ENGINEERING CATALOG

# DryCool™ Dehumidification System (DDS)

Munters

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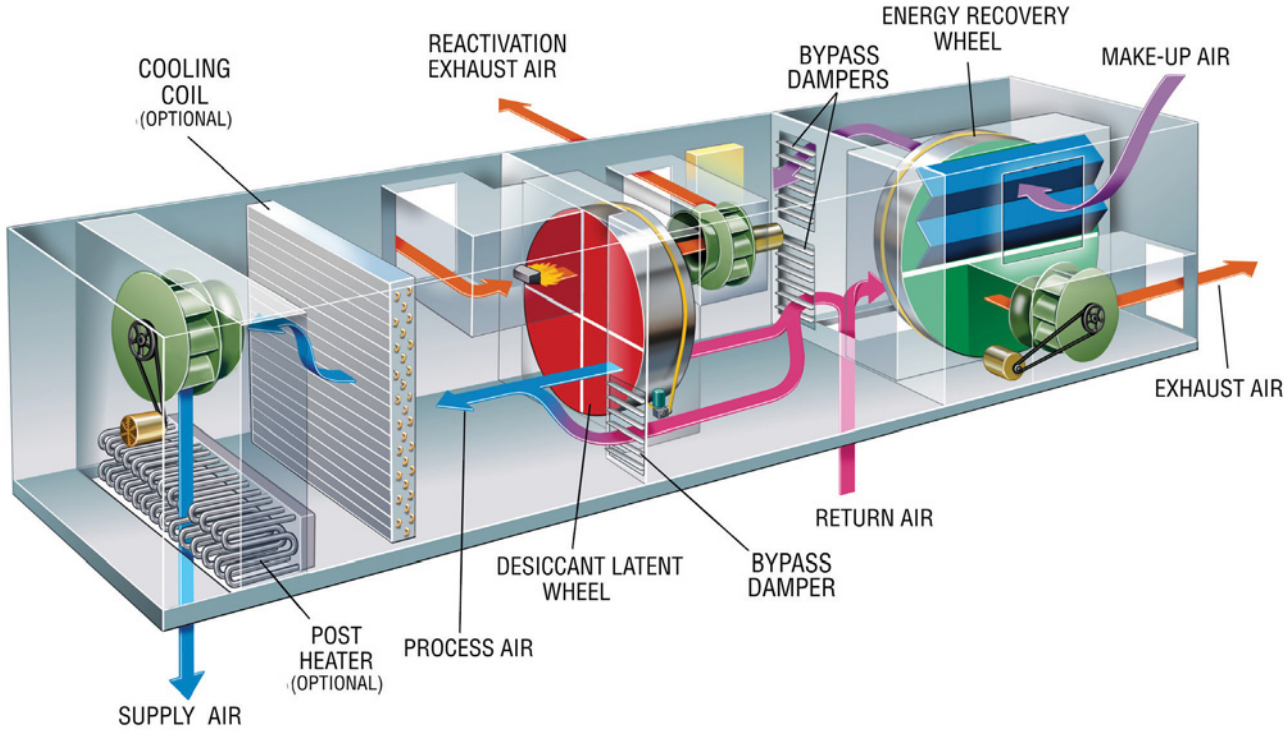
# INTRODUCTION

Munters manufacturers air conditioning systems for industrial and commercial environments that can benefit from reduced humidity levels. Using Munters HoneyCombe® wheel technology, the desiccant systems dehumidify and control air temperature separately ensuring proper control for space conditioning and comfort.

Today, indoor air quality has become a global environmental issue. In reaction, the leading professional organization of HVAC engineers, ASHRAE, has created new standards for building operation, which are being incorporated into local building codes. As building operators seek to meet the new standards, they find that humidity in the increased levels of outside air creates control and comfort problems and that exhausting large volumes of conditioned air raises energy costs.

DDS systems address both of these problems. Markets currently using Munters DDS desiccant technology include supermarkets, ice arenas, hospitals, schools, hotels, restaurants, office and retail space and many more.

The DDS offers the flexibility and integrity of a custom product, the convenience and value of a pre-configured system, backed by the international support and capabilities of the world's largest desiccant dehumidifier manufacturer. The DDS features double wall construction, enclosed insulation, easily removable panels, component flexibility and an FRP pultrusion frame that ensures no thermal bridging by providing a true "no through metal" design. Standard DDS configurations of airflow and dehumidifier positions provide the flexibility to accommodate most applications.

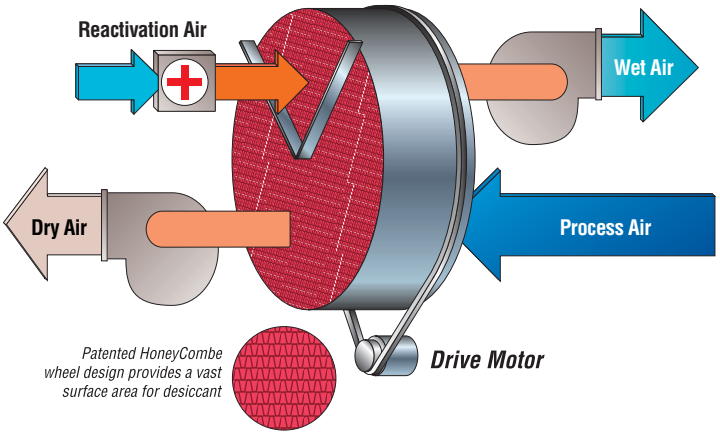


## MUNTERS HONEYCOMBE® WHEEL TECHNOLOGY

Munters equipment removes moisture from air by using a desiccant — a material that easily attracts and holds water vapor. The primary desiccant used in DryCool systems is Titanium Silica Gel. Titanium Silica Gel is an adsorbent. Water is attracted to the walls of many fine pores within the material. Munters has developed a patented method for manufacturing Titanium Silica Gel in a HoneyCombe® wheel form, which results in a strong and stable structure, yielding ideal drying performance in a wide range of applications. Because Titanium Silica Gel is a solid, insoluble desiccant, it is not possible to "wash out" the desiccant from the wheel. This means no special precautions are required even when it is exposed to air at 100% relative humidity. The permanent nature of the desiccant makes it possible to literally wash the wheel with water if dust or other particulate block the air passageways. Air passes through the HoneyCombe® wheel coming in contact with the desiccant. The wheel rotates slowly (6 to 10 rph) between two airstreams. The process air stream—the airstream being dehumidified—gives off its moisture to the desiccant. The process air is dry as it leaves the wheel. The humidity laden wheel rotates slowly into a second, smaller airstream which has been heated. This smaller exhaust airstream — called the reactivation air—warms the desiccant.

The warmed desiccant gives off its moisture, which is then carried away by the reactivation air. The newly dried desiccant material is rotated back into the process airstream where it again begins to adsorb moisture. Munters equipment provides modulating control of the reactivation heat source based on the reactivation air leaving temperature. This internal modulation control works with the external call for dehumidification to provide proportional capacity based on the moisture load seen by the desiccant wheel. Capacity is closely matched to the load to minimize cycling, maximize efficiency, and to protect the wheel from extreme temperatures.

Cross contamination of the supply and exhaust/reactivation air streams is a concern when applying any type of wheel technology. In a Munters unit, the fans are located to provide a negative pressure in the reactivation cabinet to insure any airflow moves from the supply to the reactivation air stream. This prevents the transfer of moisture and contaminants from the exhaust airstream to the process airstream. To provide added performance the process and reactivation airstreams are separated by a radial bulb seal covered with a self lubricating graphite filled teflon to prevent moisture leakage between the two airstreams.



# OVERVIEW

Munters offers a wide variety of system configurations to meet the stringent demands of dehumidification project requirements. The units are designed around the desiccant dehumidification module. This module consists of the desiccant wheel, process fan, reactivation heat source, and reactivation fan. Numerous desiccant wheel sizes are available to match the dehumidification requirements of specific applications. The DDS is available in many sizes and offers a wide variety of optional air conditioning modules.

DDS is a modular product line that provides consistent construction between all Munters dehumidification units world wide. It utilizes two inch double wall construction. It is available in up to 36,000 CFM supply air and can dehumidify up to 10,000 CFM. Options include sensible heat wheel, enthalpy recovery wheel, cooling coils, various heat options, and many others.

### Available Unit Sizes and Options

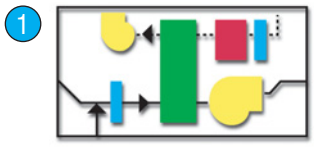
| PRODUCTS | DDS |
|---|---|
| **Supply CFM** | 3000-36,000 |
| **Wheel Size Diameter & Depth** | 1000mm x 200, 400mm<br>1300mm x 200, 400mm<br>1500mm x 200, 400mm |
| **Reactivation Options** | Natural Gas/<br>Propane/ Steam/Hot Water/ Elec. |
| **Fan Hp (supply/reactivation)** | Up to 50 Hp |
| **Heating Options** | Steam/ Hot Water/Indirect Gas |
| **Cooling Options** | Pre cooling DX or CHW<br>Post cooling DX or CHW |
| **Condensing Units** | Split Systems<br>Packaged up to 120 Tons |
| **Energy Recovery** | Enthalpy Pre cooling |

## DDS PRODUCT

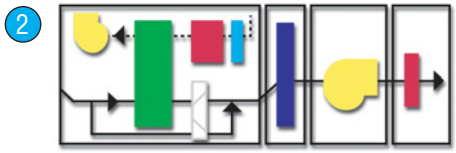
The DDS is a modular product that is built up around the desiccant dehumidifier module. It consists of two housing sizes—the 20 and 30—and a variety of modules that offer a significant level of flexibility. The modules available in the 20 and 30 housings are shown in the next two pages. Although the product is constructed in a modular fashion, the following five configurations provide an engineered solution for most commercial dehumidification applications. Modules can be added or removed from these standard configurations to add further flexibility to the product. The capacity of the configurations depends upon the components included. The DDS configuration capacities are shown on page 5.

## CONFIGURATIONS

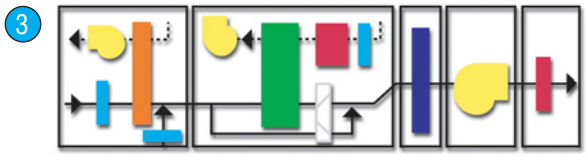
*Stand alone dehumidifier. Nominal dehumidifier capacity of 5,000, 7,500 and 10,000 scfm. 0-100% makeup air. Return and makeup air connections included.*



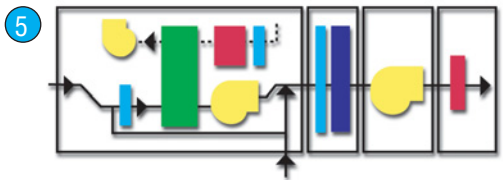

*Dehumidification system with bypass. Cooling and heating options available. 0-100% makeup air. Nominal total supply air volume up to 24,000 scfm. Dehumidification capacity up to 10,000 cfm.*




*Dehumidification system with total energy recovery. Cooling and heating options available. 0-100% makeup air. Nominal total supply air volume up to 15,000 scfm. Dehumidifier capacity up to 10,000 cfm.*




*Dehumidification system where large airflow is required for sensible heating and cooling. Pretreatment of makeup air not available. Nominal total supply volume up to 36,000 cfm. Dehumidifier capacity up to 10,000 cfm. Includes process and supply fan to minimize required fan horsepower. Includes return and makeup air connections in dehumidifier module which is a modified version of Module A for selection and sizing purposes.*




## MODEL NUMBERS

The model number is used to indicate the housing size and the system configuration. For example, a configuration 2 system utilizing a size 30 housing to process 24,000 scfm is a DDS-30-2.

**LEGEND**

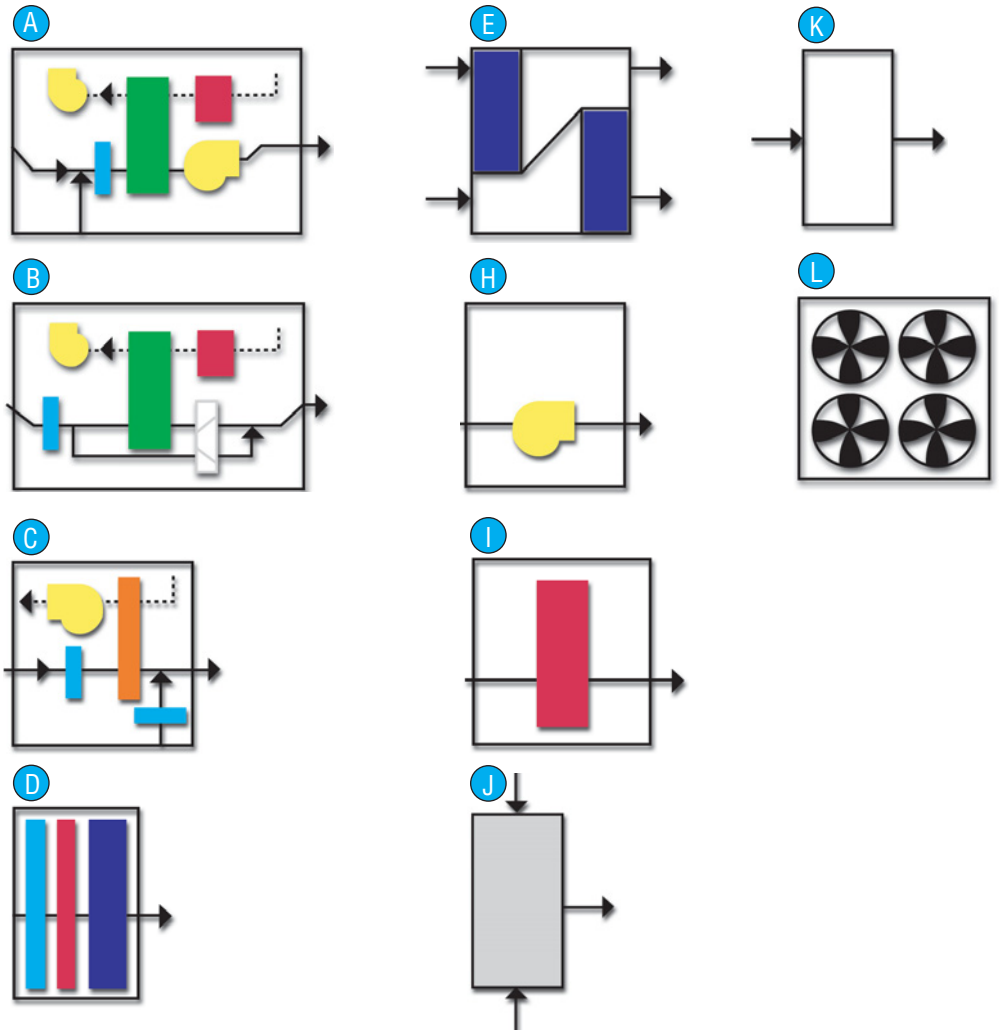
| | | |
|---|---|---|
| Active Desiccant Dehumidification Wheel | Cooling Coil | Exhaust Air Enthalpy Wheel |
| Filter | Heater | Fan |
| — Process Air | — Reactivation/ | |

# DRYCOOL DEHUMIDIFICATION SYSTEM CAPACITIES

| Config. | Housing | Dehumidifier Wheel | Max Dehumid. Volume (cfm) | Max Supply Volume (cfm) | Max Reactivation Burner Input (MBH) | Maximum Fan Horsepower (hp) | | | | DH Module | Supply Fan |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Supply | Process | React | Exhaust | FLA @ 460/3/60 | FLA @ 460/3/60 |
| 1 | 20 | 1001 | 5000 | 5000 | 400 | | 5 | 2 | | 10.5 | |
| | 20 | 1000 | 5000 | 5000 | 400 | | 7.5 | 3 | | 14.4 | |
| | 20 | 1301 | 7500 | 7500 | 750 | | 7.5 | 5 | | 16.7 | |
| | 20 | 1300 | 7500 | 7500 | 750 | | 10 | 5 | | 19.5 | |
| | 30 | 1501 | 10000 | 10000 | 750 | | 10 | 5 | | 19.5 | |
| | 30 | 1500 | 10000 | 10000 | 750 | | 15 | 7.5 | | 28.1 | |
| 2 | 20 | 1001 | 5000 | 12000 | 400 | 25 | | 2 | | 4.6 | 29.7 |
| | 20 | 1000 | 5000 | 12000 | 400 | 25 | | 3 | | 5.6 | |
| | 20 | 1301 | 7500 | 12000 | 750 | 25 | | 5 | | 7.9 | |
| | 20 | 1300 | 7500 | 12000 | 750 | 25 | | 5 | | 7.9 | |
| | 30 | 1001 | 5000 | 24000 | 400 | 40 | | 2 | | 4.6 | 47.7 |
| | 30 | 1000 | 5000 | 24000 | 400 | 40 | | 3 | | 5.6 | |
| | 30 | 1301 | 7500 | 24000 | 750 | 40 | | 5 | | 7.9 | |
| | 30 | 1300 | 7500 | 24000 | 750 | 40 | | 5 | | 7.9 | |
| | 30 | 1501 | 10000 | 24,000 | 750 | 40 | | 5 | | 7.9 | |
| | 30 | 1500 | 10000 | 24,000 | 750 | 40 | | 7.5 | | 10.8 | |
| 3 | 20 | 1001 | 5000 | 5000 | 400 | 10 | | 2 | 5 | 4.6 | 11.6 |
| | 20 | 1000 | 5000 | 5000 | 400 | 10 | | 3 | 5 | 5.6 | |
| | 20 | 1301 | 5000 | 7500 | 750 | 10 | | 5 | 5 | 7.9 | |
| | 20 | 1300 | 5000 | 7500 | 750 | 10 | | 5 | 5 | 7.9 | |
| | 30 | 1001 | 5000 | 15000 | 400 | 40 | | 2 | 15 | 4.6 | 47.7 |
| | 30 | 1000 | 5000 | 15000 | 400 | 40 | | 3 | 15 | 5.6 | |
| | 30 | 1301 | 7500 | 15000 | 750 | 40 | | 5 | 15 | 7.9 | |
| | 30 | 1300 | 7500 | 15000 | 750 | 40 | | 5 | 15 | 7.9 | |
| | 30 | 1501 | 10000 | 15000 | 750 | 40 | | 5 | 15 | 7.9 | |
| | 30 | 1500 | 10000 | 15000 | 750 | 40 | | 7.5 | 15 | 10.8 | |
| 4 | 20 | 1001 | 3000 | 3000 | 400 | 5 | | 5 | | 7.9 | 5.9 |
| | 20 | 1000 | 5000 | 5000 | 400 | 10 | | 10 | | 13.6 | 11.6 |
| | 30 | 1501 | 7500 | 7500 | 750 | 10 | | 10 | | | |
| | 30 | 1500 | 10000 | 10000 | 750 | 15 | | 20 | | 25.8 | 17.3 |
| 5 | 20 | 1001 | 5000 | 12000 | 400 | 15 | 5 | 5 | | 13.8 | 17.3 |
| | 20 | 1000 | 5000 | 12000 | 400 | 15 | 5 | 5 | | 13.8 | |
| | 20 | 1301 | 7500 | 12000 | 750 | 15 | 5 | 5 | | 13.8 | |
| | 20 | 1300 | 7500 | 12000 | 750 | 15 | 7.5 | 5 | | 16.7 | |
| | 30 | 1501 | 10000 | 22000 | 750 | 30 | 7.5 | 5 | | 16.7 | 35.2 |
| | 30 | 1500 | 10000 | 22000 | 750 | 30 | 10 | 7.5 | | 22.4 | |
| | 30 | 1501 | 10000 | 36000 | 750 | 50 | 10 | 5 | | 19.5 | 58 |
| | 30 | 1500 | 10000 | 36000 | 750 | 50 | 10 | 7.5 | | 22.4 | |

Process fan moves air stream that passes through desiccant wheel and is located in the dehumidifier housing.
Supply fan moves total airstream and is located in a separate plenum.
System can be equipped with either or both fans depending upon system configuration.
DH Module FLA includes process, reactivation and desiccant wheel drive motors. Also includes control circuit.

# SIZE 20 HOUSING MODULES

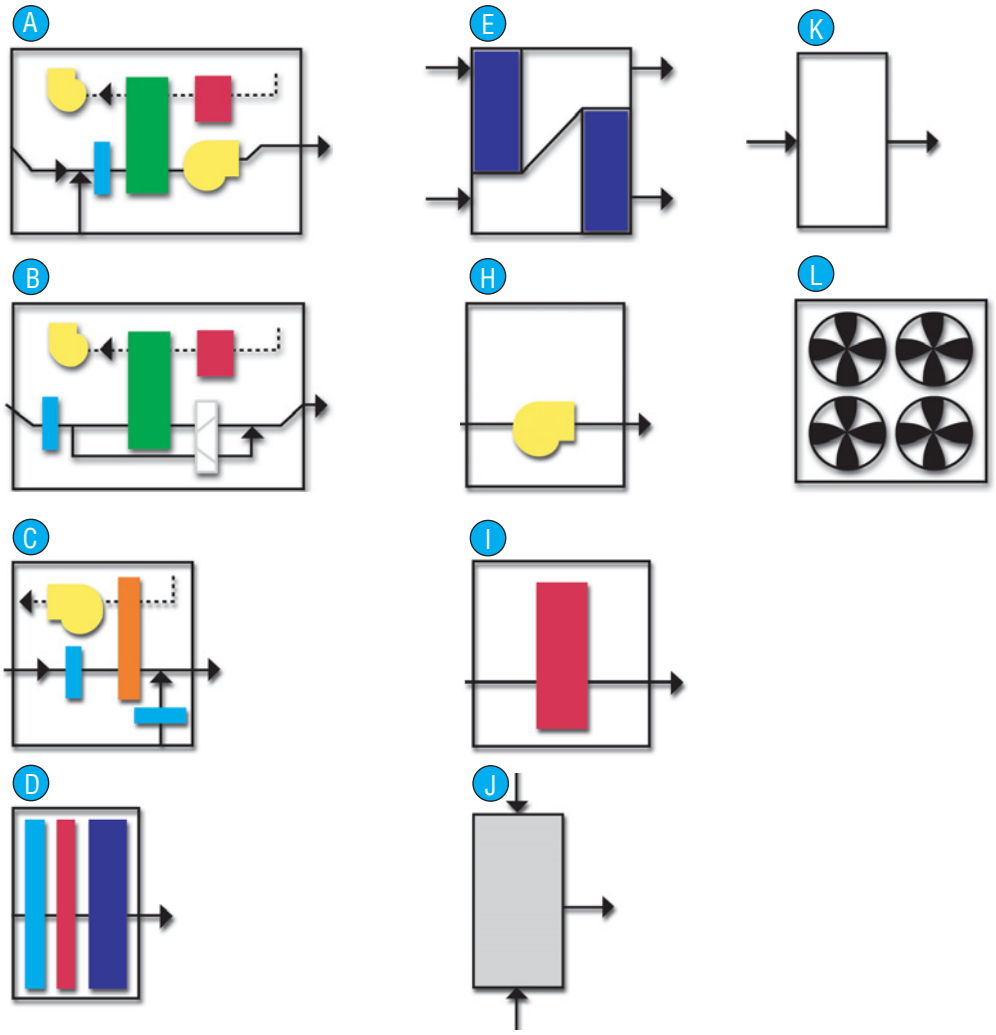



| | MODULE | LENGTH | WEIGHT |
|---|---|---|---|
| A | Dehumidifier Module (includes process fan) | 123 | 3850 |
| B | Dehumidifier Module with Bypass (requires supply fan module H) | 123 | 3500 |
| C | Enthalpy Module | 92 | 2000 |
| D | Cooling/Heating Module (1) up to 10000 cfm | 31 | 600 |
| E | Staggered Coil Module up to 12000 cfm | 61 | 1250 |
| H | Supply Fan Module (Downblast, End, Side Discharge) (3) | 61 | 1228 |
| I | Indirect Fired Post Heater (Rated at Input, Efficiency = 80%) | | |
| | 400, 800 MBH with Downblast (fits in Supply Fan Module H) | 0 | 622 |
| | 400, 800 MBH End or Side Discharge | 61 | 1180 |
| J | Mixing Section | 31 | 280 |
| K | Access Sections or Blank Section | 31 | 280 |
| L | 3 - 30 Ton Condensing Unit | 61 | 1900 |
| | 35 - 40 Ton Condensing Unit | 92 | 2700 |

To calculate system length sum module lengths and add 4 inches.
Height is 70 inches, width is 80 inches for all modules.
Return and outside air pass through 30% filters.

(1) Can accommodate up to 10 rows of cooling and 2 rows of heating.
(3) For systems without bypass the fan is mounted in the dehumidifier module.
(4) DH module and supply fan FLA is shown on DryCool Dehumidification System Capacities table on page 5.

# SIZE 30 HOUSING MODULES




| | MODULE | LENGTH | WEIGHT |
|---|---|---|---|
| A | Dehumidifier Module (includes process fan) | 123 | 4850 |
| B | Dehumidifier Module with Bypass (requires supply fan module H) | 123 | 4450 |
| C | Enthalpy Module | 123 | 3400 |
| D | Cooling/Heating Module (1) up to 24000 cfm | 31 | 1000 |
| E | Staggered Coil Module up to 36000 cfm | 61 | 1200 |
| H | Supply Fan Module (Downblast, End , Side Discharge) (3) | 61 | 2200 |
| I | Indirect Fired Post Heater (Rated at Input, Efficiency = 80%) | | |
| | 400, 800 MBH Downblast up to 20000 cfm (fits in Supply Fan Module H) | 0 | 500 |
| | 400, 800, 1200 MBH Side Discharge | 0 | 750 |
| | 400 and 800 MBH Downblast over 20000 cfm, 1200, 1600 MBH Downblast | 61 | 1850 |
| | 400, 800, 1200, 1600 MBH End Discharge | 61 | 2400 |
| J | Mixing Section | 31 | 360 |
| K | Access Sections or Blank Section | 31 | 360 |
| L | 10 - 30 Ton Condensing Unit | 61 | 2150 |
| | 35 - 60 Ton Condensing Unit | 92 | 3550 |
| | 65 - 80 Ton Condensing Unit | 123 | 4700 |
| | 85 -100 Ton Condensing Unit | 153 | 5750 |

To calculate unit length total module lengths and add 4 inches.
Height is 101 inches, width is 96 inches for all modules.
Return and Outside air pass through 30% filters.

(1) Can accommodate up to 10 rows of cooling and 2 rows of heating.
(3) For systems without bypass the fan is mounted in the dehumidifier module.
(4) DH module and supply fan FLA is shown on DryCool Dehumidification System Capacities table on page 5.

# SELECTION PROCESS

The first step of the selection process is the determination of the internal latent load. The internal latent load includes such sources as personnel, air infiltration, standing water and open flames. In many cases most of these elements can be reduced to negligible levels. The individual load elements are added to determine the total internal latent load. The required delivered air condition to the controlled space can be calculated once the internal latent and sensible loads have been determined. The latent work performed by the dehumidification system will include the moisture removal required in the conditioned space and the moisture removed from the outside air.

Compare the calculated load with the Wheel Data Chart located in the Appendix. This will determine the approximate wheel size required to meet the load. More precise performance data is available in the Wheel Performance Charts located in the Appendix. The selection of the wheel and the specific performance requirement will provide the air quantity that is required through the desiccant wheel. It is not uncommon for only a portion of the total airstream to be processed through the desiccant rotor. This is attributable to a number of factors. Munters wheels outperform other desiccant rotors and can often achieve more moisture removal with smaller diameter or thinner wheels. This results in more moisture removal capacity with lower energy consumption. Also, the total airflow is often determined by makeup air or sensible load requirements. If the dehumidification load is small enough, processing a portion of the total airstream is sufficient to appropriately control space humidity.

The performance of the desiccant wheel can be enhanced by adding pre-cooling. This will reduce the quantity of air required for dehumidification. Pre-cooling can be achieved with a cooling coil or an enthalpy wheel if exhaust recovery is available.

As moisture is adsorbed by the desiccant rotor, the temperature of the air rises. The DDS has an extensive list of options to meet the sensible requirements of the space load and air flow requirements. Please review the configuration options in the DDS section for more information.

It is important to note that performing the latent cooling separate from the sensible cooling may require a rethinking of air quantities supplied to the space. The desiccant unit can be utilized as a 100% outside air unit or with return air similar to conventional equipment. The flexibility provided by this decoupling of the latent and sensible capacity needs to be utilized to maximize the effectiveness of the overall system.

*Consult a DryCool Applications Engineer for detailed performance selection.*
*1-800-MUNTERS*

# EXAMPLE

Outside design summer: 95°F db, 75°F wb, 99 gr/lb
Indoor design summer: 75°F db, 50% rh, 65 gr/lb
Supply air (SA) volume: 15,000 cfm
Return air (RA) volume: 2,000 cfm
Return/exhaust air condition: 80°F db, 67°F wb, 79 gr/lb
Internal latent load: 91,000 btuh

Outside design winter: 10°F db
Indoor design winter: 70°F db
Outside air (OA) volume: 13,000 cfm
Exhaust air (EA) volume: 12,000 cfm
Internal sensible cooling load: 220,000 btuh
Internal sensible heating load: 712,000 btuh

*LOAD CALCULATION*—The internal load calculations are a combination of the loads generated by people, lighting, infiltration, etc. and should not include the outside air load. The internal load should also take into account any cooling and/or heating credits available(i.e. display cases, ice surface, etc.).

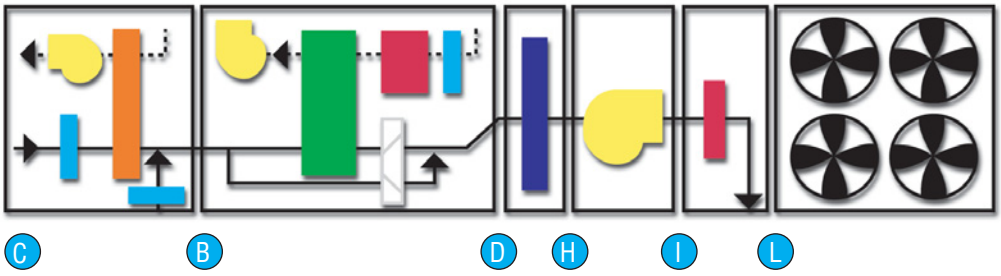
The delivered air conditions to satisfy the internal loads are calculated in the following manner:

Internal Latent: Delivered Moisture = Indoor Moisture – [(internal latent load x 7000/(4.5 x SA volume x 1050)]=
65 – [(91,000 x 7000)/(4.5 x 15,000 x 1050)] = 56.0 gr/lb
Internal Sensible (cooling): Delivered Temp = Indoor Temp – [internal sensible load/(SA volume * 1.08)] =
75 – [220,000/(15,000 * 1.08)] = 61.4°F db
Internal Sensible (heating): Delivered Temp = Indoor Temp + [internal sensible load/( SA volume * 1.08)] =
70 + [(712,000/(15,000 * 1.08)] = 114.0°F db

*COMPONENTS*—Exhaust air is available for energy recovery. The use of an enthalpy (sensible and latent) recovery wheel results in increased dehumidification capacity and lower operating costs. The enthalpy wheel acts as a pre-cooler, transferring sensible and latent heat from the outside airstream to the exhaust air stream, reducing the total outside air load. The enthalpy wheel alone is not capable of satisfying the entire external and internal loads, therefore the use of desiccant dehumidification, mechanical cooling and heating are still required.

Based upon this determination, Configuration 3 is selected. The result is a Model DDS-30-3.
The following components are shown in sequential order from air entering to air leaving.

Module C – Enthalpy Wheel
Module B – Dehumidifier module with bypass
Module D – Cooling Coil
Module H – Supply fan
Module I – Indirect fired post heater
Module L – Condensing unit




*ENTHALPY WHEEL*—The outside air is drawn through filters and the enthalpy wheel first. The leaving air condition of the enthalpy wheel is a product of the wheel efficiency and the enthalpy difference of the two airstreams. Select the enthalpy wheel efficiency from the Enthalpy Wheel Selection Chart in the Appendix.

The ratio of outside air to exhaust air = 13,000/12,000 = 1.1
From the chart, the wheel efficiency at 13,000 cfm and 1.1 is 66%.

Leaving air temperature = OA temp – [(OA temp – EA temp) x Wheel efficiency] =
95 – [(95 – 80) x .66] = 85.1°F
Leaving air moisture = OA moisture – [(OA moisture – EA moisture) x Wheel efficiency] =
99 – [(99 – 79) x .66] = 85.8 gr/lb

## EXAMPLE CONTINUED **(Component Performance Selection)**

*DESICCANT WHEEL*—The 13,000 cfm processed through the enthalpy wheel is blended with 2000 cfm of return air. The blend air (BA) condition is 15,000 cfm at 84.3°F, 84.9 gr/lb.

Select the desiccant wheel from the Wheel Data Chart on page A1 of the appendix. Start by choosing the largest desiccant wheel available for the BA volume. Wheel size should be adjusted if significant excess capacity is present. The 1500 is a 400mm desiccant wheel that can process up to 10,000 cfm. The remaining 5000 cfm will be bypassed. Starting with the maximum cfm, determine the face velocity in feet per minute (10,000/12.5 = 800 fpm). From the 400mm Wheel Performance Chart on page A2 the process air leaving air (PAL) moisture = 40 gr/lb.

In the process of adsorbing moisture in the desiccant wheel the temperature of the air increases as latent heat is converted into sensible heat. The process air temperature rise is equal to approximately 0.8°F per gr/lb removed.
PAL Temp = BA Temp + [(0.8 * (BA moisture – PAL moisture)] = 84.3 + [(84.9 – 40) x .8] = 120.2°F

The air processed through the dehumidifier blends with the bypass air. The blended condition = 108.2°F , 54.9 gr/lb

*SUPPLY FAN*—Determine the supply fan horsepower on page 5. The supply fan horsepower for a configuration 3, housing size 30 is 40 hp. To estimate heat added to the airstream multiply the fan motor hp by 2544 = 40 x 2544 = 101,760 btuh.
Supply fan temperature. rise = [(motor heat/(1.08 * SA volume)] = [(101,760/(1.08 x 15000)] = 6.3°F

*COOLING*—The temperature of the air entering the coil is 108.2°F. Based on the load calculations air at 61.4°F is required to satisfy the space sensible load. In this example the supply fan is located after the post cooling coil. Therefore the condition leaving the coil = 61.4 – 6.3 = 55.1°F

Coil btuh = (Coil entering temp – Delivered air temp) x SA volume x 1.08 =
(108.2 – 55.1 ) x 15,000 x 1.08 = 860,220 btuh or 71.7 tons.

*HEATING*—The outside air enters the enthalpy wheel first. Use the same method as before to determine the leaving air temperature from the enthalpy wheel.

LA temp = OA temp + [(Return air temp – Outside air temp) x Wheel efficiency] =
10 + [(70 – 10) x .66] = 49.6°F

This air is blended with return air. The resulting temperature = 52.3°F

Dehumidification in the winter is not required and all of the air will bypass the desiccant wheel.
Temperature rise across fan = 6.3°F. Post heater entering air temperature = 52.3 + 6.3 = 58.6°F.
Based on the load calculations the required air temperature is 114°F to satisfy the space-heating load.

Heating btuh = (Delivered air temp – Entering air temp) x SA volume x 1.08 =
(114.0 – 58.6 ) x 15,000 x 1.08 = 897,480 btuh.

Heater efficiency = 80%. Heater size = Heating btuh/heater efficiency = 897,480/.8 = 1,121,850 btuh

*SIZE & ELECTRICAL DATA*—To determine dimensions, weight and FLA of the selected system, use the table on page 7.

| | MODULE | LENGTH | WEIGHT |
|---|---|---|---|
| 2 | Dehumidifier Module with Bypass (requires supply fan module #8) | 123 | 4450 |
| 3 | Enthalpy Module | 123 | 3400 |
| 4 | Cooling/Heating Module (1) | 31 | 1000 |
| 8 | Supply Fan Module (Downblast, End , Side Discharge) (3) | 61 | 2200 |
| 9 | Indirect Fired Post Heater (Rated at Input, Efficiency = 80%) | | |
| | 1200, 1600 MBH Downblast | 61 | 1850 |
| 12 | 65-80 Ton Condensing Unit | 123 | 4700 |
| | **Totals** | **522** | **17600** |

# Appendix

| Wheel Designation | Nom CFM | Dia (mm) | Depth (mm) | Face Area (sq. ft.) |
|---|---|---|---|---|
| 1001 | 5000 | 1000 | 200 | 6.25 |
| 1000 | 5000 | 1000 | 400 | 6.25 |
| 1301 | 7500 | 1300 | 200 | 9.25 |
| 1300 | 7500 | 1300 | 400 | 9.25 |
| 1501 | 10000 | 1500 | 200 | 12.5 |
| 1500 | 10000 | 1500 | 400 | 12.5 |

Formulas:

Q sensible =
1.08 x CFM x delta temperature; at standard air

Q latent =
0.68 x CFM x delta grains; at standard air

Temperature rise approx. =
0.8 x humidity depression in gr/lb

| Wheel Designation | Entering Temp F / Entering Grains | 85 / 135 | 85 / 120 | 95 / 105 | 80 / 80 | 77 / 135 | 73 / 120 | 69 / 105 | 67 / 80 | 55 / 62 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1001 | Latent Cooling | 182,580 | 171,700 | 126,480 | 139,740 | 205,700 | 204,680 | 198,900 | 167,620 | 154,700 |
| | Leaving grains | 81.3 | 69.5 | 67.8 | 38.9 | 74.5 | 59.8 | 46.5 | 30.7 | 16.5 |
| | Leaving Temp F | 126 | 124 | 125 | 113 | 123 | 118.6 | 114 | 105 | 91 |
| 1000 | Latent Cooling | 216,920 | 203,320 | 152,320 | 161,500 | 237,660 | 233,920 | 228,820 | 195,840 | 172,720 |
| | Leaving grains | 71.2 | 60.2 | 60.2 | 32.5 | 65.1 | 51.2 | 37.7 | 22.4 | 11.2 |
| | Leaving Temp F | 137 | 134 | 133 | 119 | 133 | 128 | 123 | 113 | 95 |
| 1301 | Latent Cooling | 273,870 | 257,550 | 189,720 | 209,610 | 308,550 | 307,020 | 298,350 | 251,430 | 232,050 |
| | Leaving grains | 81.3 | 69.5 | 67.8 | 38.9 | 74.5 | 59.8 | 46.5 | 30.7 | 16.5 |
| | Leaving Temp F | 126 | 124 | 125 | 113 | 123 | 118.6 | 114 | 105 | 91 |
| 1300 | Latent Cooling | 325,380 | 304,980 | 228,480 | 242,250 | 356,490 | 350,880 | 343,230 | 293,760 | 259,080 |
| | Leaving grains | 71.2 | 60.2 | 60.2 | 32.5 | 65.1 | 51.2 | 37.7 | 22.4 | 11.2 |
| | Leaving Temp F | 137 | 134 | 133 | 119 | 133 | 128 | 123 | 113 | 95 |
| 1501 | Latent Cooling | 365,160 | 343,400 | 252,960 | 279,480 | 411,400 | 409,360 | 397,800 | 335,240 | 309,400 |
| | Leaving grains | 81.3 | 69.5 | 67.8 | 38.9 | 74.5 | 59.8 | 46.5 | 30.7 | 16.5 |
| | Leaving Temp F | 126 | 124 | 125 | 113 | 123 | 118.6 | 114 | 105 | 91 |
| 1500 | Latent Cooling | 433,840 | 406,640 | 304,640 | 323,000 | 475,320 | 467,840 | 457,640 | 391,680 | 345,440 |
| | Leaving grains | 71.2 | 60.2 | 60.2 | 32.5 | 65.1 | 51.2 | 37.7 | 22.4 | 11.2 |
| | Leaving Temp F | 137 | 134 | 133 | 119 | 133 | 128 | 123 | 113 | 95 |

# STANDARD WHEEL PERFORMANCE

**To calculate the process air leaving moisture:**

1. Choose the model size and calculate the process air velocity.

2. Select proper wheel performance chart based on wheel depth (400 mm or 200 mm)

3. Enter the wheel performance curves at the process air inlet moisture.

4. Proceed vertically to intersect the process inlet temperature curve.

5. Move horizontally to the left, intersecting the reactivation heated temperature.

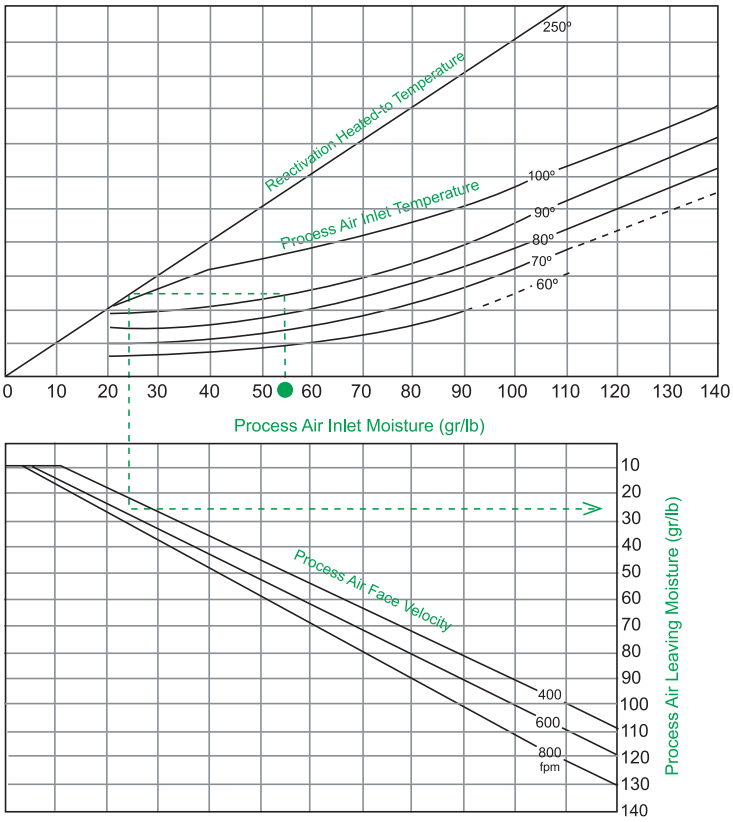
6. Proceed down vertically to intersect the process air face velocity line.

7. Move horizontally to the right edge of the chart to find the moisture content of the process air as it leaves the dehumidifiers.

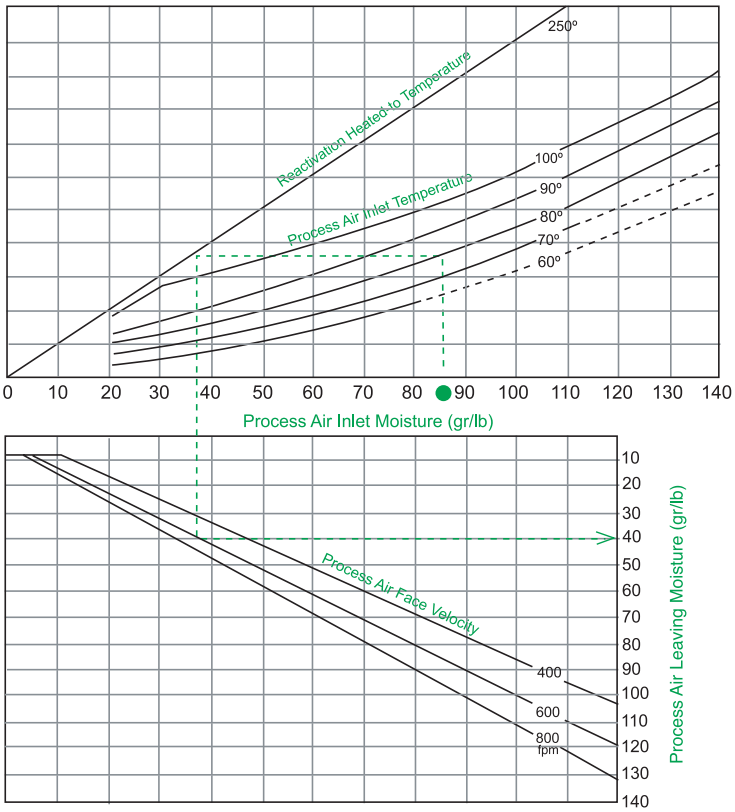
**To calculate the process leaving air temperature:**

The temperature rise across the desiccant rotor is approximately 0.8°F per gr/lb of moisture removal.

## 400mm Wheel Performance




## 200mm Wheel Performance




*Consult Factory for Detailed Performance Selection*
*1-800-MUNTERS*

# DRYCOOL DEHUMIDIFICATION SYSTEM SPECIFICATIONS

## PART 1 GENERAL

### 1) WARRANTY / GUARANTEE

A) The DryCool Dehumidification System (DDS) and any auxiliary components provided by the manufacturer shall be warranted free from defects in workmanship or material for a period of 12 months from date of factory documented startup, or 18 months from date of original shipment. The basis of design is Munters. Named alternate manufacturers who do not manufacture the active desiccant dehumidification wheel must provide a 5 year parts and labor warranty for the wheel. If any defects appear under this warranty, the manufacturer shall be notified by the owner, and the manufacturer shall provide appropriate replacement parts at no cost to the owner other than freight. The owner shall be responsible for labor performed in replacing parts provided by the manufacturer.

B) Honeycombe® Wheels
Munters warrants its Titanium-enhanced Silica Gel Honeycombe® wheels to be free from defects in workmanship and material for a period of five years from the date of original shipment.

## PART 2 PRODUCT

### 1) HOUSING

A) Unit Base

1) Unit base shall be bolted steel construction with formed 12 gauge galvanized steel channels around the outside perimeter and reinforced with galvanized steel cross members bolted on centers not exceeding 31 inches. Base shall have a minimum of four lifting brackets bolted in place.

B) Unit Case

1) The unit casing shall be constructed using a double wall panel and frame system for torsional rigidity. This includes walls, floors and ceilings. This system shall not contain any through metal. The unit casing shall also meet the following criteria based on ASTM E84-90 (Standard Test Method for Surface Burning of Building Materials), flame spread = 25, smoke index = 50.

2) The frame system components shall be constructed of fiberglass reinforced plastic (FRP) pultruded members. Horizontal frame members shall be supported along their length by intermediate supports and internal partitions. Through metal systems shall not be allowed. To avoid condensation, heat loss or loss of cooling capacity, each panel shall be 2 inches thick and constructed such that there are no through metal connections between the exterior surface and the interior surface. The exterior casing shall be 22-gauge corrosion resistant galvalume. The interior casing shall be 22-gauge galvanized steel. Manufacturers not providing exterior galvalume construction must provide painted galvanized exterior panels. Painted coating must be corrosion resistant exceeding ANSI 2000 hour salt spray standards. Panels shall be foam injected into individual panels with a density of 2-1/2 lb/ft3. The heat transfer rate through casing walls shall be less than 0.0625 Btu/sq. ft./°F equivalent to an R-value of 14. This construction shall be suitable for a 50°F difference as tested between process air dry bulb temperature and the dew point of the air surrounding the plenum. The unit casing shall be manufactured as an air and vapor tight system. There shall be a gasket system which seals the panels to the structure. Fixed panels shall be provided with flat closed cell neoprene and be sealed in place with FDA approved silicon. Doors and plug panels shall be provided with polyvinyl chloride seals.

C) Access Doors and Plug Panels

1) Access doors or plug panel doors will be provided as indicated on the drawings. Doors shall be rigid double wall construction and shall use heavy-duty hinges with lockable latches on each door. Doors shall be a minimum of 30.5” in width and be the full height unit plenum. Doors shall be of the same construction as panels. Hinges shall be installed by locating hinges no more than 36 inches on center from hinge to hinge. Door latches shall be capable of being fully tightened against gasket surfaces. All major components such as coils, filters, blowers, etc., within the air handling structure shall be easily removable through access panels without dismantling plenums or distributing ductwork. Equipment that requires disassembly of components rather than access through removable or hinged panels shall not be acceptable. The unit casing shall include access panels for inspection and for any maintenance required by the operating and maintenance manual. Panels without gaskets shall not be acceptable.

# DRYCOOL DEHUMIDIFICATION SYSTEM SPECIFICATIONS

D) Weather Protection

1) The dehumidification system shall be capable of continuous outdoor operation. The air inlets shall be protected from flowing water by mist eliminators or connected duct work. Consequently, all access panels shall be weather tight, as shall all joints between casing and electrical conduits and between the unit casing and any components mounted in separate enclosures.
2) For outdoor units a roof shall be fabricated using a capped standing seam style construction. Outside air inlets shall be provided with mist eliminating architectural louvers and rain hoods. Mist eliminating louver shall be an extruded aluminum construction utilizing a 2" vertical blade with a 2 phase separation chamber per blade. Frame shall be no less than 2 3/8" deep and arranged with bottom front drainage. Standard AMCA testing shall show beginning of water penetration to be not less than 930 FPM. The pressure drop through the louver shall not be not more than 0.125". Louvers shall bear the AMCA Seal and have its ratings certified to comply with AMCA Publication 511.

2) DESICCANT WHEEL

The desiccant wheel media shall be a monolithic, extended-surface contact medium, fabricated entirely of inert, inorganic binders and glass fibers formed into narrow passages in the direction of airflow. The wheel shall be non-toxic. It shall also meet the following requirements:

The process and reactivation air streams shall be separated by air seals and internal partitions so that the humid reactivation air does not mix with the dry process air. Suppliers who do not also manufacturer the active desiccant dehumidification wheel must provide a 5 year parts and labor warranty for the wheel. Manufacturers must provide the desiccant dehumidification capacity without exceeding a gas usage specified. Manufacturers exceeding gas usage specification must provide a deduct of $ 2000 per therm. Acceptable manufacturers must be able to procure replacement if required within 24 hours or provide a spare stock for each unit size. The proposed equipment shall meet the following minimum requirements:

A) Wheel Face Seals
The dehumidifier shall have full-face seals on both the process air entering and the process air leaving sides of the wheel. These shall seal the entire perimeter of both air streams as they enter and leave the wheel. Partial seals shall not be acceptable. The seals shall be the silicone rubber bulb-type, with a protective strip of low-friction, abrasive-resistant surface to extend seal life and reduce the force needed to turn the desiccant wheel. Neither wiper-type seals nor brush-type nor any non-contact-type seal shall be acceptable. The seals shall be documented to have a minimum working life of 25,000 hours of normal operation.

B) Materials
The glass fibers which form the support matrix shall be made from uniform continuous strands larger than five microns in diameter which are nonrespirable and are not considered a possible health risk by the International Agency for Research on Cancer (IARC).

C) Flame spread and smoke generation
The wheel shall be tested according to ASTM E84-90 (Standard Test Method for Surface Burning of Building Materials) and shall achieve the following results:

1) Flame spread index = 0
2) Smoke developed index = 10

D) Desiccant impregnation
The desiccant shall be evenly impregnated throughout the structure for predictable, consistent performance and for maximum wheel life. Coatings applied on top of the contact medium shall not be acceptable unless the manufacturer can provide independent life tests demonstrating less than a 5% decline in desiccant capacity over a five year period of normal operation.

# DRYCOOL DEHUMIDIFICATION SYSTEM SPECIFICATIONS

E) Desiccant type
The desiccant impregnated into the contact medium shall be:

1) Titanium-reinforced silica gel
The Honeycombe® desiccant wheel shall be a fabricated extended surface contact media with a multitude of small passages parallel to the airflow. The rotary structure shall be a monolithic composite consisting of inert silicates with microscopic pores designed to remove water in a vapor phase. The desiccant shall be hydrothermally -stabilized silica gel reinforced with titanium for maximum strength and stability over time. The fabricated structure shall be smooth and continuous having a depth of 400 or 200 millimeters, as specified in unit schedule, in the direction of airflow without interruptions or sandwich layers which restrict air flow or create a leakage path at joining surfaces. Nominal face velocity shall not exceed 800 fpm. The Honeycombe® wheel shall be manufactured in the United States. The manufacturer shall provide documentation to establish that:

(a) The desiccant retains more than 90% of its original capacity after ten years of continuous operation in clean air, with inlet air conditions up to an including 100% relative humidity.

(b) The wheel as impregnated with silica gel is capable of withstanding five complete water immersion cleaning cycles while retaining more than 95% of its original adsorption capacity.

3) DESICCANT WHEEL SUPPORT AND DRIVE ASSEMBLY

Desiccant wheels less than 86" in diameter shall be a single piece for fast removal and simple handling. The desiccant wheel shall be supported by four rollers at the base of the unit so the wheel can be easily removed by lifting it over the rollers using the drive belt. Center-axle support or any arrangement which requires disassembly of the support structure for wheel removal shall not be acceptable. In addition, the wheel drive assembly shall provide:

A) Rotation speed
To avoid excessive heat carryover from reactivation to the process air, the wheel rotation speed shall not exceed 16 rph while achieving the required moisture removal rate at the specified conditions.

B) Drive belt
The drive belt shall be the flat, toothed type, with aramid fiber reinforcement.

C) Drive motor
The drive motor shall be fractional horsepower and rated for continuous duty for a period of 20,000 hours under the load conditions imposed by the drive assembly.

D) Rotation detection
The drive assembly shall be equipped with a rotation detection circuit which shuts down the dehumidifier and signals the operator through an indicating light on the control cabinet if the wheel is not rotating.

4) REACTIVATION CIRCUIT
The reactivation circuit shall conform in all respects to the current National Electrical Code.

A) Direct-fired natural gas reactivation

1) The direct-fired raw gas burner shall have a rust-resistant cast iron air-fuel manifold and stainless steel air mixing plates. The burner assembly shall be mounted inside a housing constructed of G-90 hot dipped galvanized steel. The housing shall be welded and equipped with internal insulation of fibrous glass with a minimum thickness of 1 inch.

2) Burners with less than 401 MBH input capacity shall be equipped with a single-stage combination gas valve. The complete pilot ignition system has been A.G.A. design certified to A.N.S.I. Standard Z21.7A-1985 "Automatic Intermittent Pilot Ignition Systems for Field Installation.". Gas valves and ignition control units also are A.G.A. design certified (separately) to applicable A.N.S.I. standards:

| | |
|---|---|
| Z21.15 | Manual Gas Valves |
| Z21.18 | Gas Pressure Regulators |
| Z21.20/Z21.20A | Automatic Ignition Systems |
| Z21.21/Z21.21A | Automatic Valves |
| Z21.35 | Gas Filters |

# DRYCOOL DEHUMIDIFICATION SYSTEM SPECIFICATIONS

The butterfly valve utilized for gas flow control is a UL recognized component. The actuator provided to modulate the valve is powered by a UL listed Class 2 cover mounted transformer.

3) Burners with 401 MBH and greater input capacity shall be equipped with a general-purpose ANSI-standard gas train with redundant fluid power valves rated for duty at the specified gas supply pressures.

4) Reactivation energy shall be automatically matched to dehumidification requirements by means of a modulating gas valve with proportional electric valve actuator. The valve/actuator assembly shall be connected to a temperature sensor/controller mounted in the discharge of the reactivation air stream.

5) FILTERS

A) Reactivation Filter
The unit shall include a disposable pleated filter with 25% to 30% minimum efficiency with 90% to 92% arrestance minimum as rated by ASHRAE Test Standard 52-76.

B) Standard Medium Efficiency Filters
The unit shall include removable filters at the inlet of both process and reactivation air streams. These filters shall be mounted on sliding racks and accessible through access panels. All supply air is filtered through filters of 25% to 30% minimum efficiency with 90% to 92% arrestance minimum as rated by ASHRAE Test Standard 52-76. Filters are disposable 2" deep, pleated disposable type with non-woven media held in place by a welded wire grid. Filters are held in aluminum channels top and bottom with spacers and back-up plates to minimize bypass. Filter channels are welded and sealed in place to eliminate air bypass.

6) FANS

A) General Requirements
Blowers provide the specified air volume(s) through the system with adequate static pressure to overcome duct and distribution losses specified. Blowers are of the non-overloading, backward inclined, air foil blade type for air volumes greater than 1000 scfm. Blowers are direct or belt drive provided fan speed does not exceed 80% of the fan shaft critical speed. Access shall be provided on both sides of the supply blower for inspection and servicing. All fans shall be rated in accordance with AMCA Standard 210. Fan motors shall be TEFC, high efficiency type with Class B insulation and a 1.15 service factor

B) Construction
Fans shall be single width-single inlet (SWSI) housed construction if mounted on exterior of unit housing.
Fans shall be single width-single inlet (SWSI) plenum type if mounted interior to the unit housing.

C) Balancing
Fans shall be balanced after assembly and after coating at the speed the unit is scheduled to operate. Fans are balanced such that the maximum displacement in any plane does not exceed 1.5 mils for fans operating at or below 2000 rpm or 1.0 mils for fans operating above 2000 rpm.

D) Belt Drive Fans
For fan motors of 10 hp and smaller, the belt-drive shall be selected for 120% of rated capacity. For fans driven by motors larger than 10 hp, the drive shall be selected for 150% of rated capacity. All belt-driven fans shall be equipped with:
1) Motors mounted on slide rails or bases and belt tension is adjustable without repositioning of belt guard.
2) Fan assemblies mounted on a rigid structural steel base supported at not less than 4 points by rubber-in-shear or spring type vibration isolators. Overall isolation efficiency is not less than 95% at the design fan speed.
3) Fan and base assembly shall be equipped with not less than 3 tie down bolts for stability during shipment to prevent damage.

E) Direct Drive Fans
Direct drive blowers are 1725 or 3450 RPM. Direct drive blowers are mounted on vibration pads or rubber-in-shear type vibration isolators. Overall isolation efficiency is not less than 95% at the design blower speed.

F) Fan Motors
Fan motors shall be the totally-enclosed fan-cooled (TEFC), high-efficiency type with Class B insulation and shall be selected for a service factor of 1.15.

# DRYCOOL DEHUMIDIFICATION SYSTEM SPECIFICATIONS

## 7) CHILLED WATER COOLING COILS

A) Coils shall be sized to provide the full capacity scheduled. Coils shall be arranged to condition the full volume of process air with bypass or balancing dampers as required. Tube water velocities are 6 fps or less and air face velocities are 500 fpm or less. Coil circuiting provides for optimum performance with minimum pressure loss. Coil shall be designed for 250 PSI working pressure and factory tested under water at 300-PSI air pressure.

B) Chilled water coils are fin and tube type, constructed of seamless copper tubes of 5/8-inch diameter with 0.016 inch wall thickness and aluminum plate type fins of .006 inch thickness, mechanically bonded to tubes. Casing and tube support sheets are 16 gauge galvanized steel formed to provide mounting flanges and structural support for the finned-tube assembly. Supply and return headers are heavy wall copper pipe with vent and drain connections. Supply and return connections are brazed in place with sweat connections for piping. Coils conform to ARI standard 410.

## 8) DIRECT EXPANSION (DX) COOLING COILS

A) Coils shall be sized to provide the full capacity scheduled. Coils shall be arranged to condition the full volume of process air with bypass or balancing dampers as required. Refrigerant pressure drop to be between 1.5 psi and 5 psi, and air face velocities are 500 fpm or less. Coil circuiting provides for optimum performance with minimum pressure loss. Coil shall be designed for 250 PSI working pressure and factory tested under water at 300-PSI air pressure.
B) Direct expansion cooling coils are fin and tube type constructed of 0.016 inch seamless copper tubes and .006 inch thickness aluminum fins mechanically bonded to tubes. Casing and tube support sheets are 16 gauge galvanized steel formed to provide mounting flanges and structural support for the finned-tube assembly. Supply header consists of a distributor to feed liquid refrigerant through seamless copper tubing to all circuits in the coil equally. Tubes are circuited to insure minimum refrigerant pressure drop and maximum heat transfer. Fin spacing of up to 12 FPI provides adequate transfer area to minimum air pressure drop. Coils are mounted for counter flow and have a maximum air face velocity of 500 fpm. Direct expansion coils conform to ARI Standard 410 and are compatible with all other components of the same refrigeration circuit.

## 9) DRAINS PANS

A) The drain pan is to be constructed of welded 304 SS and bolted in place. The cooling coil drain pan shall extend the entire length of the coil and extend a minimum of 4 inches beyond the air leaving side of the coil. Drain pans with a single drain connection shall be double-sloped to ensure zero standing water. Drain pans with drain connections on both sides of the unit shall use a single-sloped drain pan, sloped in the direction of airflow. Drain connection shall extend through unit base. Connection(s) to be 1 inch male NPT.

## 10) REFRIGERATION CONDENSING UNITS

A) Condensing units are complete with compressor(s), condenser heat exchanger, optional receiver tank (if required) and all controls and accessories required to regulate refrigerant pressure, flow rates and temperatures. The condensing unit is piped together with evaporator coil(s) and is sized and controlled to operate at all conditions required. Condensing units manufactured by a separate company and then mounted and piped and a single skid are not acceptable.

B) Compressors are scroll type. Service Access shall be provided around the entire compressor for maintenance. Isolation valves shall be provided in the refrigeration circuit to allow removal of pressure sensors and other control instruments. Condenser fans shall be provided with fan guards both on the intake and discharge. Condensing unit section shall be accessed through access doors. Access panels are not acceptable. Condenser coils shall be provided with exterior coil guards to prevent damage.

C) All piping connections are brazed using a filler material with not less than 15% silver content for copper to brass joint. Brazing flux is used on all joints and all interior surfaces of brazed assemblies are exposed only to dry nitrogen during heating and cool down periods. All refrigeration tubing is copper, type “L”, hard drawn, cleaned and capped, designed specifically for refrigeration service. All piping circuits contain thermostatic expansion valve with external equalization and M.O.P. feature, liquid line solenoid valves, liquid line sight glass, liquid line filter/dryer, and optional hot gas regulating valve and auxiliary side connector. All components are completely installed in piping circuit and all joints leak tested with refrigerant charge and electronic leak detector prior to evacuation, final charging and complete factory testing and set-up. All assembly and testing work is performed at the factory prior to shipping. All refrigeration circuits are pumped down, valved off and shipped with the full refrigerant charge ready for on site start-up.

# DRYCOOL DEHUMIDIFICATION SYSTEM SPECIFICATIONS

## 11) INDIRECT FIRED POST HEATER

A)Heater shall conform to ANSI Z83.9. Unit shall be suitable for operation on natural gas or propane as specified. Unit shall be of downblast or horizontal configuration. Unit shall have an input rating of 400 MBH on high firing rate and 200 MBH on low firing rate. Where input is greater than 400 MBH multiple heaters shall be used. It shall contain tube type heated exchangers, flue gas collector with vent fan, in shot burners, and controls for high and low fire. Unit shall be un-housed and fit within the unit housing envelop dimensions.

B)Burners shall be die formed in shot type with adjustable air shutters. Burners must be individually removable for cleaning or service. Entire burner assembly must be easily removable as an assembly.

C)Unit shall have a powered venting system consisting of a collection box, direct drive vent fan and ana air proving switch. The collection box shall be made of the same material as the heat exchanger bulkhead plate and shall be removable. The venting fan bearings shall have a minimum L10 bearing life of 24000 hrs. The vent fan shall exhaust the flue gas horizontally out the side of the unit. The unit fan shall operate on 120/1/60 and not exceed 2 FLA.

D)Tubes shall be permanently attached to a bulkhead plate to form an airtight seal between combustion byproducts and heated air system. Heat exchanger shall be constructed of 18 gauge aluminized tubes with 14 gauge aluminized steel bulkhead plate. Heat exchanger shall be rated for a minimum lifespan of 100,000 cycles.

E)Gas train shall utilize components certified by AGA. Gas train shall consist of a 24 VAC two stage combination valve (manual on-off, automatic safety shutoff, regulation to handle 0.5 psig input pressure and adjustable pilot valve). The combination valve shall be rated at a flow of 400 MBH. The valve shall feed inshot burners through a manifold with screw in brass orifices sized for either natural gas or propane, as required by unit schedule. The flame controllers shall be solid state module that operates on 24 VAC. It shall have a built in spark igniter and flame sensor with 100% gas shutoff. The pilot shall be ignited during each cycle of operation. After the pilot is proven, the main burner valve shall open. Pilot and main burners shall be extinguished during the off cycle. The thermal disc type high temperature limit switch shall shut off main and pilot valves if an overheat occurs.

## 12) ELECTRICAL CONTROL CABINET

The electrical control cabinet shall be weather tight to NEMA 3R standards and shall include:

A)Wiring to comply with the current National Electrical Code with further fuse and wiring sizing to meet or exceed UL 508A Industrial Control Panel.
B)Wires shall be color-coded or numbered at both ends and all terminal block connection points shall be numbered. These markings shall correspond with the electrical diagram provided in the operating and maintenance manual.
C)Components shall be UL or CSA approved where possible.
D)Control System

The unit sequence of operations shall include separate indication for:
1)Power on
2)Unit running
3)Desiccant wheel rotation fault
4)Burner fault
5)High Condensing pressure (packaged condensing units)
6)Motor overload

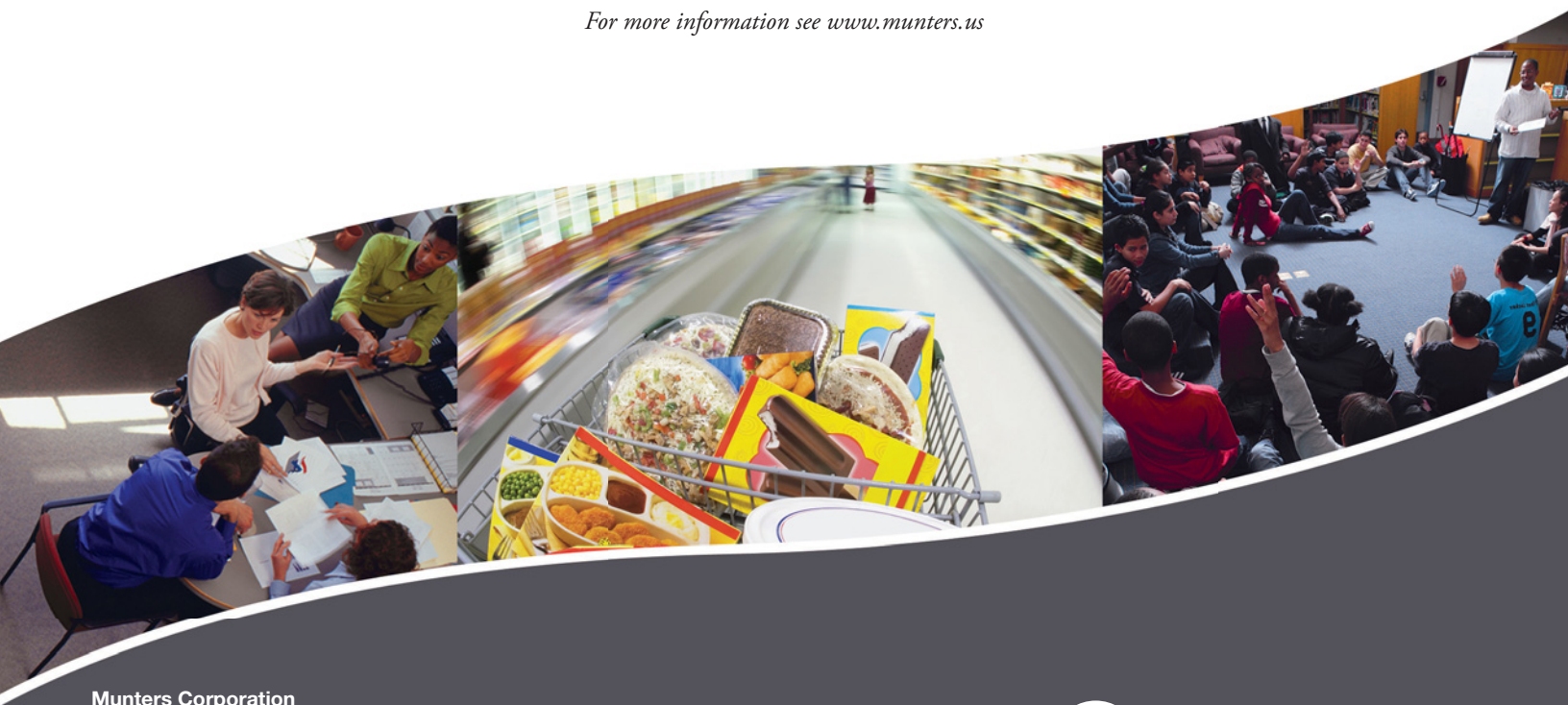
E)Operating and maintenance manual
The control cabinet shall include a copy of the O & M manual, mounted in a separate compartment or pocket to allow access to critical information by maintenance personnel after installation.

F)Disconnecting Means
Unit shall have a built in non-fused means of disconnecting from the power supply.

## Munters is a global leader in energy efficient air treatment solutions.

Munters manufactures engineered products that can economically control humidity and temperature, provide energy recovery, and/or utilize direct or indirect evaporative cooling for comfort, process and environmental protection. With permanent or temporary solutions, Munters offers a wide variety of options to meet specific climate, application and budget requirements. Munters has net sales approaching $1 billion USD with more than 20 manufacturing facilities across the globe and sales offices in over 30 countries. Munters employs approximately 4,300 people worldwide.

*For more information see www.munters.us*



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EC0001-03 02/09