotor cassette may be located within a customer supplied air handler, within a ducted system, or as a “stand alone” component with the proper exterior covers, insulation and weather-proof. Cassette location should ensure that the dehumidification rotor and drive are protected from the elements or a direct impingement stream from cooling coil or humidifier, and should include sufficient structure to adequately support the cassette from distorting during transit or operation.

Attachment method

The driving motor is recommended to locate on the process outlet side and should be close to the inspection door. Dehumidification rotor cassettes should be securely mounted by bolting, riveting, screwing or welding. Note that the cassette must be installed with care: when drilling, exercise caution not to damage rotor seals, rotor face or rotating parts, when welding, ensure that seals and rotating parts are protected from the heat of welding. Weld in locations away from seals and moving parts. Cassette structure should be insulated to prevent condensation on the metal surfaces of the cassette. Access doors should be provided to allow for cassette and drive maintenance, as well as rotor removal. All attachment within the customer supplied air handler should be additionally sealed to prevent loss of dry air from the process air stream or leakage of moist air from the reactivation air steam. Attachment should be carefully done without distortion of the frame of cassette. Any improper mounting may result in substantially unequal clearance between the rotor face and the cassette. This can cause excessive drive torque requirement (reducing the life of the drive), uneven seal wear and reduced seal or media life.

Cassette Wiring

All PPSC rotor cassettes use 3-hase gear motor (380V, 50 Hz) and should be wired with care accordance with the diagram on the underside of the motor junction box and the arrow direction stuck on the motor and the cassette.

Rotor Protection

A medium efficiency filter should be mounted at the process air inlet and reactivation air inlet respectively in order to avoid dust accumulated into the structure of desiccant media and subsequently provide a protection away from increase of air pressure drop and lower dehumidification efficiency.
A functional water drop separator mounted at the behind of cooling coil should be needed for preventing water drop into the media especially when the dehumidifier is located at the humid environment.
A thermostat must be located at the heat reactivation zone and used for the over-heat (higher than 180 degree centigrade) alarm and automatically to adjust or even shut off the heater power. A sensor or micro-switch is absolutely necessary to monitor the rotation of rotor. When the rotor stops occasionally, it should provide an alarm and shut off the heater power simultaneously so that the rotor media can be protected to be destroyed by excessive high temperature.

Operation

Start Up

Start up consists of having both the proper balanced flow and temperature through both process and reactivation air streams, as well as rotation of the rotor. At start up, all standard inspections (see inspections) should be performed to ensure the cassette is operating properly, Of particular importance is the alignment of the rotor in the cassette, and drive system operation. Maximum operating temperature is 180 degree centigrade and the air velocity is not exceeding 6 m/s.

Flow

In generally, the reactivation air flow should be one third (1/3) of the process air flow, two air streams are flowing in counter-flow direction (see illustration).
In the previous illustration, “Process” flow passes through the rotor, where the silica gel structure removes moisture to dry the air stream. Simultaneously, heated reactivation airflow drives moisture from the silica gel structure, where it is subsequently exhausted to an ambient location. The unit’s drive system rotates the wheel at the pre-determined speed to provide for a continuous process. Seals located around the perimeter of the rotor face and between the process and reactivation air streams seal the unit to ensure that the dried process air and moisture laden reactivation air remain separated.

Drive system

The rotor drive system is consist of a gear motor (3 phases, 380v, 50 Hz), a sync-belt and a sync-pulley. For the rotor cassettes with a rotor size no more then 1220x200, its driving motor is fixed on a plate which can swing around a shaft so it has a self-tension function. For the rotor cassettes with a rotor size big then 1220x200, its driving motor is fastening on the bottom of cassette with a spring tension device.
With power applied, the gear motor drives the sync-belt and then rotates the dehumidification rotor. The spacers riveted on the perimeter band of rotor engage the sync-belt and ensures the belt running well.

Measurement of Performance

The main measurements of performance are:

1. Measure the data of dry bulb temperature, dew point and air volume flow of process air stream at its inlet and outlet.
2. Measure the data of dry bulb temperature, dew point and air volume flow of reactivation air stream at its inlet and outlet.
3. Measure the dry bulb temperature at the reactivation heater outlet.
4. Time rotor speed of rotation.
5. Measure process and reactivation air pressure drops.
6. Record the drive motor amperage.

All measurements should agree within a few percent (likely measurement error) of performance graphs and software performance readings. In the event of substantial (＞5%) difference between measured and predicted results, re-perform measurements. Note that common measurement and calculation errors are:

1. Process leaving dew point is inaccurately determined by measuring wet bulb (or RH) and calculating dew point. In may case, the leaving process air is so dry that even slight measurement errors in dew point (or RH) will have significant results. If possible use a chilled mirror dew point sensor for all dew point readings.
2. Turbulence in air streams causes variance in all readings. Take an average reading in a transverse across the face of the rotor in order to minimize variance due to turbulence.
3. Heat and mass transferred do not balance. The amount of heat again in BTUH on the process side must match the heat loss in BTUH on the reactivation side. Also, the amount of moisture removed on the process side must match the amount of moisture gained on the reactivation side. If mass and heat transfer do balance, it is likely that the readings obtained are correct.

Troubleshooting

In the event that a mass and heat balance was achieved, but the performance still does not match (is ＞5% difference) graph and software predictions, follow the chart below to

determine and correct the cause.

Observed Trouble	Inspection	Corrective Acton
Rotor does not Turn	Power not on	Energize
	Check rotor free to rotate	Determine cause from other Inspection
	Check drive motor operational	Replace motor/check wiring
	Check seal clearance	Check rotor alignment/seal position
	Check bearing free to rotate	Replace bearings
	Check sync-belt	Replace belt
	Check drive tension system	Adjust tension system
Rotor turns, but Drying performance Is poor	Perform measurement of performance	Determine cause from other inspection
	Check seal clearance	Adjust or replace seal
High process Outlet Temperature	Check seal clearance	Check rotor alignment / Seal position
	Check rotor speed	Contact SAT
Low reactivatioN Outlet Temperature	Check seal clearance	Check rotor alignment / Seal position
	Check rotor speed	Contact SAT
	Check heated temperature	Adjust to set point

Maintenance, Service and Repair

Routine Maintenance and inspection

The periodic maintenance and inspection are required for the desiccant rotor and cassette. Following the schedule below should result in years of trouble free operation.

Frequency	Maintenance Item
At start up	inspect shrinkage, seal and drive
After 1 week	inspect shrinkage, seal and drive
Twice yearly (1st year)	Inspect seal and drive
Once yearly	Inspect seal and drive
Pressure drop ＞1.25 x new	Clean rotor
Performance ＜95% of new	Perform measurement as troubleshoot

Rotor inspection

Carefully inspect the face of the desiccant rotor for signs of discoloration, damage, or clogging from contamination. Normally the desiccant media will be a medium gray color. Through use, some normal contamination build-up occurs, and the coloration will change

to brown. If the face has a pink coloration, this would indicate that the face has been exposed to excessive temperature (220℃ or higher). If the rotor face has been damaged, the damaged areas will show up as light tan spots. Please contact SAT for solution.
Occasionally some of minor separations will occur within the desiccant media. These separations are strictly cosmetic and will not adversely affect performance. To repair the cosmetic separations, simply fill with 100% RTV silicon sealant and remove excess.

Seal inspection

The seals are made of high temperature, anti-wear and low friction material imported from abroad. The plate type of silicon rubber plus Teflon coating seal is used for the rotor perimeter seal and the “P” type of VITON seal is used for the dividing seal between the process and reactivation zone. Inspect the condition of the seals to ensure a positive seal between the rotor faces and metallic frame structure. A small amount of black residue from the seals will occur after extended use and is normal. If large amounts of residue are evident, it indicates that the seals have been excessively worn and should be replaced. Also inspect to ensure a good seal exists between the metallic structure of the cassette and interconnecting ductwork. Any significant leakage in these areas affects overall performance and should be sealed.

Drive inspection

The rotor drive system is consist of a gear motor (3 phases, 380v, 50 Hz), a sync-belt and a sync-pulley. For the rotor cassettes with a rotor size no more then 1220x200, its driving motor is fixed on a plate which can swing around a shaft so it has a self-tension function. For the rotor cassettes with a rotor size big then 1220x200, its driving motor is fastening on the bottom of cassette with a spring tension device. Inspect the wear condition between the sync-belt and pulley for the drive system with self-tension structure, also inspect the spring tension force to ensure the belt running well.

Rotor cleaning

Periodically, the rotor may need cleaning from accumulated dust and debris. Generally, air handlers are equipped with air pressure drop monitoring devices, which indicate pressure drop through the rotor. If the air pressure drop exceeds 125% of the “new” pressure drop, the rotor should be cleaned by the following methods:

1. If there is dust on the rotor surface,
   Use a strong vacuum cleaner with a brush to suck up the dust.
2. If there is dust inside the rotor channels.
   Blow with compressed air through the channels.
3. If there is dirt sticking to the channel walls inside the rotor:

a. Saturate the rotor by blowing humid air (higher than 60%RH) through the rotor without having any reactivation on. This can be done by just turning the reactivation heater off and still have the process fan and drive motor running if the process air has high humidity. If the process air is too dry, try to put a humidifier in the air stream. Do this for one hour.
b. Depending on what the dirt is, sink the rotor into water, liquid solvent like xylene if dirt is greasy or into a detergent solution with pH 7 or lower. High pH will destroy the silica gel. Move the rotor up and down for about 15 minutes.
c. Take the rotor out of the liquid and let it rest with the channels vertically for 5 minutes so the liquid can run out.
d. Blow down the channels with compressed air to get rid of more liquid.
e. Put the rotor back in the dehumidifier and run the unit with reactivation on for at least one hour. Note that in the dry air and wet air outlets there will be high concentrations of the liquid for some time. If a solvent has been used there can be a smell from the air streams for many days.

Note that some dirt, like oil mist or other types of sticky mist, is almost impossible to clean out so the rotor has to be replaced. Also note that by cleaning the rotor some of the initial capacity will come back but usually not all.

Rotor repair

Small gaps and imperfections can be repaired in the field. All small gaps can be filled with silicon sealant with high temperature rating (220℃ or higher, such as sealant 903-1) and remove excess with care. For very small spots, application of a special face coating available from SAT will cover light areas and re-harden the face of the media. Allow to dry overnight. For deeper scratches or dents, RTV adhesive may be applied to fill it. For damaged or severely contaminated media, the rotor can be sent to SAT for repair or complete media replacement.

Seal replace

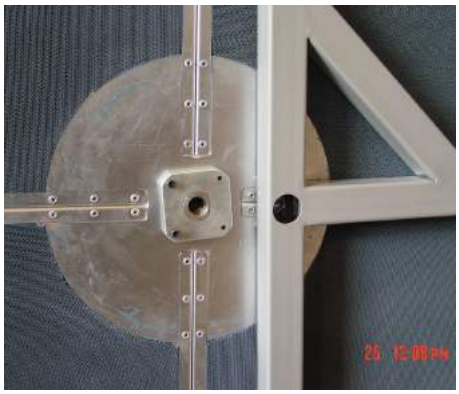
All seals can be removed from the cassette without removing the rotor. The plate type seals are riveted to the rotor perimeter structure with a stainless band, and it could be simply replaced by taking away the rivets and then re-rivet it. The P type seals are riveted to the metal frame of the cassette with a metal plate, it can be replaced same as the plate type seals. All imported seals are available from SAT.

Rotor removal and replacement

1. Secure the air handler and observe applicable safety precautions regarding confined

space entry and electrical tag out.

2. Determine if the rotor will be removed from the drive side of the cassette or the opposite side. If the rotor is to be removed from the drive side of the cassette and the drive system should be disassembled first.
3. It is better that to remove all seals prior to remove the rotor from the cassette.
4. Using a strong strap or some wooden spacers to suspend or support the rotor gently.
5. Loosen and remove both shaft end bolts at the central shaft of the rotor. Gently move the rotor a few distances towards the side it will be removed from. Slide the shaft and shaft spacer blocks out of the rotor.



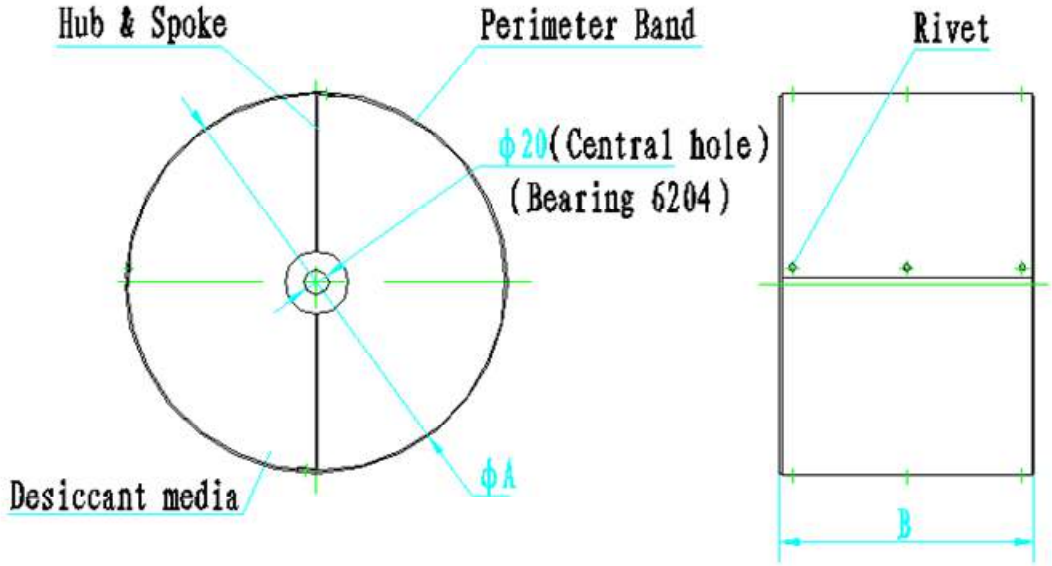
6. Put more wooden spacer blocks at the bottom of the cassette so that the rotor could be rolled out from the cassette carefully.
7. Replace the rotor using the reverse procedure. Be sure not to damage the rotor face.

Dehumidification Rotor General Arrangement

Rotor drawing and size table（D=200 mm& D=400 mm）

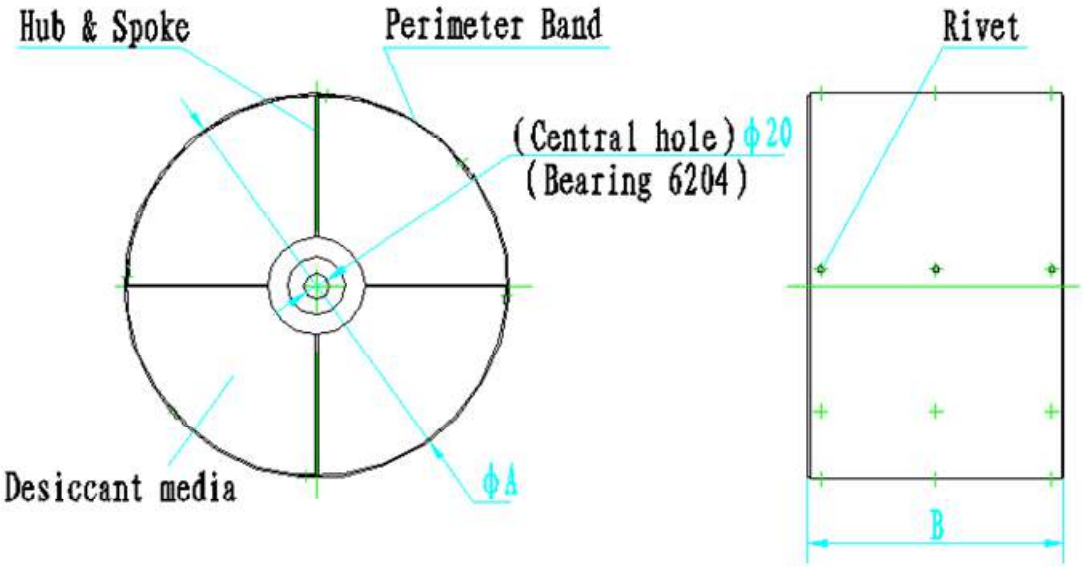
Two segment rotor

B	100、200、300、400
A	200、250、300、350、400、450、500、550



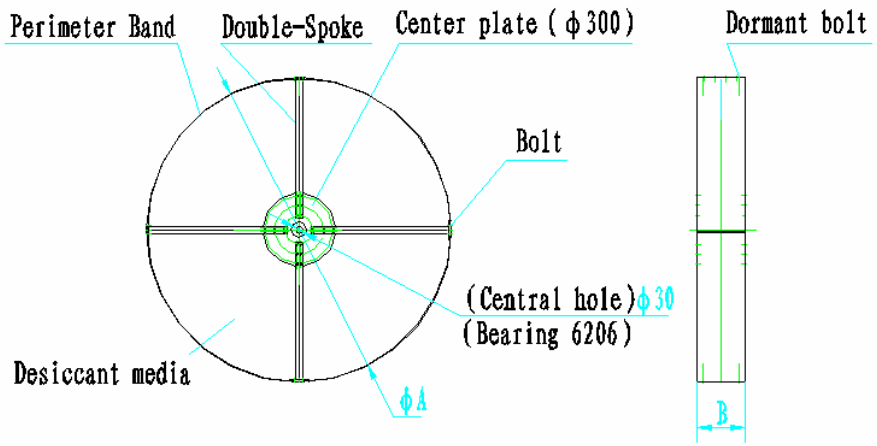
Four segment small rotor

B	200、300、400
A	600、650、700、750、770、800、850、900、950、965、1000、1050、1070



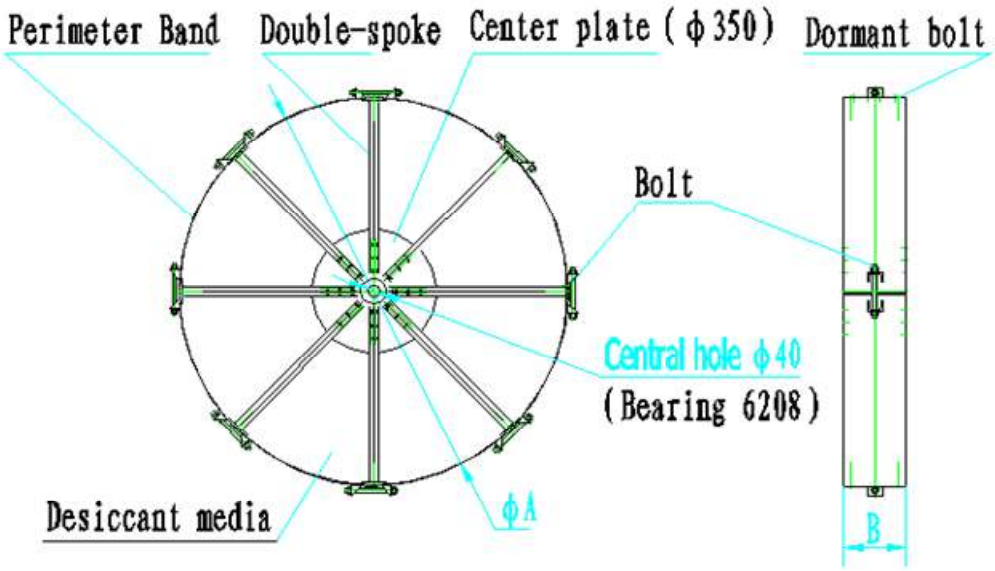
Four segment big rotor

B	200、400
A	1220、1250、1370、1500、1525



Eight segment big rotor

B	200 400
A	1730 、 1800、 1940、2000、2200、2438、2743、2896、3050

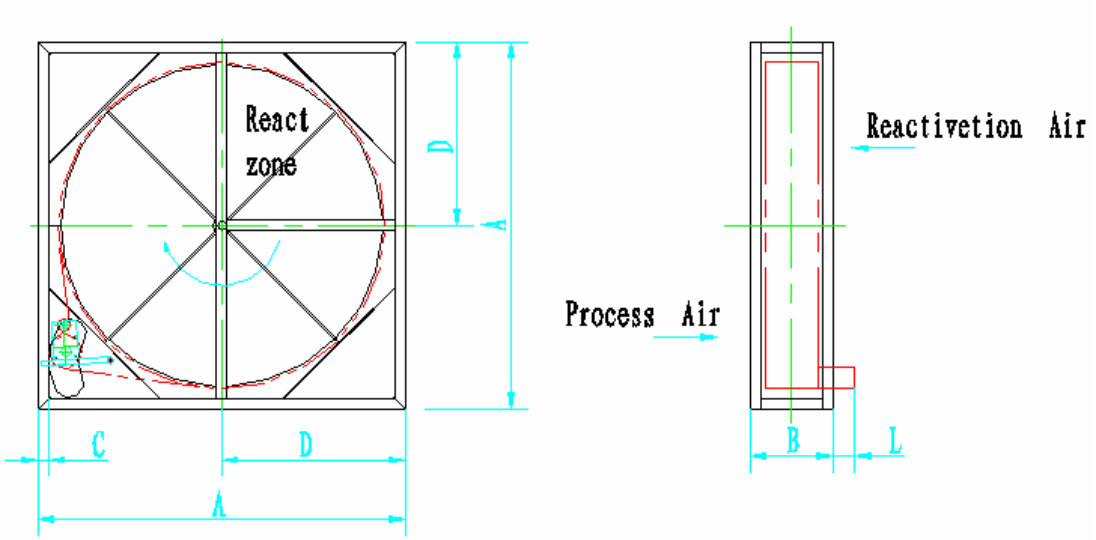


Dehumidification Rotor Cassette General Arrangement

Rotor cassette drawing and size table （T type and D=200 mm）

Small rotor cassette dimension

Rotor size	300	350	450	500	550	600	650	750	770	800	850	950	965	1050	1070	1220	1250
A	425	500	650	700	750	830	880	890	910	950	1050		1150	1200		1372	
B	291				311												
C	30				40												
D	213	250	325	350	375	415	440	445	455	475	525		575	600		686	
L	45				85				110							145	
Motor	3 phase 25 W				3 phase 40 W				3 phase 60 W							3 phase 90W	



Big rotor cassette dimension

Rotor size	1370	1500	1525	1730	1800	1940	2000
A	1570	1700	1750	1850	1950	2100	2180
B	331						
C	50						
L	145			223			
Motor	3 phase 90----100 W			3 phase 200W