



DRI... Never Too Far From You



- DRI Offices
- DRI Representatives

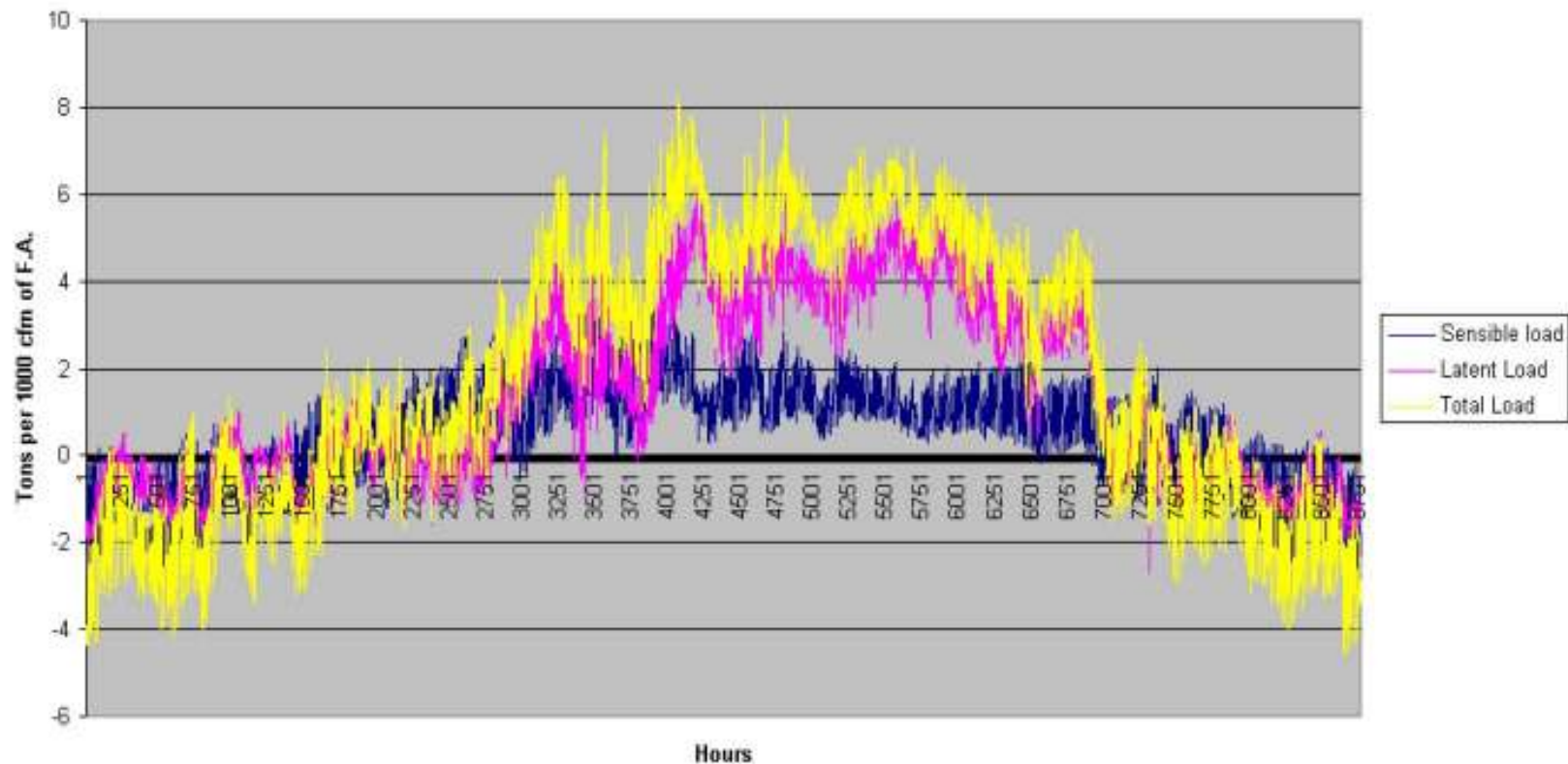


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VLI Load Profile

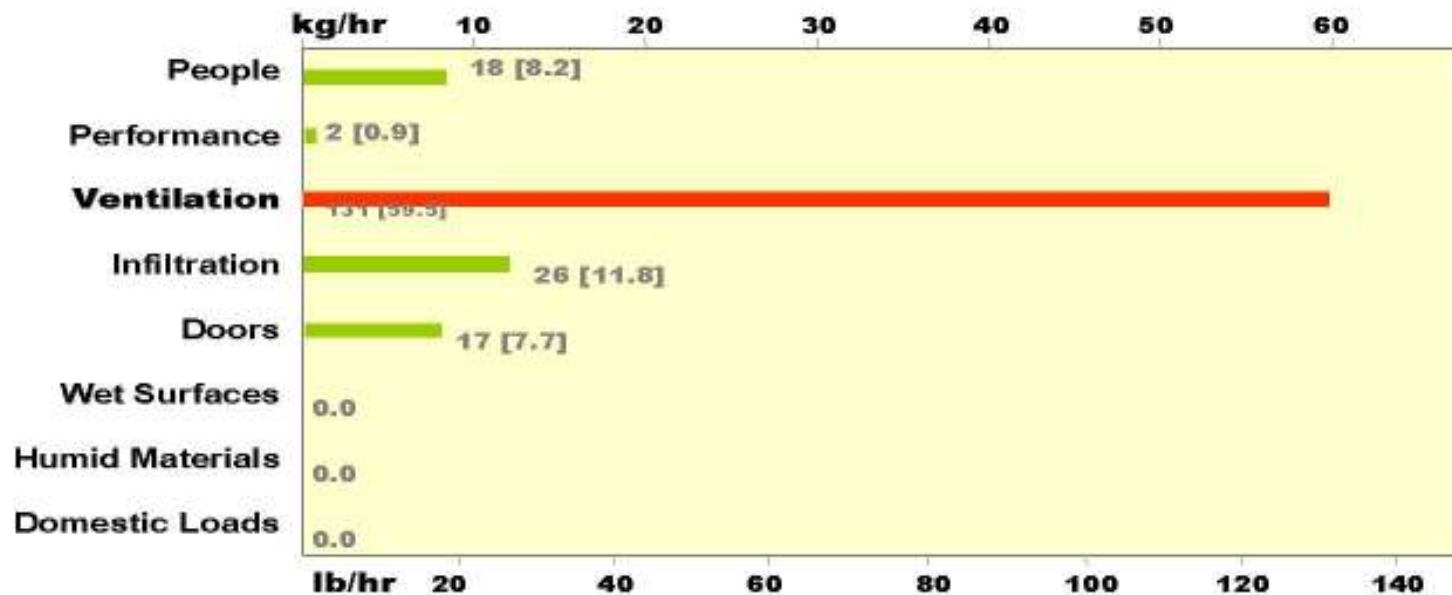
Ventilation Load Index – Ahmedabad



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Load Characteristics (Typical)



The largest moisture load in most commercial buildings comes from the ventilation air.

Medium sized retail store in : Atlanta

During : 0.4% dewpoint conditions

Source : Lewis Harriman





The Designer's Dilemma

- The conventional energy efficient building practices, resulted in construction of 'tighter' building spaces, using re-circulated air for ventilation. Poor design principles were employed to enable energy conservation in air-conditioned spaces, jeopardizing the health of the occupants.
- Fresh air ventilation runs contrary to the guidelines being followed by HVAC professionals. Higher fresh air ventilation needs translate into higher outdoor air changes per changes, which leads to more air-conditioning loads necessitating installation of higher capacity plants. This leads to higher initial cost and higher energy bills.
- The right humidity levels have to be maintained despite the increased ventilation rates and also to avoid expensive and inefficient solution like re-heat.
- New standards and increased awareness of the effect of IAQ on health necessitates the engineers and building designers conceptualize and provide cost effective *solution to indoor air quality requirements*.





Energy Recovery for cost effective IAQ

- Increased ventilation for IAQ translates as higher utility bills
- Need for effective management of energy systems
- Integrating energy recovery devices to air conditioning systems becomes imperative for meeting IAQ standards cost-effectively

AIR TO AIR HEAT EXCHANGE DEVICES LISTED ASHRAE EQUIPMENT HB 1988:

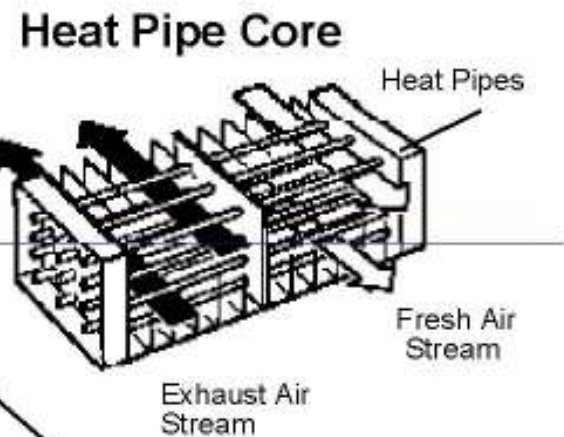
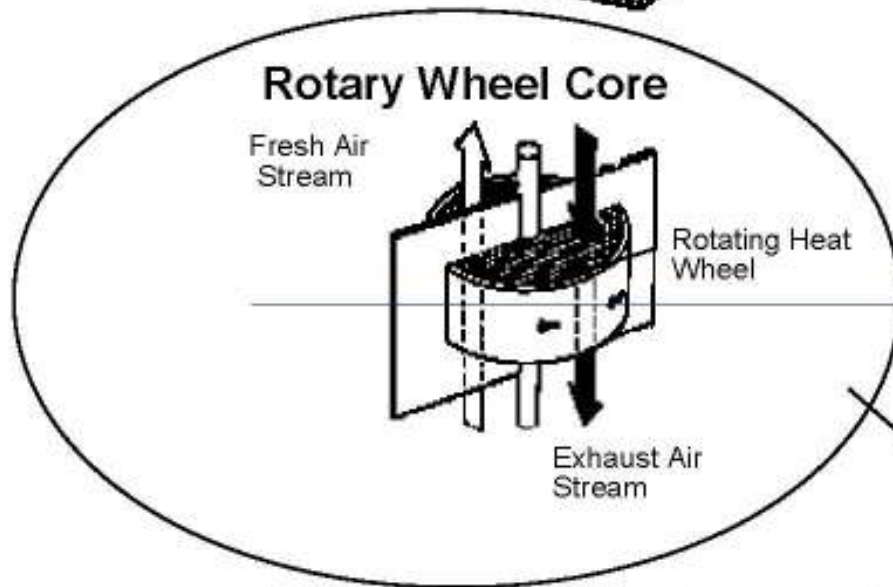
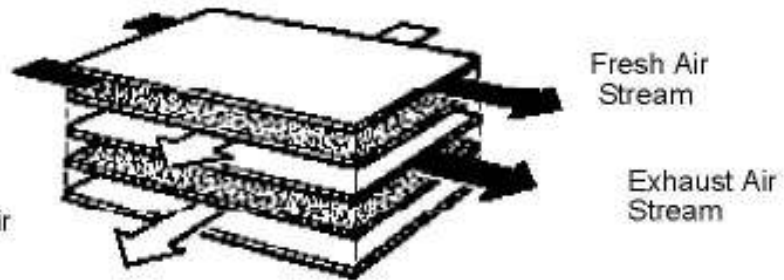
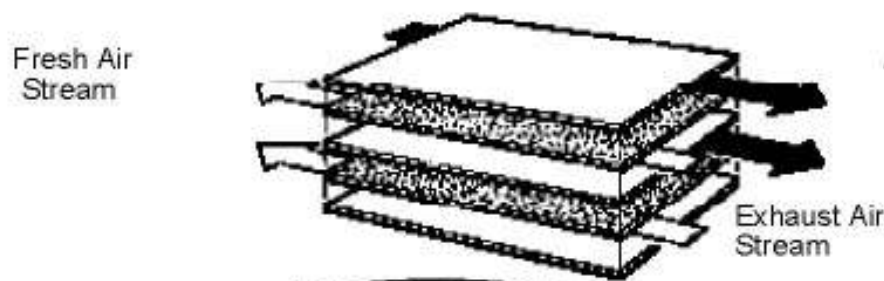
- Rotary Energy Exchangers
- Coil Energy Recovery Loop
- Twin-Tower Enthalpy Recovery Loop
- Heat Pipe Heat Exchangers
- Fixed Plate Exchangers
- Thermo-Syphon Heat Exchangers





Heat Recovery Technologies

Flat Plate Core (Counter Flow) Flat Plate Core (Cross Flow)



Most Effective Technology for Total Energy Recovery





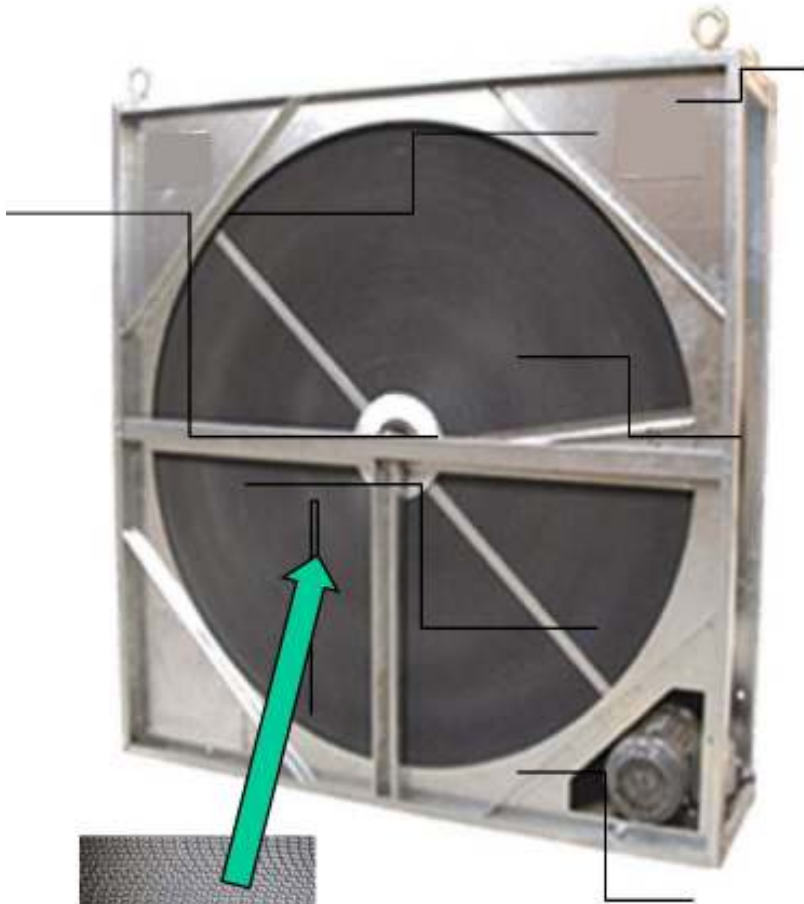
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Enthalpy Wheels



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Wheel Terms



Cassette Casing

Rotor

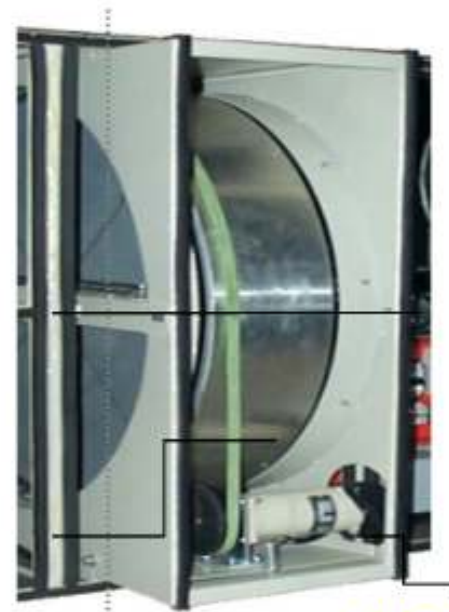
Purge

Bearing

Spoke

Motor

Media



Belt

Motor

Spoke

Ri

m



Hub



Enthalpy Wheels

The energy recovery wheel also has the additional advantage of being the only unit to deliver latent transfer efficiently. With the fresh air load patterns in India being highly latent in nature and also, that there is a need to maintain a lower humidity in the conditioned space, we shall focus on an energy recovery ventilator with enthalpy wheel.

The enthalpy wheel is perfectly suited to help control humidity. In summer when the outside is hot and humid the enthalpy wheel is able to cool and dehumidify the incoming fresh air and in winter when it cold and dry outside it is able to heat and humidify.





Enthalpy Wheels . . . *contd.*

The enthalpy wheels with low first cost and maximum energy savings combine to give an extremely low payback. With the help of enthalpy wheels one can easily down size the installed air-conditioning equipment and can also result in negative pay back in many cases. Before we go into details of Energy recovery Ventilators it is important to understand the load patterns of our country. One useful way is to check the “Ventilation Load Index” of various cities.

Other advantages:

- Increases the SHF making it simple for cooling coil to handle the thermal load
- Would mean higher ADP's hence higher CHW temperatures.
- Low row deeps of cooling coils
- Avoid re-heat.





An Overview

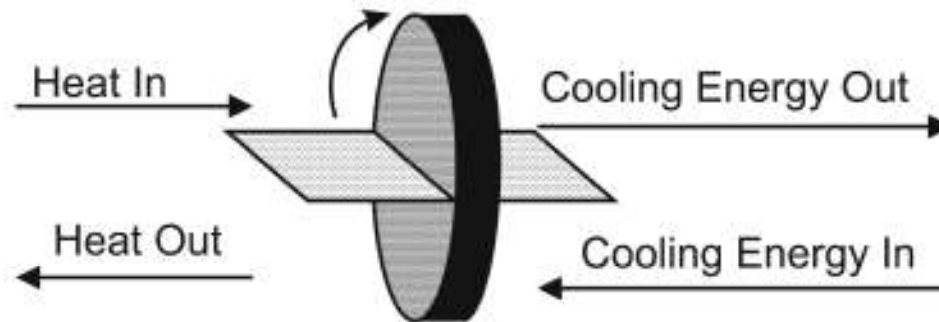
- Today, Indoor Air Quality (IAQ) is an important criteria in design of HVAC systems.
- HVAC designers, contractors & consultants are all opting for more ventilation while designing the building.
- Energy Recovery has thus become a key parameter.
- Energy Recovery Wheels provide a cost effective solution



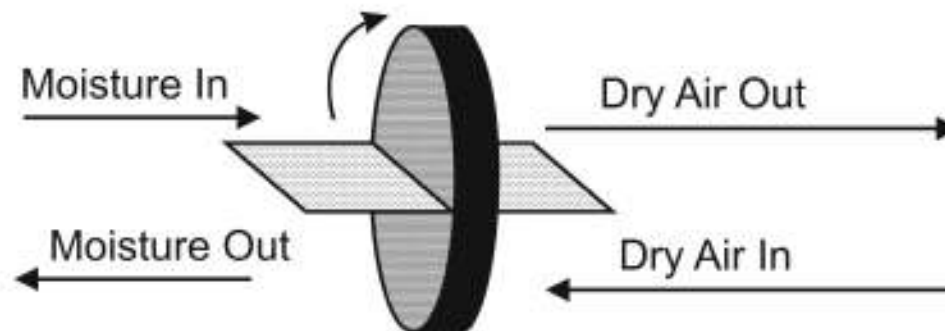


Universal Rules of Total Energy Wheels

1. Heating/Cooling Energy (e.g. 80%) Is Always Returned To Where It Came From



2. Moisture and Dry Air (e.g. 80%) Is Always Returned To Where It Came From





Advantage with **ECO**FRESH™ Wheel

- **EcoFresh Molecular Sieve MS 3Å** is recommended where there is a need to limit the cross contamination to absolute minimum and ensure exclusion of contaminants in the air streams, while transferring water vapour molecules.
- **EcoFresh** heat wheels are **ARI certified** with 100% Success Rate Performance Award for 7 consecutive years.
- **Certified for Zero Microbial Growth:** **EcoFresh** Wheels are specially treated for prevention of any microbial growth on its surface and are certified by Shriram Labs. As per the DIN EN ISO 846 standard, showing 0% fungi and bacterial growth.
- **Certified for Zero Flame Spread:** DRI conforms to NFPA-90A certification for 0% Flame spread classification and is tested in accordance with NFPA 225 and ASTM-E84-95 Standard Test Method for Surface Burning.



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Cross Contamination

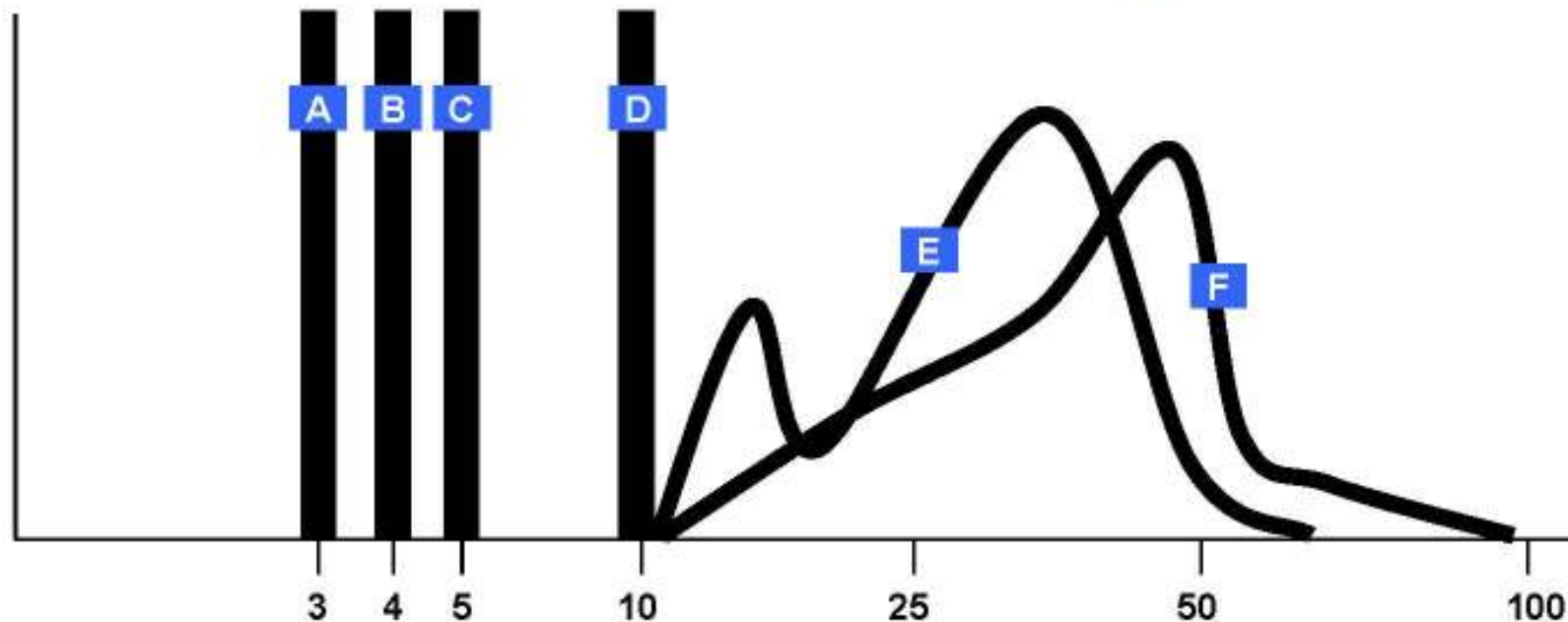
- Contaminants from Exhaust Air Stream are “Carried Over” to Supply Air Stream
- Can be Caused by the Following:
 - Desiccant Carry Over
 - Seal Bypass
 - Media Carry Over
 - Improper Air Flow Configuration
 - Exhaust discharge to outside air re-entrainment

***EcoFresh 3Å* Molecular Sieve Coated HRW ensures almost zero cross contamination**





Variations in Pore Diameter among Desiccants



Pore Diameter in Angstroms (Å)

A - 3Å Molecular Sieve
B - 4Å Molecular Sieve
C - 5 Å Molecular Sieve

D - 10Å Molecular Sieve
E - Activated Alumina
F - Silica Gel

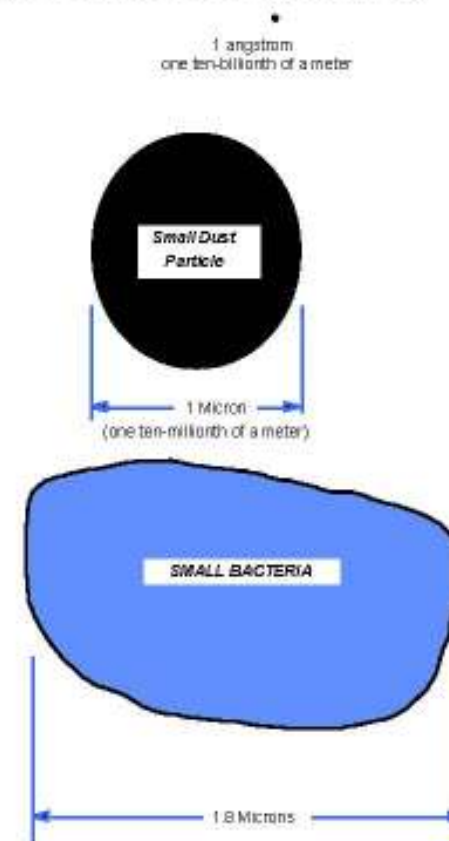




Relative Particle Sizes

Relative sizes of Various Materials in Angstroms	
Item	Size (Å)
Hair	15000
Bacteria	340-10000
Viruses	160-270
Chloroform	6.9
Toluene	6.7
Propylene	5.0
Ethanol	4.4
Methane	4.0
Ammonia	3.6
Water	2.8
Oxygen	2.8

Particle Size vs Molecular Size (microns vs angstroms)





Critical Diameters of Various Molecules

All Diameters Expressed in Angstrom Units

Helium	2.0	Propane, nC ₄ to nC ₂₂	4.9
Hydrogen, acetylene	2.4	Propylene	5.0
Water, oxygen, carbon monoxide		Ethyl-mercaptan, butene 1, butene 2 trans	5.1
carbon dioxide	2.8	Difluorochloromethane (R 22)	5.3
Nitrogen	3.0	Iso C ₂₂	5.6
Ammonia, hydrogen sulfide	3.6	Cyclohexane	6.1
Argon	3.8	Toluene, paraxylene	6.7
Methane	4.0	Benzene	6.8
Ethylene, ethylene monoxide	4.2	Carbon tetrachloride	6.9
Ethane, methanol, ethanol	4.4	Methaxylene	7.1
Methyl-mercaptan	4.5	Tri-ethylamine	8.4

The possibility of adsorption depends not only on the dimension and the shape of the molecules (linear, ramified, cyclic...) but also on their polarity.

If there is no steric hindrance the molecules are preferentially adsorbed when their polarity is well pronounced.

Adsorption increasing ↑

- H₂O
- NH₃
- CH₃, OH, alcohol, aldehydes, ketones
- SO₂
- H₂S, mercaptans
- Alcynes
- CO₂
- Alcanes
- CH₄
- CO





Pillow Block Bearings

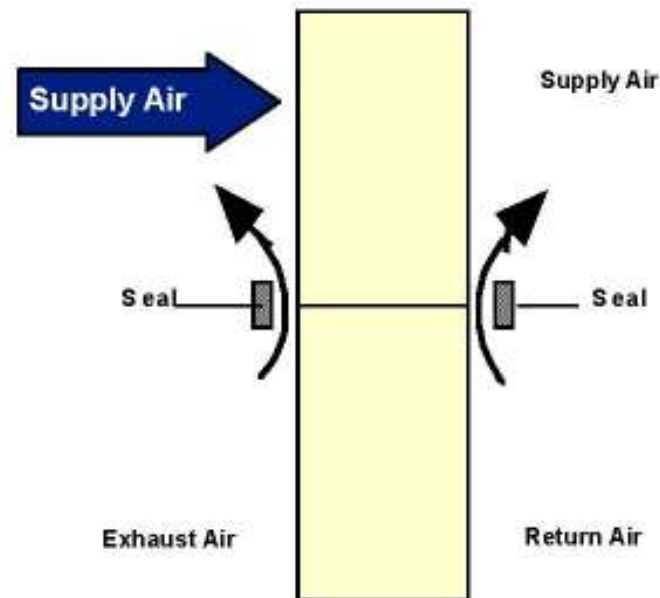


In-Board Bearings





Seal Bypass



Due to differential pressure between supply and exhaust air streams, air can bypass seals, causing cross contamination.

EcoFresh 3A MS Coated HRW uses specially designed 4 pass Labyrinth Seal to eliminate any seal bypass.

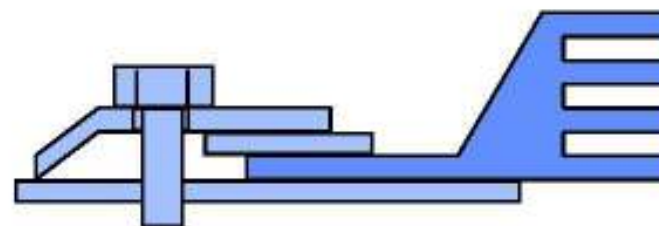
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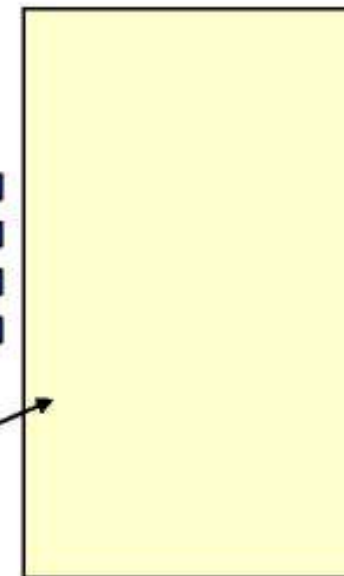


Four-Pass Labyrinth Seal

Theory of Operation - Channels in Labyrinth Seal create areas of high pressure differential, effectively acting as a barrier to Bypass.

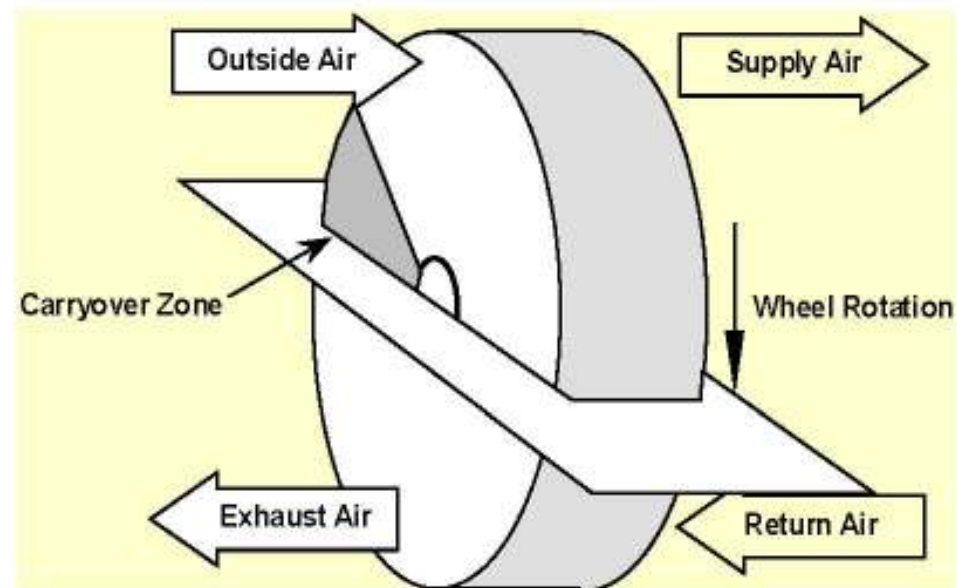


Surface of Wheel





Media Carry Over



Due to the fixed volume of air being transferred as the wheel rotates, cross contamination of the air streams occurs.

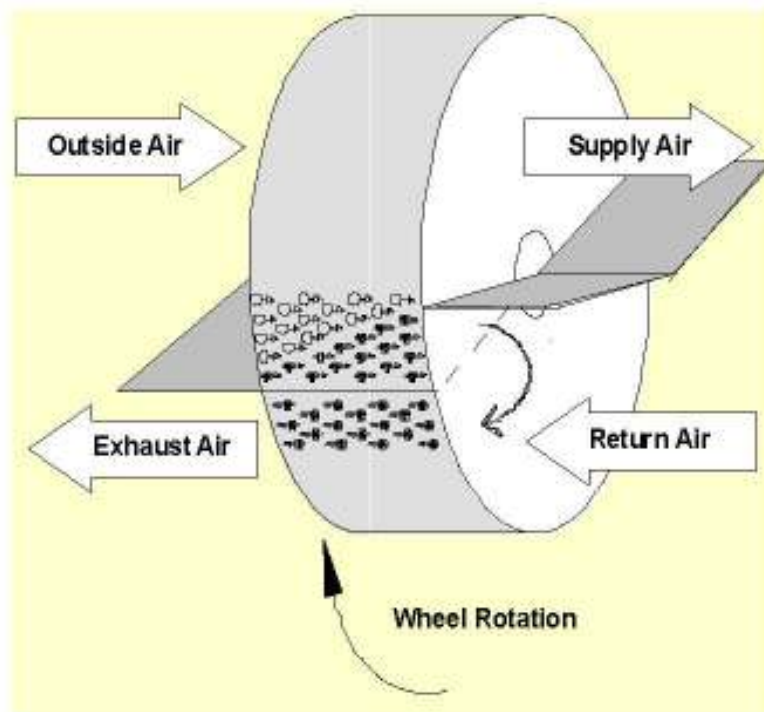
EcoFresh 3A MS Coated HRW has a factory-fitted Purge Sector which can be site-adjusted, thereby eliminating Media Carry Over.





Illustration of Wheel Purge Section

Theory of Operation - A specific volume of air is allowed to bypass into exhaust air stream, minimizing carryover of contaminants from return air.

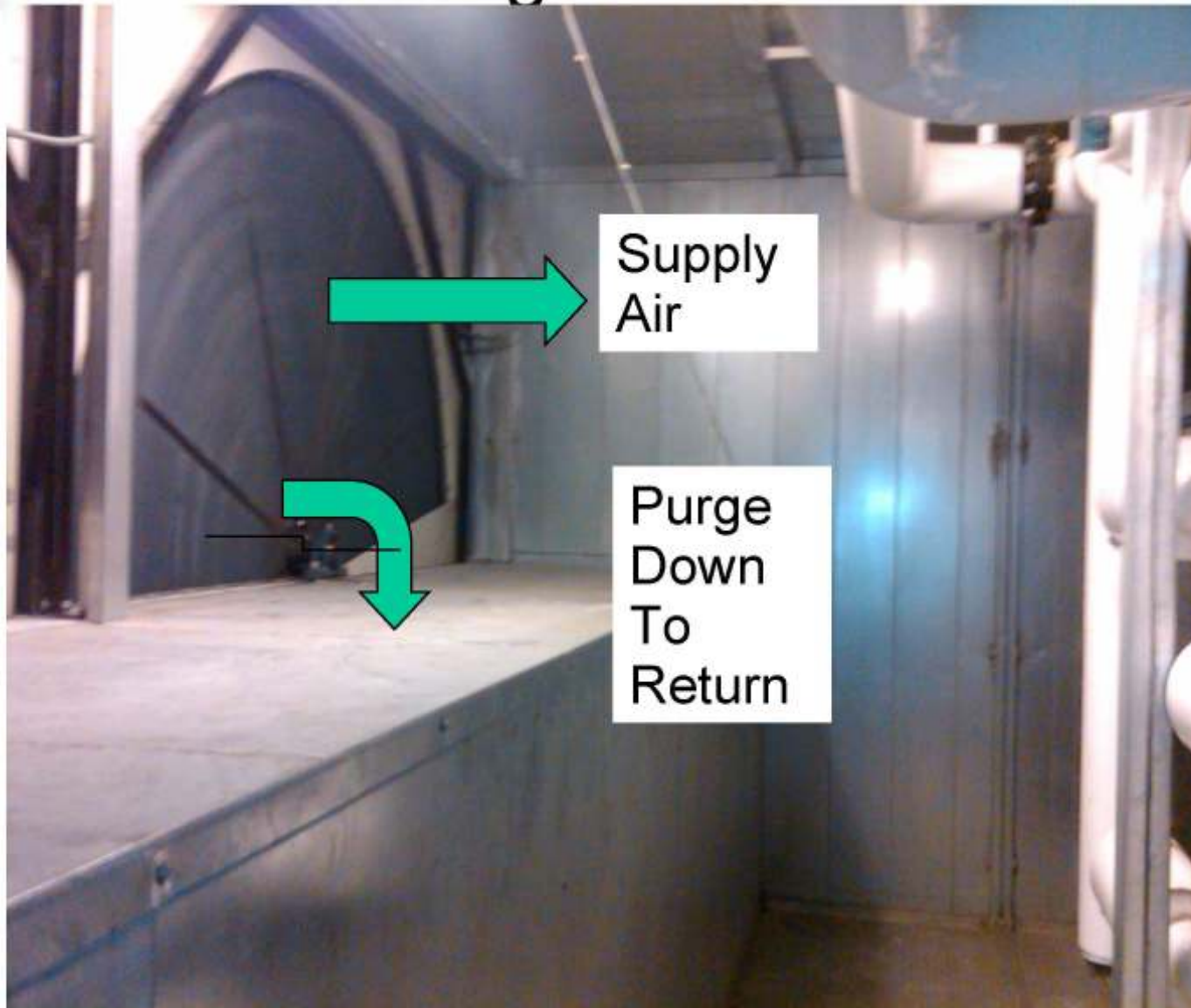


Purge angle is a function of air velocity, and purge volume is a function of wheel volume and rotation speed.





Purge Sector



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Monolithic Rotors:

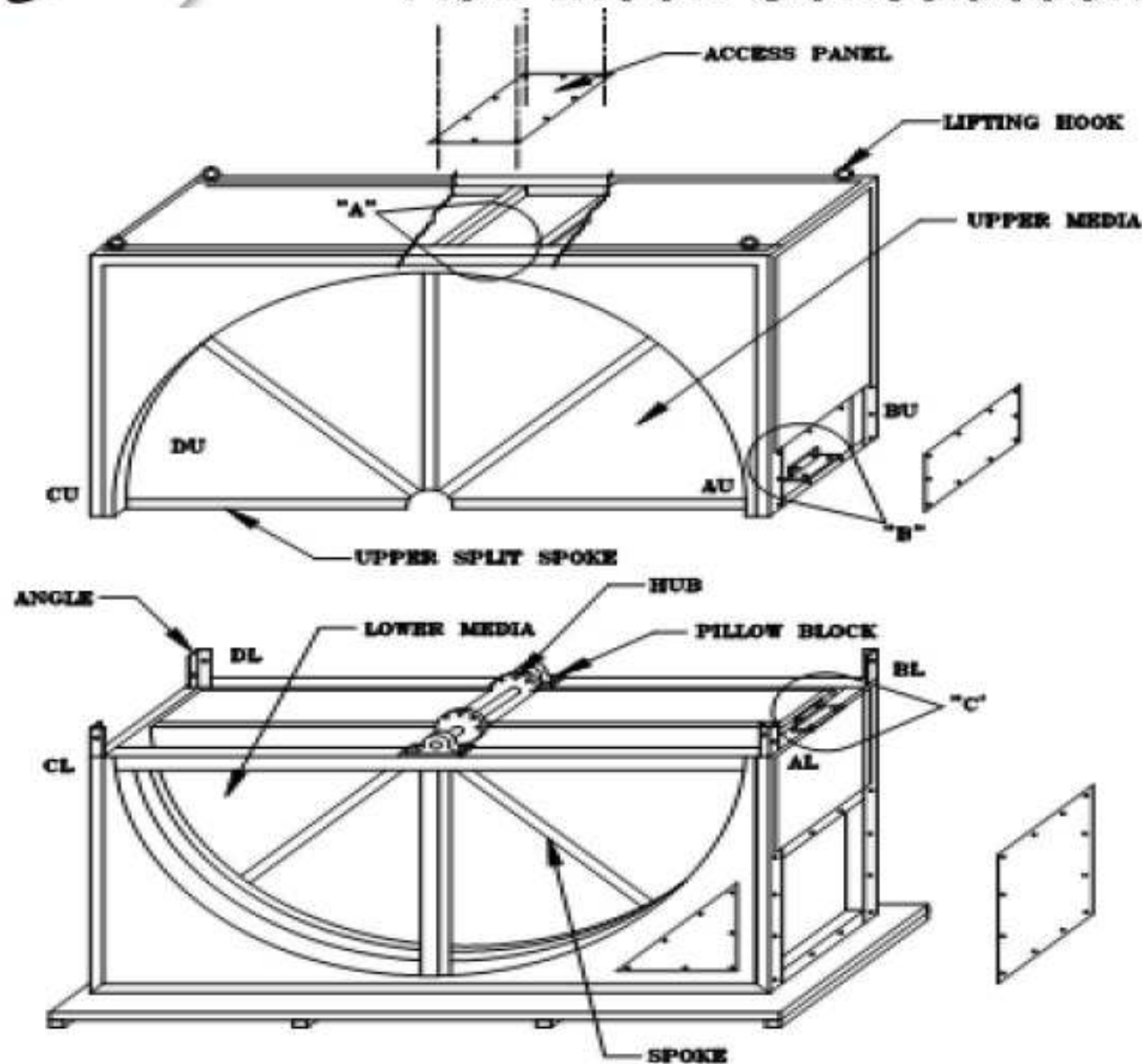


- *Folded Sheet Metal*
- *Rotor in One Piece*
- *< 2200mm (88")*
- *Labyrinth or Brush Seals*
- *Lowest First Cost*





Half Moon Construction



All Rotors
Over
2000mm will
have
Half Moon
Construction





www.drirotors.com

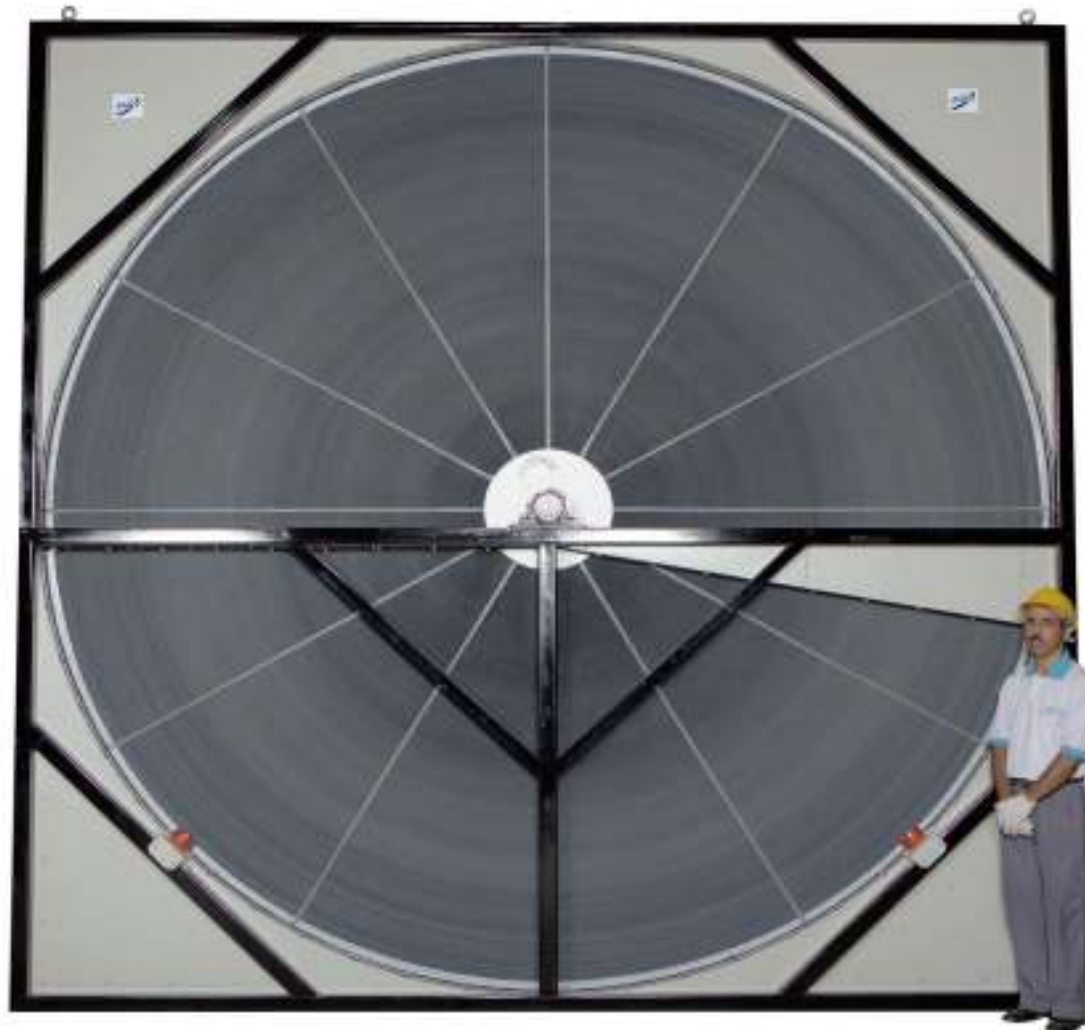
90,000 CFM Parallel Rotors



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www.drirotors.com

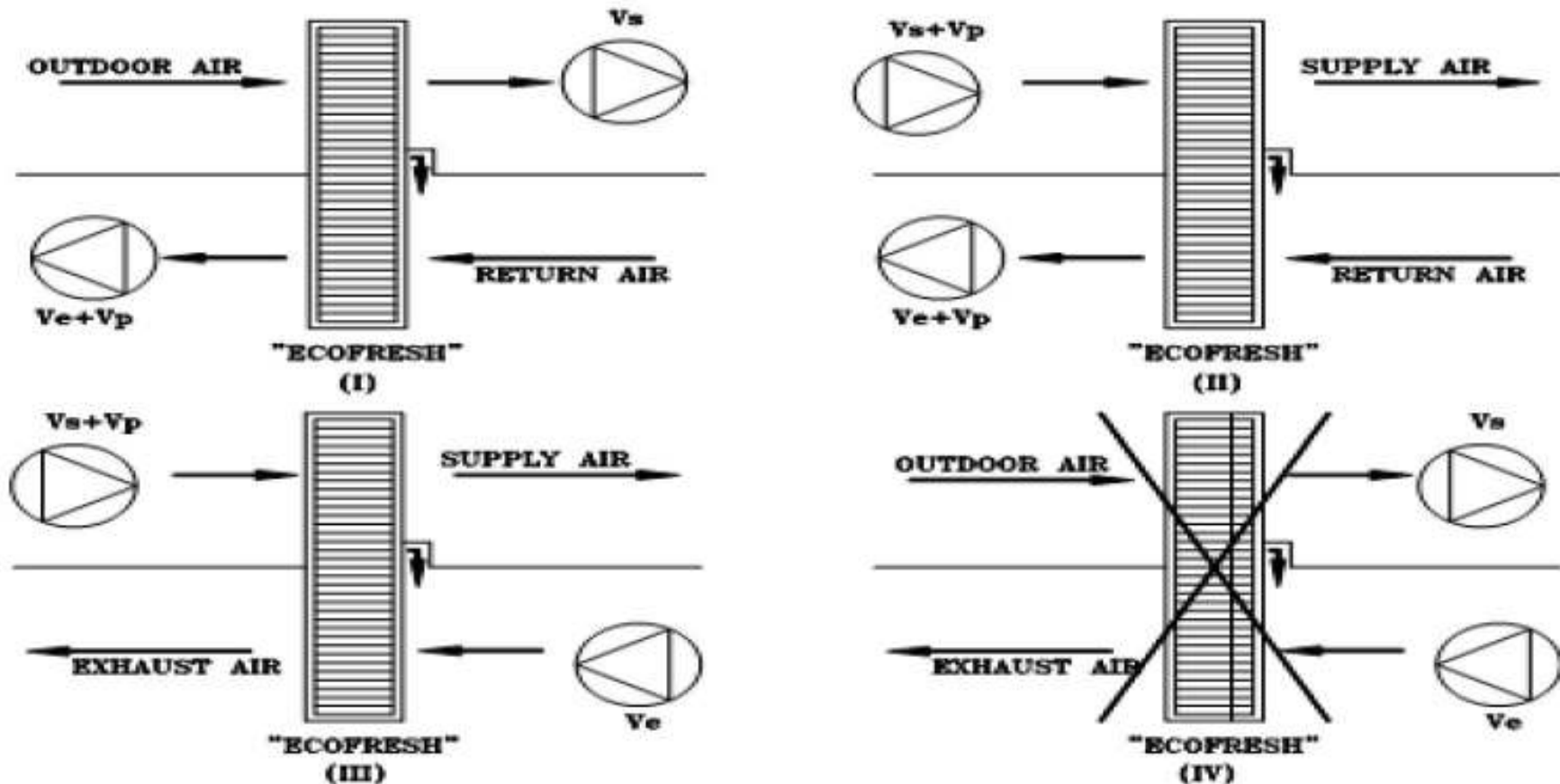


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Fan Configurations

www.drirotors.com



V_p : PURGE AIR VOLUME
 V_s : SUPPLY AIR VOLUME
 V_e : EXHAUST AIR VOLUME

FIG # 9
BLOWER LOCATIONS



Agency Certifications

- NFPA/ASTM
- NFPA 90A (Fire Ratings)
- Eurovent
- Eurovent 8/C/002-2004
- AHRI (Air Conditioning & Refrigeration Institute)
- AHRI Standard 1060
- DRI is the only Wheel Company to Carry both AHRI & Eurovent Certifications





Ecosorb, the Desiccant Synthesized in Ecofresh Rotors is

Bacteria-static

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 Address: **SHRI ROTORS (INDIA) PRIVATE LIMITED, PLOT NO. 10, SECTOR 17, GATEWAY INDUSTRIAL ESTATE, GURGAON, HARYANA**
 Date: **11/11/2011**

TEST RESULTS

1. **Test Method / Protocol** : As per specification IS 9001:2008

2. **Test Method / Protocol**

Test Method / Protocol	ASIS 9001
Test Method / Protocol	ASIS 1771
Test Method / Protocol	ASIS 9008
Test Method / Protocol	ASIS 9001
Test Method / Protocol	ASIS 9001

3. **Test Results**

Test Results	Pass
Test Results	Pass
Test Results	Pass
Test Results	Pass

4. **Remarks**

The results of the investigation carried out according to the ISIRI: 2011 (ISIRI:2011) are summarized below:

Sl. No.	Remarks	Pass	Fail
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2	As per specification IS 1771:2007	Pass	Fail
3	As per specification IS 9008:2008	Pass	Fail
4	As per specification IS 9001:2008	Pass	Fail
5	As per specification IS 9001:2008	Pass	Fail

Client Report No. 2010 Page 1 of 1

Shriram
 Director (QA) / Head of Quality Control

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Shriram
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Energy Recovery Ventilators



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What is an ERV?

An energy recovery ventilator (ERV) is a type of mechanical equipment that features a heat exchanger combined with a ventilation system for providing controlled ventilation into a building.



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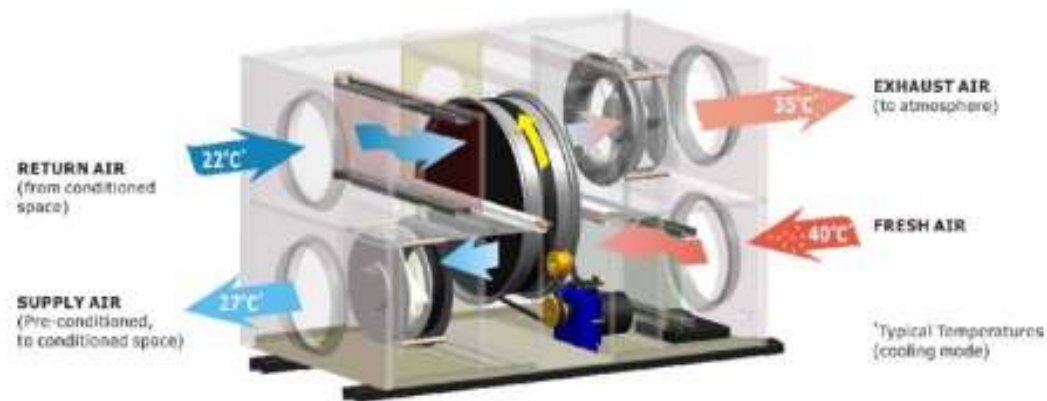
How does the **ECO-FRESH™** ERVi work?

- An ERVi exchanges the contaminated room air with fresh outdoor air, in the process recovering more than 65% of the energy from the exhaust air stream.
- The energy recovery wheel slowly rotates (@ 20 RPM) between the two counter flowing exhaust and supply air streams pickings up the sensible and latent heat from the cooler air stream and transferring to the warmer air stream or vice versa depending on the conditions.
- The energy recovery ventilator consists of two blowers and a energy recovery wheel. The two blowers run continuously to exhaust the room air and replace it with an equal amount of fresh outdoor air.





Design your Air with Energy Recovery Ventilators (ERVs) for Fresh & Healthier 'In'vironment



SOLUTION TO POLLUTION IS DILUTION

Redesign or Maintain Your IAQ (Indoor Air Quality) with  ERVs

Maintaining IAQ in



BPOs / Call Centers / Office Buildings



Conference / Meeting Rooms



Hospitals / Healthcare facilities



Schools / Institutions



Supermarkets / Retail Stores



Restaurants / Bars / Discotheques



Gymnasiums / Recreation Centres



Movie Theatres / Auditoriums

... And all other air-conditioned spaces !

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Advantages of ERVi

- Helps Designers, Contractors and Building Owners and Operators to Meet IAQ Standard ASHRAE 62.1.2001 and Conserve Energy
- Enable ASHRAE 62.1.2001 specified Ventilation rates with out Increasing Air conditioning Tonnage
- Reduces the CAPITAL AND OPERATING COST of Air-conditioning Equipment
- Ideal for New Construction or Retrofit Applications
- Meets Space Limitation Requirements/ (Could be Installed in the False Ceiling Area)





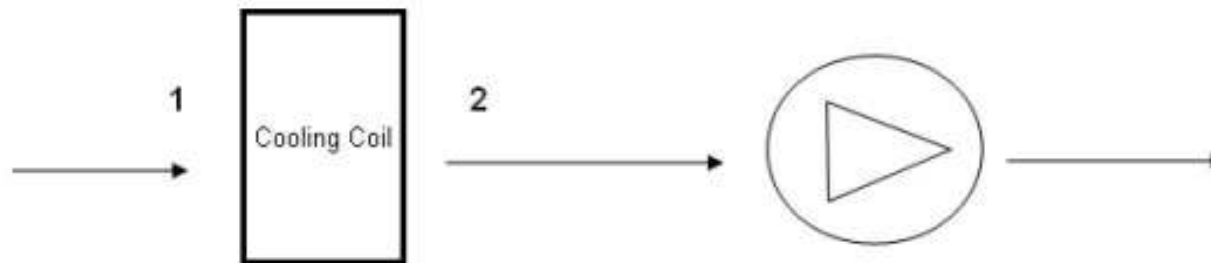
Applications

- Health Care :-** Nursing Homes, Hospitals, Clinics, Specialty Centers, Clinical Labs. etc.
- Entertainment :-** Cinema Halls, Multiplexes, Discotheques etc.
- Hospitality :-** Hotels, Restaurants, Pubs, Banquet Halls, Fast - Food centers etc.
- Commercial :-** Offices, Banks, IT complexes, Conference Halls etc.
- Places of assembly :-** Schools, Temples, Educational Instt., Supermarkets, Showrooms etc.
- Miscellaneous :-** Beauty Parlours, Gymnasiums etc.





Schedule of DOAS System with Cooling Coil

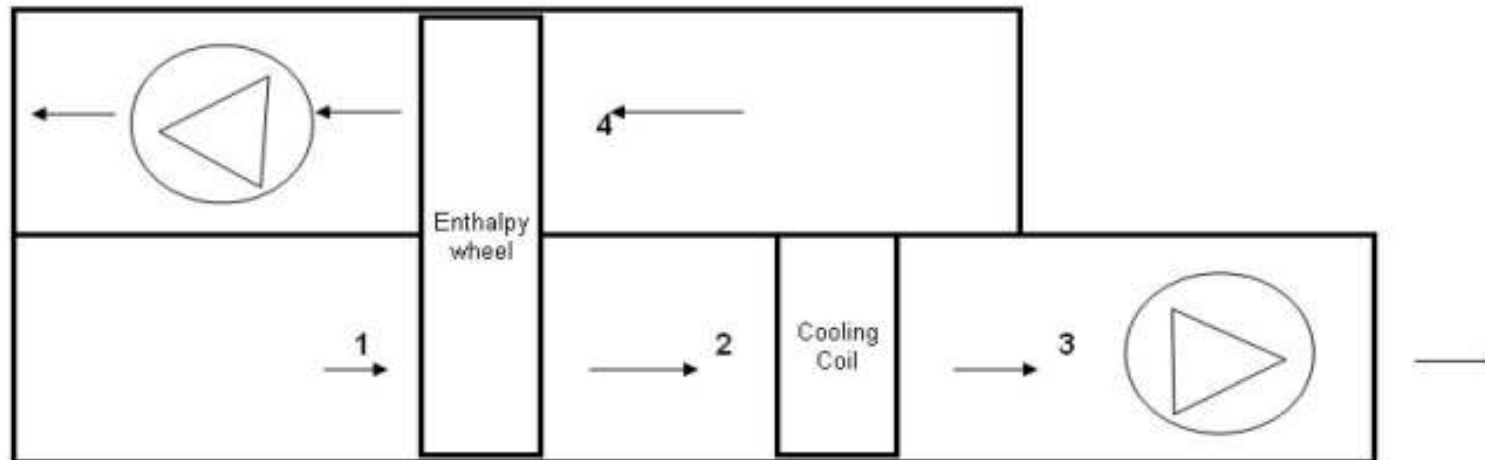


S.No.	Air Flow cfm	1			2			Cooling Coil Capacity	
		Outdoor Air Conditions			Supply Air Conditions			Sensible Load (TR)	Total Load (TR)
		DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb		
1	1000	115	142.9	50.35	55	64	23.12	5.40	10.10





Schedule of DOAS with Enthalpy Wheel and Cooling Coil



S.No.	Air Flow cfm	1			2			3			4		
		Outdoor Air Conditions			Off heat pipe Air Conditions			Supply Air Conditions			Return Air Conditions		
		DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb
1	1000	115	142.9	50.35	86.5	87.82	34.57	55	64	23.12	77	69.46	29.36

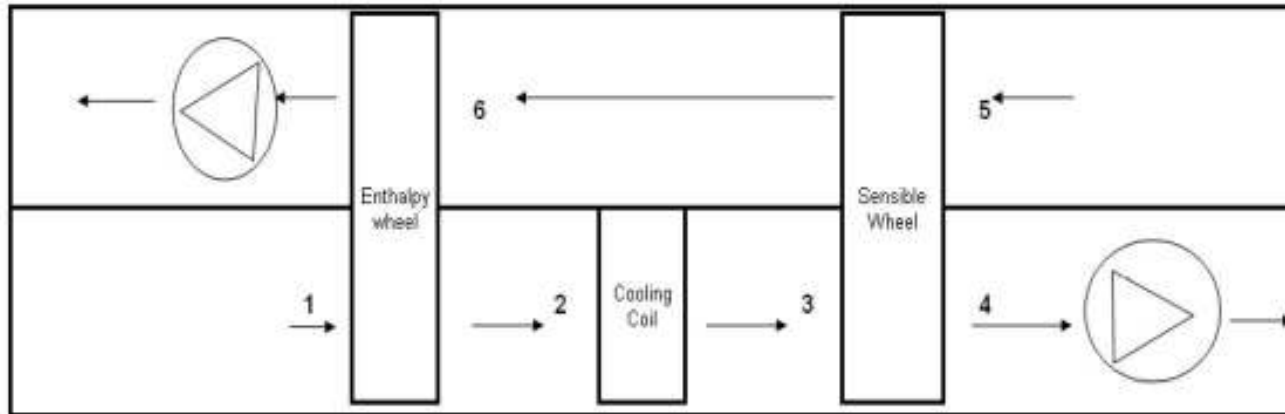
Cooling Coil	
Sensible Load (TR)	Total Load (TR)
2.84	4.25

Note : Heat Recovery wheel Efficiency is 75%





Schedule of DOAS with Enthalpy Wheel, Cooling Coil and Sensible Wheel



S.No.	Air Flow cfm	1			2			3			4			5			6		
		Outdoor Air Conditions			Off Wheel Air Conditions			Off coil Conditions			Supply air Conditions			Return air Conditions			Return air on EW Conditions		
		DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb
1	1000	115	142.9	50.35	74.95	87.82	31.72	55	64	23.12	70.4	64	26.69	77	69.46	29.36	61.6	69.46	25.58

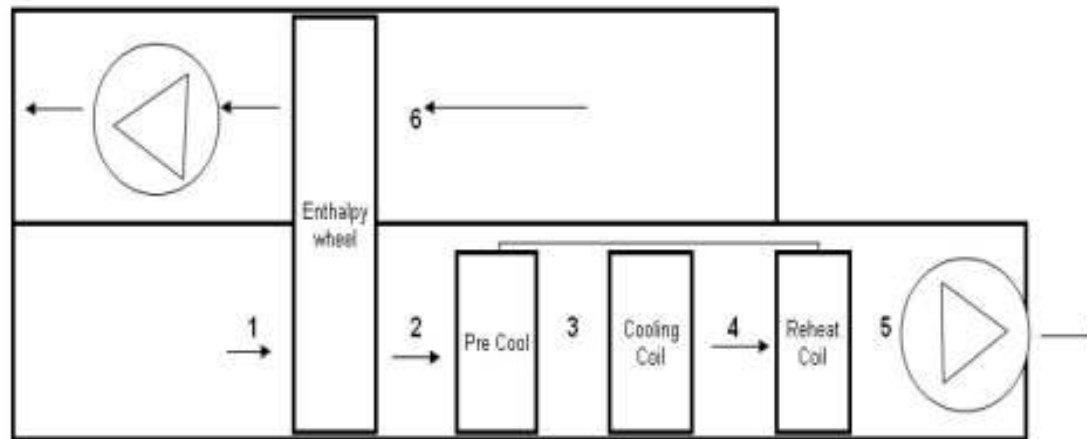
Cooling Coil	
Sensible Load (TR)	Total Load (TR)
1.80	3.19

Note : Enthalpy Wheel Efficiency is 75%
Sensible Wheel Efficiency is 70%





Schedule of DOAS with Enthalpy Wheel and Wrap around pipe



S.No.	Air Flow cfm	1			2			3			4			5			6		
		Outdoor Air Conditions			Off Wheel Air Conditions			On coil Conditions			Off coil Conditions			Supply air Conditions			Return air Conditions		
		DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb
1	1000	115	142.9	50.35	86.5	87.82	34.57	77.05	87.82	32.24	55	64	23.12	64.45	64	25.43	77	69.46	29.36

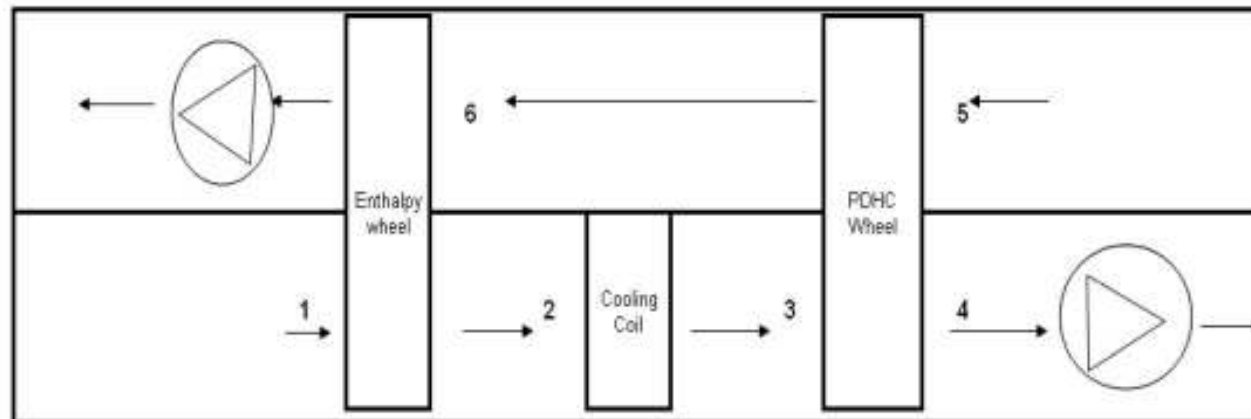
wrap around pipe		
Pre cool (TR)	Pre Heat (TR)	Total Load (TR)
0.85	0.85	3.38

Note : Wheel Efficiency is 75%
Wrap around heat pipe Efficiency is 30%





Schedule of DOAS with Enthalpy Wheel, Cooling Coil and Passive Desiccant Wheel



S.No.	Air Flow cfm	1			2			3			4			5			6		
		Outdoor Air Conditions			Off Wheel Air Conditions			Off coil Conditions			Supply air Conditions			Return air Conditions			Return air on EW Conditions		
		DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb	DBT °F	grs/lb	Btu/lb
1	1000	115	142.9	50.35	80.5	97.57	34.62	60.64	77	26.52	68.64	64	26.54	77	69.46	29.36	69	82.46	29.42

Cooling Coil	
Sensible Load (TR)	Total Load (TR)
1.79	3.00

Note : Enthalpy Wheel Efficiency is 75%
 PDHC Wheel grain depression 13 gr/lbs & Temp rise 8°F





**Design Data for Different DOAS Systems at Abu Dhabi Conditions
Supply Air Flow – 1000 CFM**

S.No.	Arrangement	Description	CC Load (Tons)	Total Kw
1	CC	Cooling Coil	10.1	12.12
2	EW+CC	Enthalpy Wheel + Cooling Coil	4.25	5.1
3	EW+wrap around heat pipe	Enthalpy Wheel + Wrap around heat pipe	3.38	4.06
4	EW+CC+SW	Enthalpy Wheel + Cooling Coil + Sensible	3.19	3.83
5	EW+CC+PDHC	Enthalpy Wheel + Cooling Coil + PDHC	3	2.85

* Kw/Tr For S.No. 1 to 5 is 1.2 & 6 is 0.95

Design Data

Outdoor Condition	Abu Dhabi – 115° F DBT, 142.9 grs/lb, 50.35 Btu/#
Return Air Conditions	77° F DBT, 50% RH





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 **G3MA PASSIVE**
DESICCANT DEHUMIDIFICATION WHEEL
(Patent Pending)



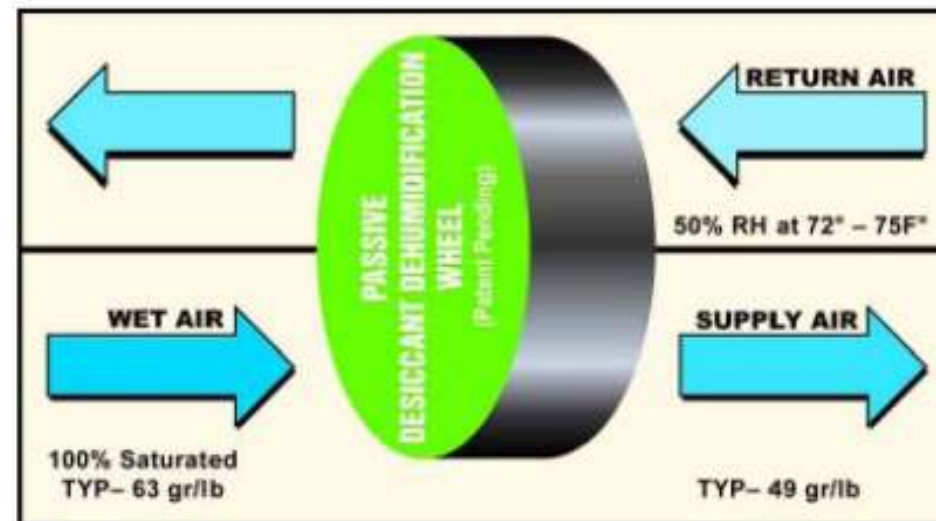
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Contd...

The unique G3MA “Passive” Desiccant Dehumidification Wheel (patent pending) has the ability to be regenerated with the 50% RH room return air allowing for substantial moisture removal through dehumidification of the fresh air being supplied to the room.

Typical Example





Advantage with G3MA “Passive” Wheel

(Patent Pending)

- Removes moisture from a saturated air stream without heat/thermal regeneration
- High performance in -situ synthesized desiccant
- Fully water washable
- 100% non-flammable
- No washing away of desiccant on continued exposure to saturated/wet air



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Green Building

A green building is an environmentally sustainable building-designed, constructed and operated to minimize the total environmental impacts.

The main strategy to achieve a green building status includes:

- **Reduced energy consumption**
- **Better IEQ (Indoor Environmental Quality)**
- **Water conservation**
- **Recycling waste**





LEED

- LEED (Leadership in Energy & Environmental design) is a “Green Building Rating System” which attempts to certify and push the advancement of a global implementation of green buildings and development standards.
- Under LEED extra points can be gained by increasing the Fresh Air Quantity by at least 30% above the minimum rates required by ASHRAE standard 62% 2007 as determined by EQ-requisite 1.





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Green Buildings with DRI Products



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DRI proud to be associated with Beijing 2008

Beijing 2008 showcased the best in technology, infrastructure, facilities, and of course sportsmanship, creating an indelible mark in history setting standards for future display.

DRI provided Indoor Air Quality management products and solutions for various Olympics venues namely Beijing Shooting Gallery, Beijing Airport, Beijing University Gymnasium, the Stated Conference Center etc. to name a few.





University of the South's Sewanee's, USA

DRI has supplied its EcoFresh Heat Recovery Wheels (HRWs) to the building to optimize energy performance of the air conditioning systems resulting in:

- *considerable reduction in installed tonnage*
- *reduction in utility bills for entire life cycle*
- *enhanced IAQ and productivity and reduced health risks*



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Malaysia Energy Centre, Malaysia

DRI is proud of its association with Malaysia Energy Centre Project. This landmark GEO building is a pilot project and a demonstrator to mark another milestone towards greater promotion and adoption of sustainable building concept in the Malaysian building sector.



DRI has installed EcoFresh Heat Recovery Wheels at the Building which recover total energy (sensible as well as latent) to meet all the requirements of Indoor Air Quality (IAQ), humidity control and energy savings.





Health & Science Building at the College of DuPage, USA



The Health and Science Center at the College of DuPage opted for DRI HRWs to achieve acceptable IAQ while minimizing energy costs. The building utilizes two 95,000 CFM custom AHUs manufactured by TMI. Each AHU utilizes two DRI EcoFresh HRWs-132 mounted in a side by side configuration.





Pacific Controls, Dubai, UAE



Pacific Controls, Dubai

DRI supplied 4 Heat Recovery Wheels (HRWs) for 2 FAHU at Pacific Controls, the first Platinum rated green building of Dubai under the LEED Certification Programme of United States Green Building Council (USGBC) based at Washington. Each FAHU consists of one sensible plus one latent wheel with Dual wheel configuration for each FAHU.



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DRI Wheel Projects...

- College of DuPage Chemistry Building, Glen Ellyn IL
- Woods Lab, University of the South, Sewanee TN
- UNCA Science & Multimedia Building, Asheville NC
- Petronos Towers, Kuala Lumpur, Malaysia
- Dubai Convention Center, United Arab Emirates
- Paul Rogers Federal Building
- NYU Smilow Hall
- Nanotechnology Center, University of Alberta
- Ryerson University, Toronto
- Worcester Courthouse, Worcester MA
- Avondale Elementary School





24 X 7 Support Structure for UAE

Desiccant Rotors International

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