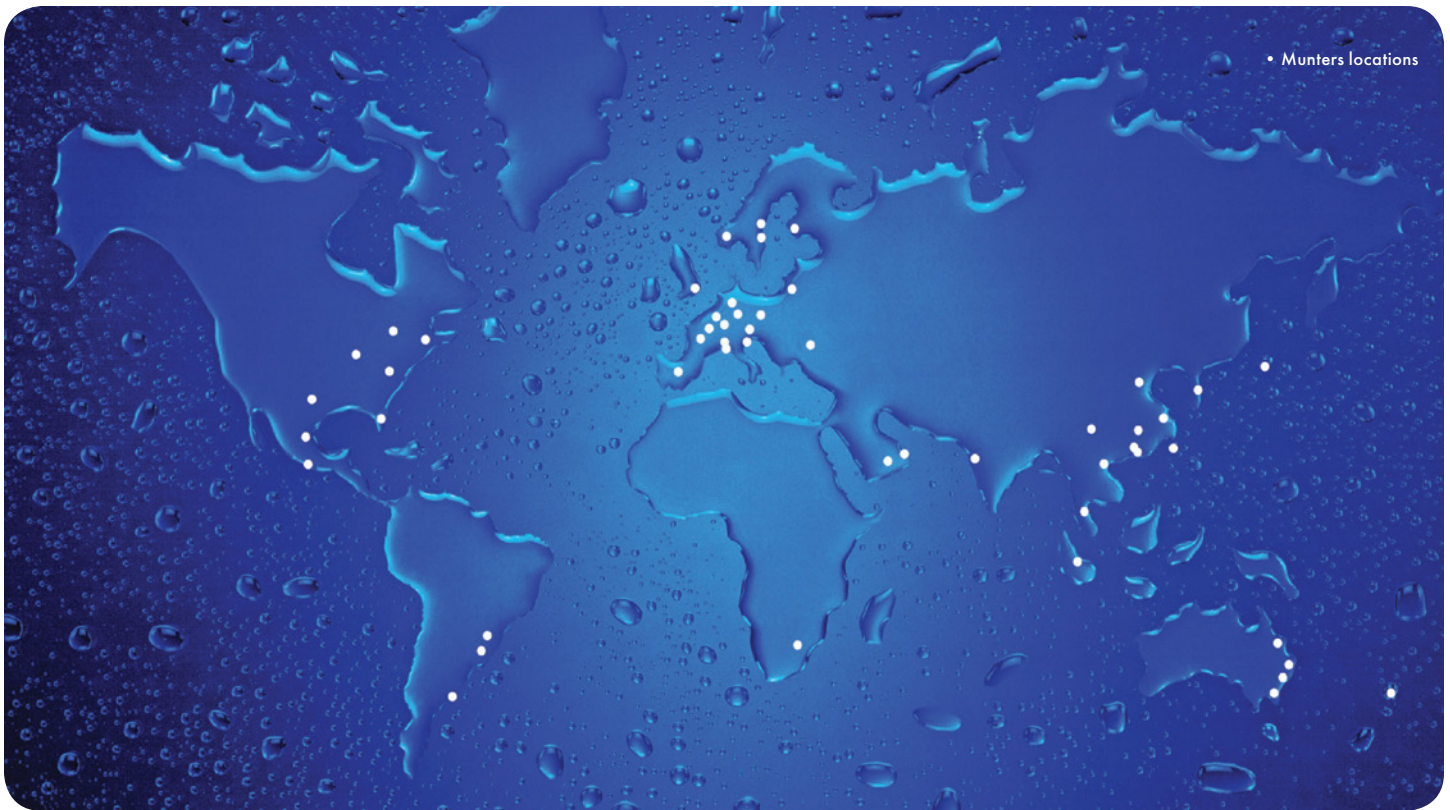


SCHOOL APPLICATION GUIDE

Smart ventilation solutions
Unique products for every room in your school





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 late 1930's, Munters has continued to innovate in the fields of dehumidification and energy recovery. Our long history and extensive expertise in dehumidification makes us the premier choice for your dehumidification needs.

School Districts and Design Professionals are faced with ever increasing challenges when designing and operating educational facilities. ASHRAE Std 62.1 prescribes the amount of outside air (OA) that must be introduced into the building to ensure good Indoor Air Quality (IAQ). Good IAQ helps keep students attentive during class and helps decrease absenteeism of students and faculty. Introducing OA has some perceived negatives in regards to cost incurred to heat, cool, and dehumidify the OA. There is also fear that unwanted moisture may potentially be introduced into the space with the OA. Poor humidity control can lead to moisture related problems such as building damage and mold growth. Add to these challenges the energy efficiency directives of ASHRAE 90.1 and design professionals are left with many things to consider. Over the past 15 years, many different designs were implemented, some successfully and some less so. In 2007 ASHRAE released the newest version of HVAC Applications that describes the most successful approach and should be considered the best design practice for educational facilities.



Munters, the humidity expert
Our extensive knowledge and experience makes us
the premier choice for your dehumidification needs.

Munters + stimulus plan = a winning grade

In February 2009, the President signed the American Recovery and Reinvestment Act of 2009 (ARRA) that will supply federal funding towards modernization, renovation and repair of our U.S. educational facilities.

The bill offers a tremendous opportunity for schools to maximize their funding with Munters energy saving ventilation products. With the emphasis on green schools, energy efficiency, indoor air quality and having a High Performance School, Munters products will help create the optimum learning environment.

Munters wide range of air quality equipment provides ventilation solutions for every room of the school and can potentially help a school earn LEED credits and qualify for utility rebates.

To find out more visit our website at www.munters.us/schoolstimulus, call 1-800-843-5360 or e-mail dhinfo@munters.com.

Conclusion

The recommended school design utilizes a DOAS system to not only remove the moisture from the outside air, but to also deliver the air to the space dry enough to absorb internal moisture loads, such as people, infiltration, and other sources. This allows the space HVAC system to be smaller, only needing to treat the sensible load of the space.

The DOAS needs to be as energy efficient as possible, utilizing energy recovery and/or desiccant technology to reduce operating costs associated with loads and to achieve the low dewpoints required for the space.

Notes:

- Design in accordance with ASHRAE standards
- Ensure familiarity with, and adherence to, all state and local building codes and standards
- Install DOAS to pre-treat ventilation air and provide continuous humidity control
- Avoid moisture in ductwork
- Design for peak dew point conditions- not peak dry bulb temperatures
- Install load reduction equipment when possible
- Apply for utility rebates





Munters offers multiple solutions

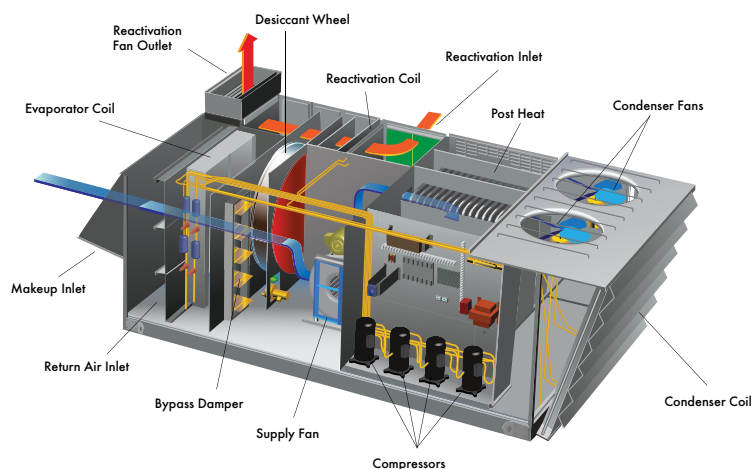
Save up to 60% on operation

Munters desiccant and energy recovery DOAS equipment is optimized for energy savings and performance. Systems not only remove ventilation loads, but can efficiently deliver low dewpoints to the space at sensible room neutral conditions. By utilizing a DOAS from Munters, your school can create a healthier learning environment, increase productivity, and save operating costs.

DryCool™

DryCool products are designed to meet dehumidification requirements for the entire building, providing 100% makeup air at space neutral temperature and below space humidity. The core of DryCool's technology is the condenser reactivated desiccant wheel. The evaporator coil provides cooling prior to the desiccant process and energy recovery devices such as heat recovery wheels and heat pipes can be incorporated to optimize performance. The DryCool product line also uses R-410a refrigerant and the latest scroll compressor technology for reliable, efficient and environmentally friendly operation. Units range from 200 to 16,000 cfm and are applicable to all buildings.

DryCool™ airflow & schematic



Wringer™

Energy recovery and dehumidification are the key ingredients to this product family. A cooling coil is used to provide dehumidification with heat exchangers providing energy recovery for free cooling prior to the cooling coil and free reheat after the cooling coil. Configurations are available with or without exhaust recovery. Units are available up to 100,000 cfm with virtually any option and configuration available.

Oasis™

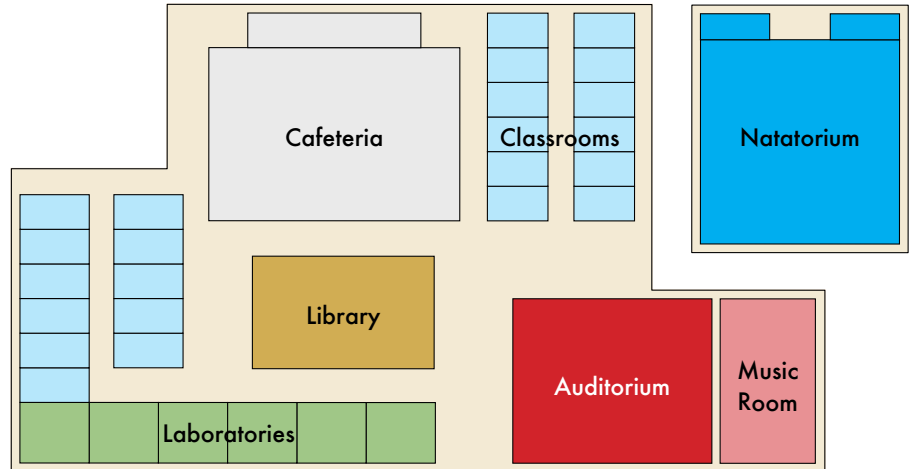
Ideal for hot and dry climates, the Oasis uses a corrosion-resistant polymer heat exchanger to produce dry, cool air without refrigeration. This allows a significant reduction in peak electrical demand as the unit treats makeup air for 50% less energy and provides cooling, energy recovery and winter heat recovery. In many cases, on a design summer dry bulb day, the system can lower the incoming air temperature

by 30°F or more. Units are available up to 100,000 cfm with virtually any option and configuration available. With efficiencies as high as 100 EER achieved, Oasis systems have earned utility rebates and LEED credits for buildings.

Best design practice: divide and conquer

Educational facilities have a unique mix of applications, many of which will be housed under one roof. Each space will require a HVAC system that can heat and cool the space as well as bring in the required amount of ventilation air.

The HVAC system chosen may be a centralized system, such as a chiller plant, with ductwork distributing air to each space through fan coil units, VAV boxes, or a chilled beam system. The design may also call for a decentralized system where each space has its own cooling/heating device such as a single zone water source heat pump (WSHP).



ASHRAE 2007

HVAC application handbook

(6.7) "Although most centralized and decentralized systems are very effective at handling the space sensible cooling and heating load, they are less effective (or ineffective) at handling ventilation air and the latent loads. As a result, a dedicated outdoor air system (DOAS) should be used."

Further on, ASHRAE states that DOAS should be used to also control the space moisture levels. "It is preferable, however, to introduce the outdoor air at a lower humidity ratio than the desired space humidity ratio, to allow the zone HVAC unit to handle only the space sensible load."

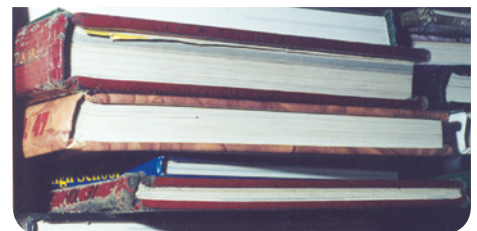
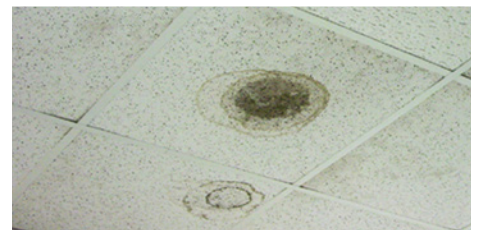
This system divides out the moisture component from the room's A/C system to conquer the many issues associated with building moisture control, energy efficiency, IAQ and others.

This method is quite a change from traditional engineering.

Typically, engineers wanting to use a DOAS

would plan to use a system that would deliver OA at a "neutral" condition, 75°F and 55°F dewpoint. This delivered condition is commonly associated with maintaining 75°F and 50% RH. A simple DOAS can accomplish these conditions during the cooling season by processing OA through a cold coil down to a 55°F saturated condition and then reheating the air back up to 75°F, ensuring the air be delivered at 55°F dewpoint.

However, introducing OA at a 55°F dewpoint will not hold the space at 50% RH. A classroom will generate its own additional moisture from the students, space processes (such as in a lab), and infiltration. Schools that mop or steam clean carpets on a regular basis will introduce an incredible amount of additional moisture to the space. All of this additional moisture must be removed from the space in order to control RH within the recommended 40-60% range. Without this moisture control, structural damage and occupant health risks can happen.



Control the moisture level in every room of your school.

Moisture affects the entire school building from the actual structure to its occupants and their health. Mold is a sure sign of moisture-related issues.



The Munters DryCool™ product line is ideal for makeup air applications such as schools.

Divide and conquer: sensible and latent loads

The best design practice uses a DOAS to manage the latent load and the A/C system to handle the sensible load only. This method not only increases the HVAC system efficiency, but will provide superior IAQ and moisture control.

Classrooms and other school spaces must be ventilated to remove odors and pollutants. A typical classroom using a DOAS system distributes OA to the rooms through a dedicated diffuser or introduced through the return air duct of the sensible cooling system.

To absorb internal latent loads properly you must design the DOAS to deliver air at a lower dewpoint than the required dewpoint condition. The dry supply air will help absorb additional internal moisture, keeping the space at desired dewpoint conditions and preventing moisture related problems.

The national consensus standard for outside air ventilation is ASHRAE Standard 62.1 - available at www.ashrae.org

Take a basic classroom with 30 students and estimate that each student needs 15 cfm of outside air. If each student gives off an average of 180 btu/h of moisture, how dry would the supply air need to be to absorb the students moisture load and maintain 65 gr/lb in the space? (65 gr/lb = 75°F and 50% RH or a 55°F dewpoint)

SUPPLY HR REQUIRED TO ABSORB PEOPLE LOAD

OA CFM: 15 cfm x 30 people = 450 cfm

People Load: 30 people x 180 btu/h = 5,400 btu/h

Latent btu/h = .68 x cfm x Δ Humidity Ratio

5,400 = .68 x 450 x Δ Humidity Ratio

5,400/306 = Δ Humidity Ratio

Δ Humidity Ratio = 18 gr/lb

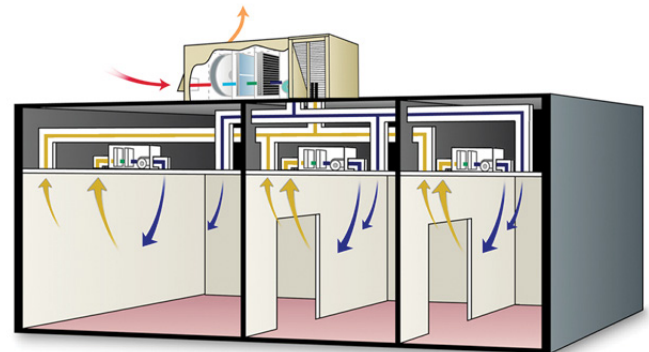
Supply HR = Space HR (65 gr/lb) - Δ Humidity Ratio (18 gr/lb)

SUPPLY HR = 47 GR/LB

Introducing 450 cfm at 47 gr/lb handles the 5,400 btu/h people load. But what about the infiltration moisture load assumed by ASHRAE? Many design consultants do not consider infiltration when calculating internal loads. To comply with the best design practice engineers must size the DOAS to take the entire internal latent load away from the space A/Cs.

Table 1: Typical Classroom Summer Latent (Moisture) Loads		
Category	Moisture Loads lb/h	Moisture Loads %
People	7.3	22.5
Permeance	0.2	0.6
Ventilation	20.3	62.5
Infiltration	4.7	14.4
2007 ASHRAE Handbook - HVAC Applications, 6.6		

Table 1: shows that for a typical classroom the ventilation air contains the greatest amount of moisture load at 62.5%. In addition the people and infiltration moisture load can account for up to 37%.



Take the same classroom example, but add an outside exposed wall with a design day moisture content of 131 gr/lb, typical of Atlanta, Wichita, Baltimore and Chicago. Running the infiltration calculation below shows that the total internal load significantly increases when the moisture from infiltration is added to the equation.

INFILTRATION LOAD EXAMPLE

40' wall x 8.5' wall = 340 ft²

340 ft² x .2 cfm/ft² leak rate = 68 cfm infiltration

btu/hr = .68 x cfm/ft² x (Design Day HR - Space HR)

68 cfm x .68 x (131 gr/lb - 65 gr/lb) = 3,050 btu/h infiltration

TOTAL INTERNAL LOAD = PEOPLE + INFILTRATION

Internal Load: 5,400 btu/h + 3,050 btu/h = 8,450 btu/h

SUPPLY HR REQUIRED TO ABSORB TOTAL INTERNAL LOAD

Internal Load = CFM x .68 x Δ Humidity Ratio

8,450 = 450 x .68 x Δ Humidity Ratio

8,450/306 = Δ Humidity Ratio

Δ Humidity Ratio = 27 gr/lb

Supply HR = Space HR (65 gr/lb) - Δ Humidity Ratio (27 gr/lb)

SUPPLY HR = 38 GR/LB

To properly maintain the space at 75°F and 50% RH, the OA needs to be introduced at 38 gr/lb or a 41° F dewpoint. This is extremely dry and not attainable with standard HVAC equipment.

DEWPOINT OF 450 CFM OA TO ACHIEVE:

75°F/ 50% RH = 41°F dewpoint

75°F/ 55% RH = 45°F dewpoint

75°F/ 60% RH = 48°F dewpoint



To select a dedicated outside air system

What humidity ratio does the DOAS need to deliver or supply to the space? Use worksheet below.

1. Number of people in the space: _____
2. Based on ASHRAE 62, how much ventilation or OA is required: _____ cfm
3. Calculate the people load: $\frac{\text{\# of people}}{\text{(from question 1)}} \times \frac{\text{btu/h}}{\text{space HR}} = \text{_____} \text{ btu/h}$
4. Desired Space HR (ex. 75F db at 50% RH = 64.7 gr/lb): _____ gr/lb
5. Design Day HR (ASHRAE design dewpoint day): _____ gr/lb
6. Infiltration OA HR differential: $\frac{\text{design day HR}}{\text{(from question 5)}} - \frac{\text{space HR}}{\text{(from question 4)}} = \text{_____} \text{ gr/lb}$
7. Calculate the infiltration leak rate:
 $\frac{\text{ft}^2 \text{ of space}}{\text{leak rate (cfm/ft}^2\text{)}} \times \frac{\text{infiltration differential}}{\text{(from question 6)}} \times .68 = \text{_____} \text{ btu/h}$
8. Δ Humidity Ratio:
 $\frac{\text{internal load}}{\text{(question 3 + 7)}} / \left(\frac{\text{OA CFM}}{\text{(from question 2)}} \times .68 \right) = \text{_____} \text{ gr/lb}$
9. Required DOAS Supply HR: $\frac{\text{space HR}}{\text{(from question 4)}} - \frac{\Delta \text{ Humidity Ratio}}{\text{(from question 8)}} = \text{_____} \text{ gr/lb}$

FORMULAS AND CONVERSIONS

- Humidity Ratio (HR) = gr/lb
- Δ Humidity Ratio = difference in absolute humidity of the supply air and the indoor space
 $(\Delta \text{ Humidity Ratio} = \text{space HR} - \text{supply HR})$

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

btu/hr = .68 x cfm/ft² x (design day HR - space HR)

People Load (per person)	btu/hr	lbs/hr
Seated at rest	105	0.10
Seated, light work	210	0.20
Moderate Dancing	546	0.52
Light Exercise	872	0.83
Medium Athletic Activity	966	0.92
Athletics	1092	1.04

- Internal Load (btu/hr)
 = Infiltration + People Load

* Refer to the ASHRAE Handbook for design criteria and guidelines

Benefits

- Control moisture
- Improve IAQ
- Downsize sensible loads
- Lower total first cost*

*Based on smaller room A/C selections with associated lower electrical, and/or smaller pumps, duct connections, etc...





Munters is a global leader in energy efficient air treatment solutions

Using innovative technologies, our expert engineers create the perfect climate for customers in a wide range of industries, with the largest being food, pharmaceutical and data center sectors.

Munters has been defining the future of air treatment since 1955. Today, manufacturing and sales are carried out in 30 countries by around 3,000 employees. Munters reports annual net sales in the region of SEK 4 billion and is owned by Nordic Capital Fund VII.

For more information see www.munters.com

Australia Munters Pty Limited, Phone +61 2 6025 6422, Fax +61 2 6025 8266, **Austria** via sales organization in Germany, **Brazil** Munters Brasil Industria e Comercio Ltda, Phone +55 41 3317 5050, Fax +55 41 3317 5070, **China** Munters Air Treatment Equipment (Beijing) Co., Ltd., Phone +86 10 80 481 121, Fax +86 10 80 483 493, **Denmark** via sales organization in Sweden, **Finland** Munters Oy, Phone +358 9 83 86 030, Fax +358 9 83 86 0336, **France** Munters France S.A., Phone +33 1 34 11 57 50, Fax +33 1 34 11 57 51, **Germany** Munters Euroform GmbH, Phone +49 241 89 00 0, Fax +49 241 89 00 5199, **Indonesia** Munters, Phone +62 21 9105446-7, Fax +62 21 5310509, **Italy** Munters Italy S.p.A., Phone +39 0183-52 11, Fax +39 0183-521 333, **Japan** Munters K.K., Phone +81 3 5970 0021, Fax +81 3 5970 3197, **Kingdom of Saudi Arabia and Middle East** Munters, c/o Hawa United Cooling Syst. Co. Ltd., Phone +966 1 477 15 14, Fax +966 1 476 09 36, **Korea** Munters Korea Co., Ltd, Phone +82 2 761 8701, Fax +82 2 761 8777, **Mexico** Munters Mexico Phone +52 722 270 40 30, Fax +52 722 270 41 95, **Norway** via sales organization in Sweden, **South Africa** and **Sub-Saharan Countries** Munters (Pty) Ltd, Phone +27 11 997 2000, Fax +27 11 608 3501, **Spain** Munters Spain S.A., Phone +34 91-640 09 02, Fax +34 91-640 11 32, **Sweden** Munters Europe AB, Phone +46 8 626 63 00, Fax +46 8 754 56 66, **Switzerland** via sales organization in Germany, **Thailand** Munters (Thailand) Co. Ltd., Phone +66 2 645 2708-12, Fax +66 2 645 2710, **United Kingdom** Munters Ltd, Phone +44 845 644 3980, Fax +44 845 644 3981, **USA** Munters Corporation Fort Myers, Phone +1 239 936 1555, Fax +1 239 936 8858, Munters Corporation Mason, Phone +1 888 335 0100, Fax +1 517 676 7078, **Export & other countries** Munters, Phone +46 8 626 63 00, Fax +46 8 754 56 66.



Your closest distributor

Munters Corporation

Tel: (800) 843-5360 E-mail: dhinfo@munters.com www.munters.us