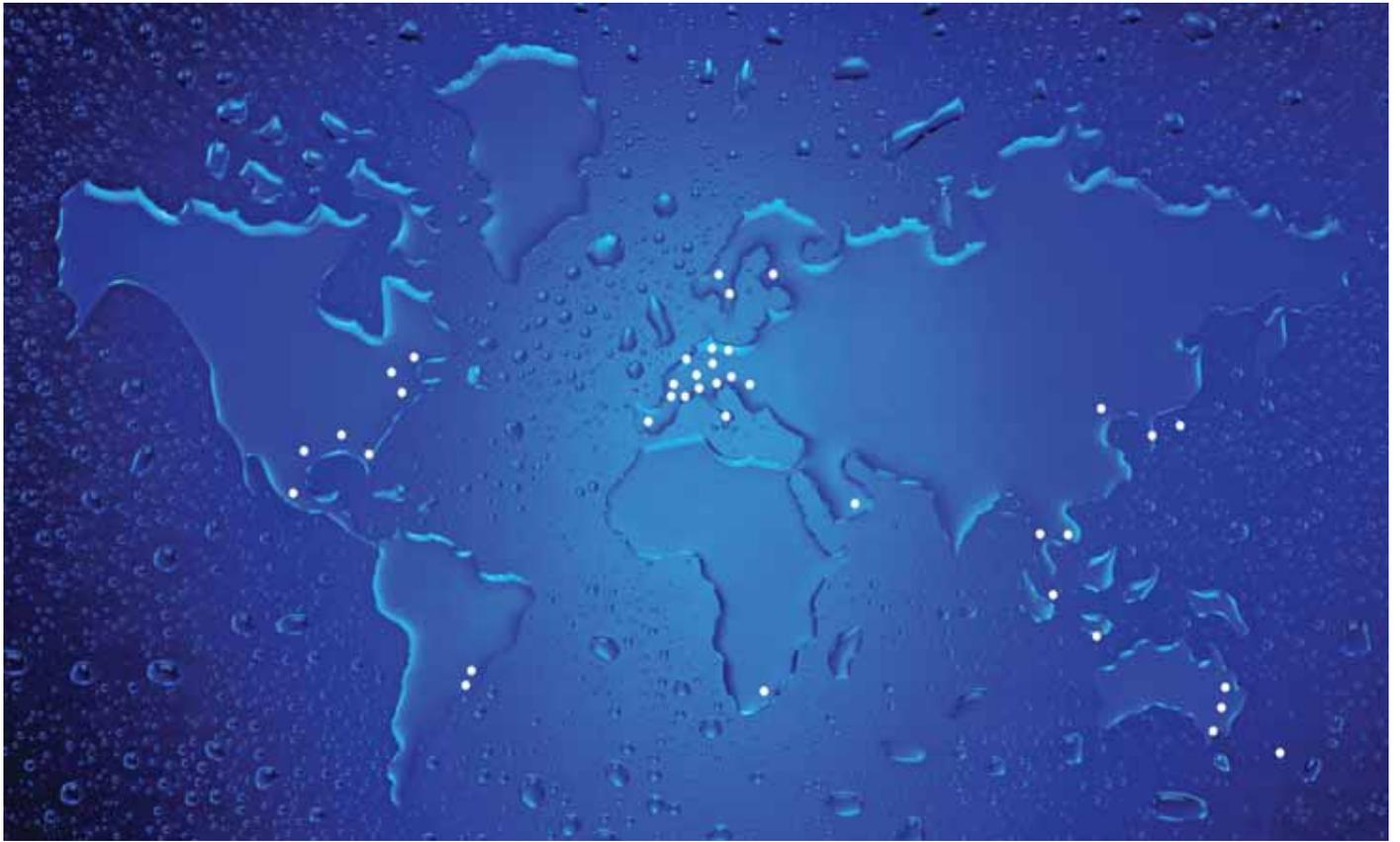


DEHUMIDIFICATION: Ice Arena Application & Product Guide

Design, construct and operate
to control indoor humidity in ice rinks





Munters is the world leader in dehumidification

Munters is the largest manufacturer of dehumidifiers in the world. Since developing the first desiccant dehumidifier in the 1930's, Munters has provided dehumidifiers to over 1,500 ice rinks and arenas. We are the NHL preferred supplier for desiccant dehumidifiers. Our long history and extensive expertise in ice arena dehumidification makes us the premier choice for your dehumidification needs.

Ice rinks experience a multitude of issues associated with the control of the air conditions in the space. These issues are primarily associated with humidity in the air and include: fog, condensation, drips, “mushrooms”, mildew stains, peeling paint, rust and corrosion, and poor ice quality. In addition to these issues, operators may incur increased operating cost, more resurfacing operation, and reduced rentable ice time if the humidity is not properly controlled in a rink. By utilizing a desiccant dehumidifier to efficiently provide low humidity conditions, operators can eliminate the issues associated with poor air conditions in ice rinks.

Munters offers a variety of systems in several different sizes and configurations to meet the customer's needs.



Munters, The Humidity Expert

Our extensive knowledge and experience makes us the premier choice for your dehumidification needs.

Building Design

The three most important elements when designing an ice rink facility are the envelope, ice sheet and air dehumidification. Provided are some basic suggestions the owner and architect should consider before the HVAC engineer sizes and selects equipment. Refer to the ASHRAE Humidity Control Design Guide for additional guidance.



- ❑ Design a tight building enclosure
- ❑ Vapor barrier goes on outside of insulation regardless of building location
- ❑ Low-e (emissivity) ceilings help reduce the load on the ice sheet;
- ❑ Avoid window installation on the west exposure of building where solar load is greatest
- ❑ Provide people access through a vestibule with airlock to reduce infiltration
- ❑ Consider location and access of the resurfacing machine to minimize outdoor air leakage

HVAC System Design

Calculating the dehumidification load and outside air (OA) quantity is the first step in sizing the HVAC system for an ice rink. Since the ice sheet typically provides the entire cooling requirement (approx 30 to 50 tons of cooling effect), the HVAC systems primary function in an ice rink is to dehumidify.

The outside air or OA is the largest dehumidification load for the rink. Outside air is brought into the space to dilute contaminants and maintain IAQ requirements. It is most effective to dehumidify or treat the OA before it enters the building and to use dew point sensor control, not relative humidity control. In addition, by incorporating CO and CO₂ sensors or an occupied/unoccupied mode time clock the facility will be able to reduce and monitor the amount of OA being delivered to the space.

Since ice rinks require a large outside air quantity and the differential between space condition and outside air condition can be extreme, energy recovery is often a good enhancement to the dehumidifier. An enthalpy wheel can be added to dehumidification equipment to lower the work required by the active desiccant dehumidification portion of the equipment and provide substantially lower operating costs.

Once the equipment has been selected, it needs to be positioned and ductwork sized and arranged. Air distribution is generally routed around the rink, but care should be taken so that supply air does not discharge on to the ice surface as sublimation or melting of the ice is possible. High supply parallel to the floor has worked well with the return at floor level and close to the unit.

Units mounted inside require condensation control for specific ductwork system to avoid moisture problems. Outside air duct should be positively drained and insulated to minimize and control condensation inside the ductwork in the summer. Reactivation ductwork for desiccant systems should be treated the same as outside air ductwork.

A common mistake in facilities with multiple sheets is to utilize common return ductwork from all ice sheets. Supply and return ductwork should be designed so that individual ice sheets can be isolated when they are taken offline for non use periods or maintenance. High return conditions will overload the capacity of the dehumidification equipment if return from an offline sheet is allowed to recirculate through the dehumidifier.





Space Conditions

The majority of ice rinks in the United States operate at 35°F dewpoint with 55° to 65°F temperature.

A 35°F dewpoint minimizes the humidity impact on the ice and the rink facility. The temperature is low enough to provide for efficient ice plant operation without being too cold for skaters and spectators.

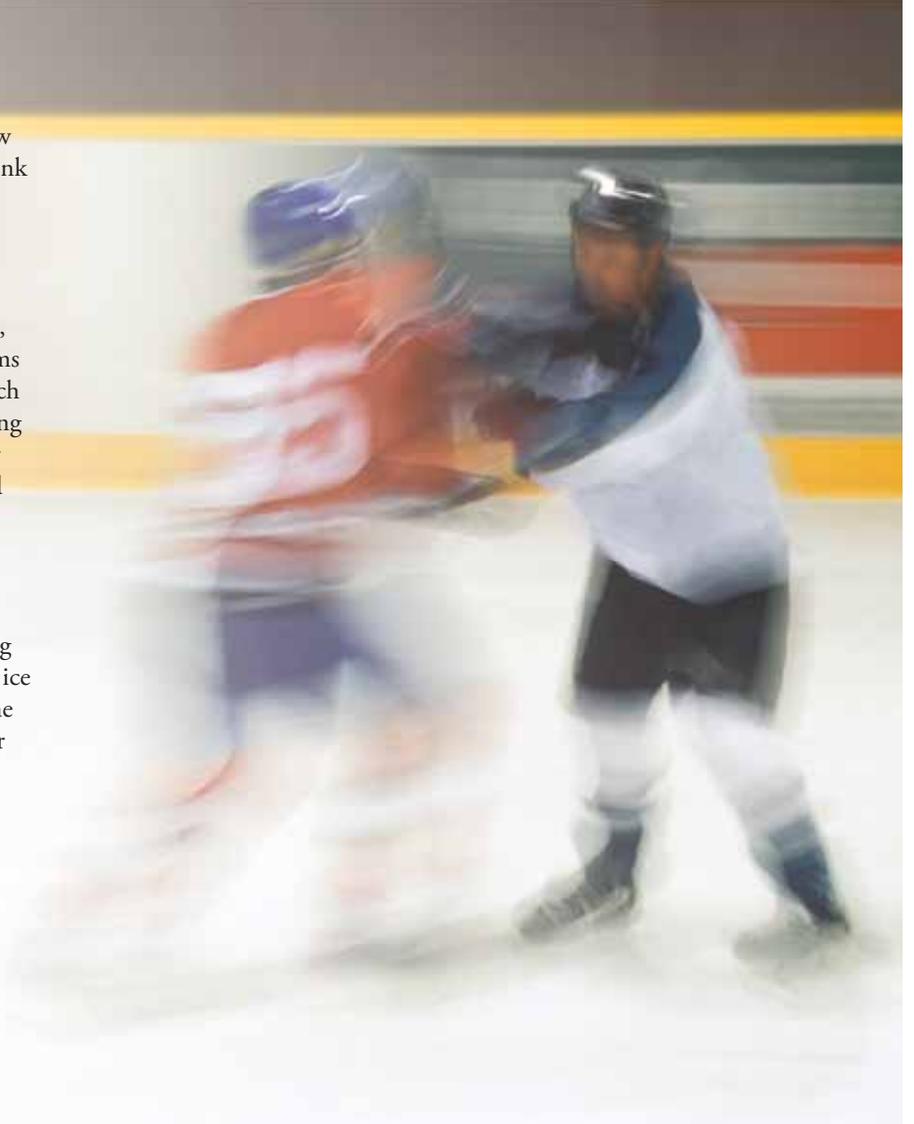
Get to the point...the dewpoint.

Controlling the rink conditions at a low dewpoint benefit the rink occupants, the rink facility, and the rink owners and operators.

Risks associated with high humidity, such as sight obstructing fog and uneven, frosty ice surfaces can cause physical harm to the skaters. In addition to safety hazards, excess moisture in areas such as locker rooms encourages mold growth and bacteria, which impacts IAQ and occupant health. Providing a low dewpoint minimizes the opportunity for risks associated with high humidity and poor IAQ .

High humidity in the space also increases condensation on the building structure and components, which can lead to rust, corrosion, and decrease the building longevity. In addition, the efficiency of the ice making refrigeration plant suffers due to the increased costs to eliminate the water vapor on the ice surface.

Dehumidifying the rink to a low dewpoint creates significant benefits by enabling the rink to extend the season and operate efficiently in all climates. By increasing the amount of days the rink operates, the rink can achieve greater profitability.





TO SELECT A DEHUMIDIFIER

Use the worksheet and formulas below to calculate the total moisture load of your ice arena.

1. What is the building size? _____
TOTAL SIZE (ft²)
2. Maximum occupancy of building? _____
3. How much outside air (OACFM) is needed? See **A**

$$\frac{\text{SPECTATOR AREA (cfm)}}{\text{SPECTATOR AREA (cfm)}} + \frac{\text{PLAY AREA (cfm)}}{\text{PLAY AREA (cfm)}} = \text{OUTSIDE AIR (cfm)}$$
4. Using ASHRAE design dewpoint conditions*, determine the outside air grains.

5. Calculate the delta grains. See **B**

$$\frac{\text{OUTSIDE AIR GRAINS (Answer from question 4)}}{\text{OUTSIDE AIR GRAINS (Answer from question 4)}} + \frac{\text{INDOOR SPACE GRAINS**}}{\text{INDOOR SPACE GRAINS**}} = \Delta \text{ GRAINS}$$
6. Calculate your building's infiltration leak rate? See **C** _____ (lbs/hr)
7. Calculate the people load. See **D** _____ (lbs/hr)
8. Calculate the total moisture load (lbs/hr) of the building. See **E, F, A, B**

$$\frac{\text{INTERNAL LOAD (lbs/hr)}}{\text{INTERNAL LOAD (lbs/hr)}} + \frac{\text{OA LOAD (lbs/hr)}}{\text{OA LOAD (lbs/hr)}} = \text{TOTAL MOISTURE LOAD}$$

Using the total moisture load, refer to the product dehumidification capacity charts on page 5 and 6 to estimate a suitable equipment size for your arena.

FORMULAS AND CONVERSIONS

A OACFM = Ventilation Air Quantity (cfm)
 * Sports arena (play area) = 0.30 cfm/ft²
 * Spectator area = 0.06 cfm/ft² + 7.5 cfm/person

B Δ Grains = difference in absolute humidity of the outside air and the indoor space (gr/lb)

C Infiltration	Leak Rate
Tight	0.1 cfm/ft ²
Average	0.3 cfm/ft ²
Loose	0.6 cfm/ft ²

Convert cfm into lbs/hr using following formula:
 lbs/hr = 0.000643 x CFM x Δ Grains

D People Load (per person)	lbs/hr
Seated at rest	0.10
Seated, light work	0.20
Moderate Dancing	0.52
Light Exercise	0.83
Medium Athletic Activity	0.92
Athletics	1.04

E Internal Load (lbs/hr) = Infiltration + People Load

F OA Load (lbs/hr) = humidity load of outside air
 *lbs/hr = 0.000643 x OACFM x Δ Grains

* Refer to the ASHRAE Humidity Design Guide for these conditions

** NHL suggests indoor arena conditions be held at a 35°F dewpoint or 30 grains

Locker Rooms are the Forgotten Space

Frequently air is blown into locker rooms from the rink, or exhaust fans are used to migrate air from the rink to the locker rooms. "Rink air" is very expensive to produce and it is not encouraged to release that cool, low dewpoint air for distribution to other areas of the arena. It is more cost efficient to install smaller, separate systems to condition the locker rooms and other common areas.

The building load differs greatly depending on the type of occupancy and the quantity of people in any specific area during that time. For example, after a game a large quantity of people typically crowd the locker room with increased metabolisms and raised temperatures. This type of swing occupancy in a space needs a dedicated system to efficiently control the space conditions and provide healthy IAQ for occupants. If designed properly, the system will contribute to the total building energy savings by cycling off exhaust fans when the space is not occupied to minimize operating costs.



FreeDry™



Product Description

FreeDry™ combines advanced low temperature desiccant technology with refrigeration based technology. Utilizing the benefit of both technologies provides a dehumidifier that can provide and maintain low dew point in the space at very low operating cost. In addition, the FreeDry™ system provides lower leaving temperature is the summer to minimize the load on the ice sheet.

The FreeDry™ system uses the condenser side of a heat pump circuit to reactivate a desiccant dehumidification wheel. The efficiency of this cycle provides an extremely efficient reactivation input.

The evaporator side of the circuit can be used to provide cooling to the supply air in higher ambient conditions or is rejected to the condenser water loop for the refrigeration plant to lower the heat rejection requirements of the condenser loop. The pre-cooling can be a brine coil utilizing the refrigeration plant or package DX built into the unit.

The system can be sized to handle the outdoor air requirement of the facility and can provide modulating or demand control ventilation. In non ice event mode the system can provide cooling and heating to maintain more tradition space conditions.

FreeDry™ Capacity Chart

Airflow CFM	Performance 0% Fresh Air ¹			Performance 100% Fresh Air ¹			Dimensions L x W x H	Weight Pounds
	Energy Input ²	Moisture Removal	Supply Air ⁴	Energy Input ³	Moisture Removal	Supply Air ⁴		
6000	7.0 kW	54 lbs/hr	68°F	22.1 kW	231 lbs/hr	77°F	203 x 96 x 71	6300
8000	9.4 kW	68 lbs/hr	69°F	29.5 kW	324 lbs/hr	75°F	203 x 96 x 86	8500
12000	14.1 kW	108 lbs/hr	68°F	44.2 kW	462 lbs/hr	77°F	371 x 126 x 102	16000
16000	18.8 kW	136 lbs/hr	69°F	59.0 kW	648 lbs/hr	75°F	402 x 126 x 102	18000

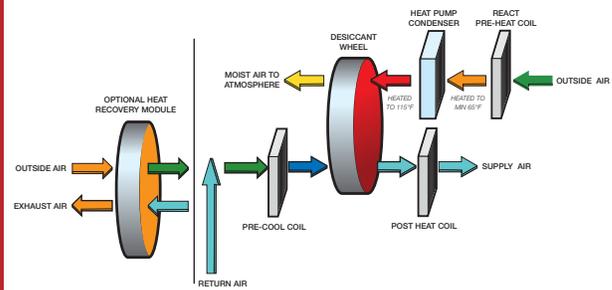
(1) Return Air Conditions = 55°F, 32 gr/lb / Fresh Air Conditions = 80°F, 120 gr/lb

(2) Heat Pump Compressor Only

(3) Heat Pump Compressor & Pre-Cool Energy

(4) Supply Air Temperature Indicated in Dehumidification Mode

FreeDry™ Airflow & Schematic



Features and Benefits

- Advanced low-temperature regenerated desiccant wheel
- Utilizes waste-heat from refrigeration compressors to regenerate the desiccant wheel
- Dual heat-pump and desiccant technology for unsurpassed efficiency
- Liquid or Packaged DX pre-cooling coil
- Waste-heat from refrigeration compressors for winter space heating
- Variable Frequency Drives for optimum performance
- Microprocessor controls with available BMS interface
- Foam injected 2" double wall casing
- Optional heat recovery module available for LEED certification

IceAire™ Desiccant



Product Description

The IceAire™ dehumidifier is installed in more ice rink applications than any other dehumidifier. It provides a low cost, low maintenance dehumidifier for the low humidity levels associated with ice rinks. It utilizes a direct fired gas burner or steam to reactivate a desiccant wheel. This allows the air stream to be dried to extremely low levels to provide maximum capacity.

The system can be configured with optional energy recovery wheel, cooling coils, heating coils and burners, and packaged dx condensing sections. It can be configured to handle up to 100% outside air and can modulate the outside air quantity.

The high temperature reactivation allows for the delivery of supply air conditions as low as 10°F dewpoint.

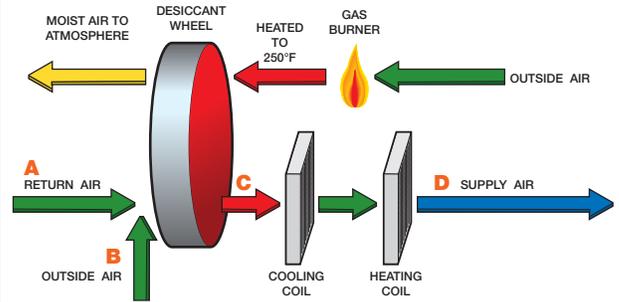
The simple direct fired burner reactivation and slow turning desiccant wheel (0.1 RPM) provide a very simple, very reliable dehumidification system.

This low leaving air condition provides extremely large capacity in a small airflow and cabinet size.

IceAire™ Desiccant Capacity Chart

Unit	OA	Maximum CFM Return	Total	Minimum Exhaust	Maximum Exhaust	Tons	Dehumid lbs./hr.	Dimensions LxWxH	Weight Pounds
DDS 20	10,000	10,000	10,000	250	10,000	100	250	219 x 80 x 70	6,500
DDS 30	30,000	30,000	30,000	500	15,000	200	350	219 x 96 x 101	8,500
DDS 40	50,000	50,000	50,000	1,000	25,000	300	500	280 x 134 x 101	10,500

IceAire™ DDS Airflow & Schematic



State	No Outside Air			With Outside Air		
Point	CFM	°F	gr/lb	CFM	°F	gr/lb
A Outside Air	0	75	70	2,500	95	120
B Return Air	10,000	55	30	7,500	55	30
C Post Desiccant Wheel	10,000	83	4	10,000	100	17
D Supply Air	10,000	55	4	10,000	60	17

■ Features and Benefits

- Foam injected 2" double wall casing
- High temperature desiccant cycle for low leaving dewpoints
- Optional DDC microprocessor controls
- Option for modulating outside air
- ETL listed
- Optional energy recovery wheel for high outside air applications
- Packaged DX, split system or chilled water options



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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