

DATA CENTERS

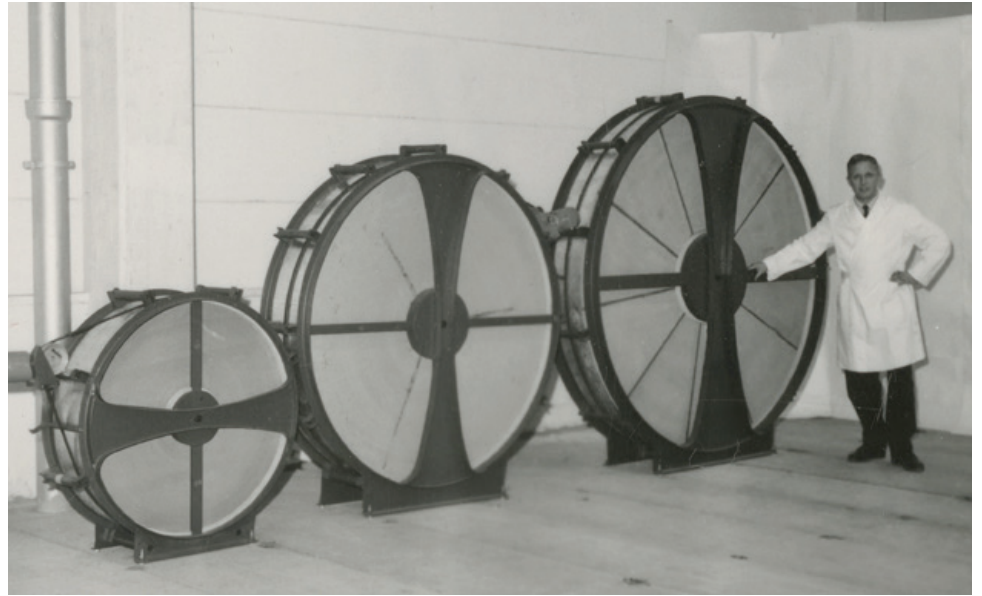


Energy Efficient Climate Control



Munters History of Innovation

Munters has been an industry leading innovator of climate control products since 1955. Desiccant dehumidification, direct and indirect evaporative cooling, and air-to-air heat exchangers are a few technology areas where Munters is recognized as a leader. Our history combining areas of core competency within packaged systems to meet customer needs is without equal in the industry. Driven by customer demand to reduce energy consumption, Munters has extensively applied its deep knowledge of direct/indirect evaporative cooling and air-to-air heat exchangers to provide products that efficiently reject heat from data centers.

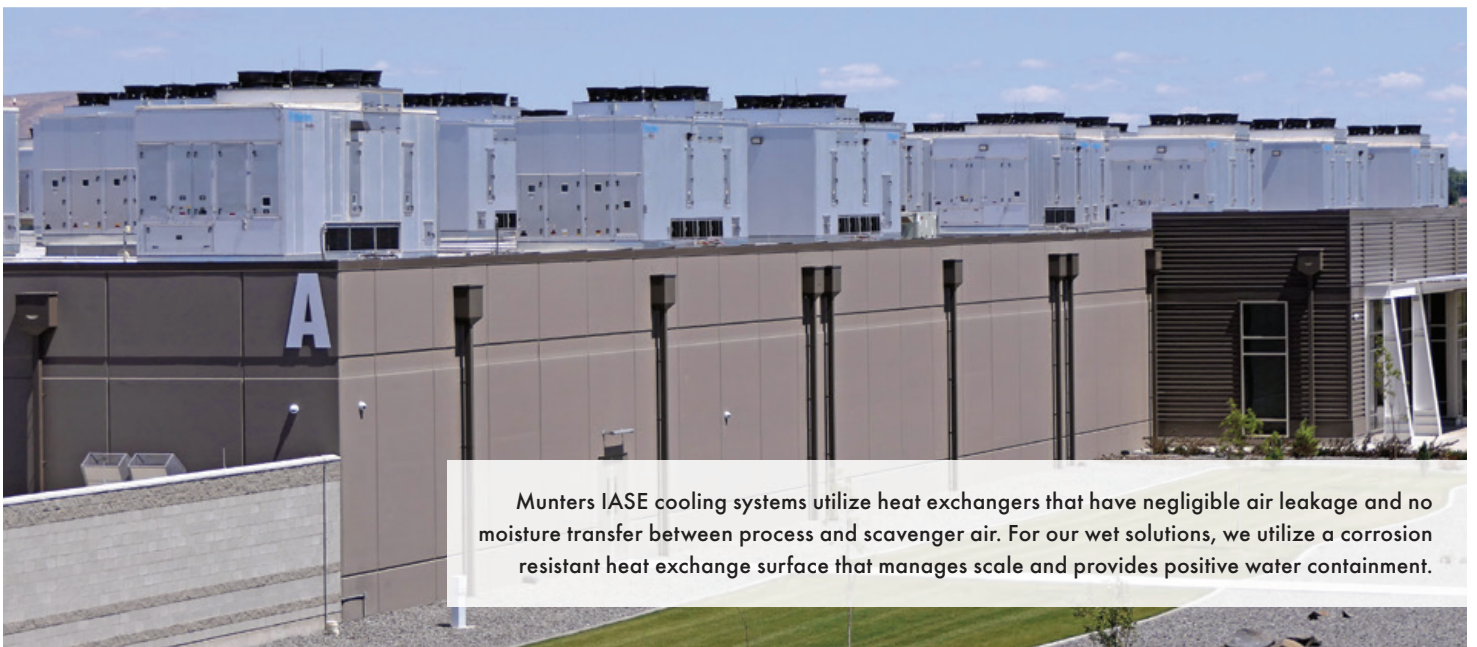


Data Center Cooling Technology

When choosing a Munters cooling solution there are a variety of considerations, including past experience, ambient design conditions, space operating envelope, water availability, and a balance between efficiency, cost and reliability. Some large hyperscalers utilize direct air-side economizers, usually

with direct evaporative cooling active during warm ambient periods. These data centers operate with an expanded temperature and humidity envelope. Other customers require more precise space control and are more sensitive to ambient pollution and humidity extremes, requiring a closed loop cooling solution.

Closed loop cooling may also incorporate the benefit of air-side economization using an air-to-air heat exchanger. Ambient air (scavenger air) is drawn through one side of the heat exchanger while the hot return air from the data hall (process air) passes over the opposite side of the heat exchanger.



Munters IASE cooling systems utilize heat exchangers that have negligible air leakage and no moisture transfer between process and scavenger air. For our wet solutions, we utilize a corrosion resistant heat exchange surface that manages scale and provides positive water containment.

Cooler scavenger air extracts heat from the process air, but the two air streams are completely separate.

Munters provides solutions for both direct and indirect economizer options. For indirect economizers, we utilize a variety of heat exchange technologies that work either exclusively dry or with a combination of dry (during cooler ambient conditions) and wet (evaporatively, during warmer ambient

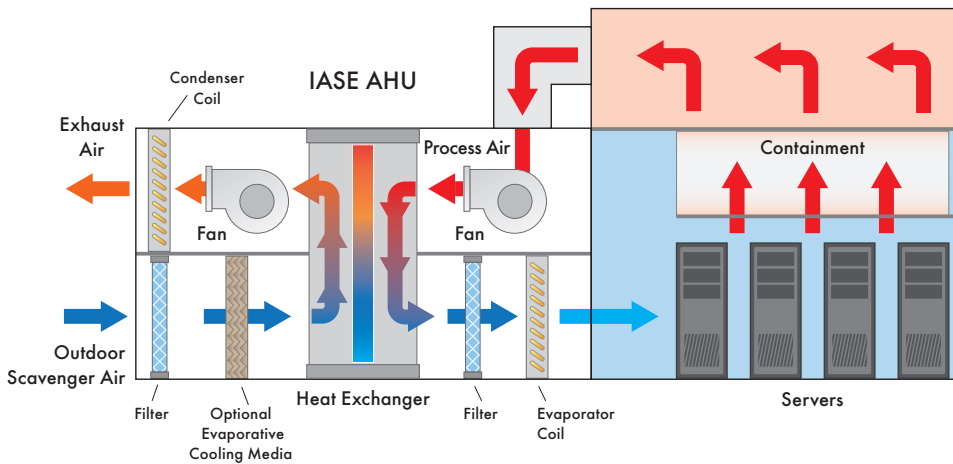
conditions) to reject data center heat to ambient air without the introduction of outdoor air into the data hall.

Dry solutions cool the process air toward ambient dry-bulb (DB) temperature while the wet (indirect evaporative cooling) solutions cool the process air towards ambient wet-bulb (WB) temperature. The approach of process air to ambient conditions is a measure of exchanger effectiveness. Munters typically

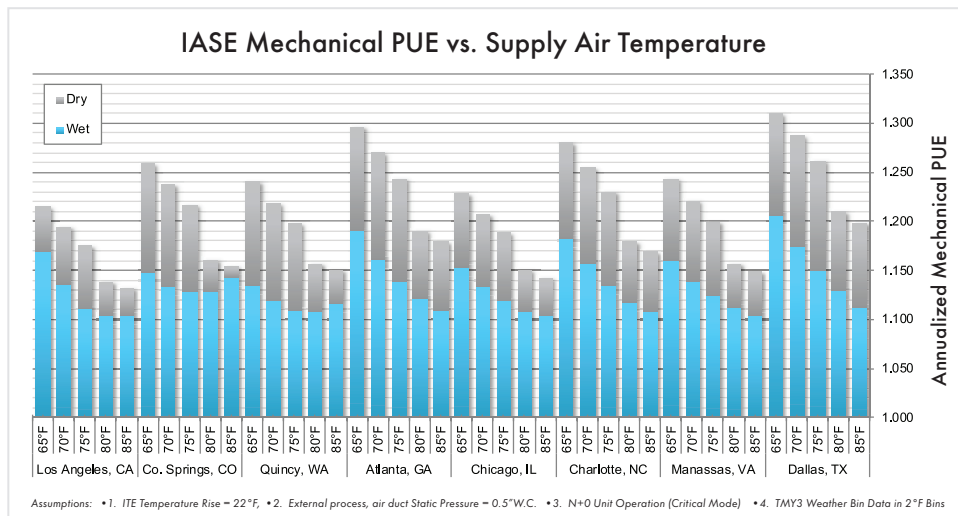
achieves up to 70% or better heat transfer effectiveness either dry (approach to DB) or wet (approach to WB).

With our indirect solutions, we can often satisfy data center cooling demands with no mechanical refrigeration deployed for most annual operating hours. In some cases, usually in dry and cooler climates, our wet heat exchanger solutions can eliminate the need for DX cooling completely.

Indirect Air-Side Economizer



The concept of IASE was used in the mid 70's with heat exchangers used to cool large DC motors operating in dirty coal mines. In the 90's, IASE's were used to cool remote mounted electrical enclosures for telecom. By 2007, data center cooling was considered as process air cooling, making the IASE concept a simple and viable energy efficient solution.



Both dry and wet IASE cooling approaches offer excellent performance with annualized pPUE's in the 1.1-1.3 range depending on location and operating temperatures.

Wet or Dry Packaged Solutions - 100 to 600 kW Capacity

Wet: Polymer Tube Heat Exchanger with Indirect Evaporative Cooling (Oasis®)



BENEFITS

- 70-80% approach to ambient wet bulb for maximum “economizer cooling”
- Reduce or eliminate mechanical cooling - peak PUE typically 1.25 or lower
- Positively contains water to the scavenger side of heat exchanger
- Polymer tubes flex during operation, shedding scale that forms during the evaporative process
- Polymer and stainless steel heat exchanger construction minimizes corrosion and helps manage scale formation
- Typically operates dry below 50°F reducing annual water consumption and eliminating freeze issues

Dry: Aluminum Plate or Heat Pipe Heat Exchanger with Sensible only Heat Transfer



BENEFITS

- Waterless technology
- 50-70% approach to ambient dry bulb for maximum “economizer cooling”
- No moving parts for maximum reliability and minimum maintenance
- Minimum filtration required for scavenger air (large HX plate spacing allows small particles to pass through)
- Economizer savings available when ambient temperature is less than data center hot air return

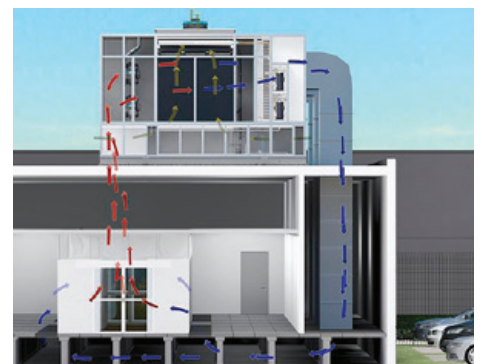
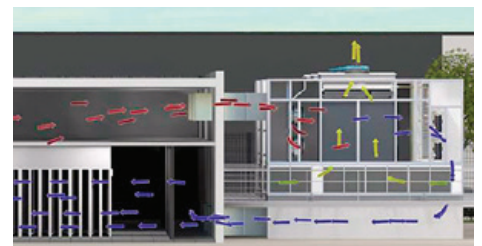
Mounting Configurations

PERIMETER MOUNT CONFIGURATIONS

Include supply and return air ducts on the same end. Typically, either a bottom plenum (shown) or top plenum routes air to or from the data center. Units can be grouped side by side to optimize layout.

ROOF MOUNT CONFIGURATIONS

Units can be installed on steel dunnage or roof curbs. Curb mounted versions can include a base-frame that is designed to self flash over the roof curb for ease of installation. Utilities can be routed from below or above the roof line through factory provided chases and penetrations. Munters' standard all welded stainless steel floor includes an upturn flange around all openings and unit perimeter to minimize the risk of water intrusion.



Dry Split Solution - 400 kW Capacity

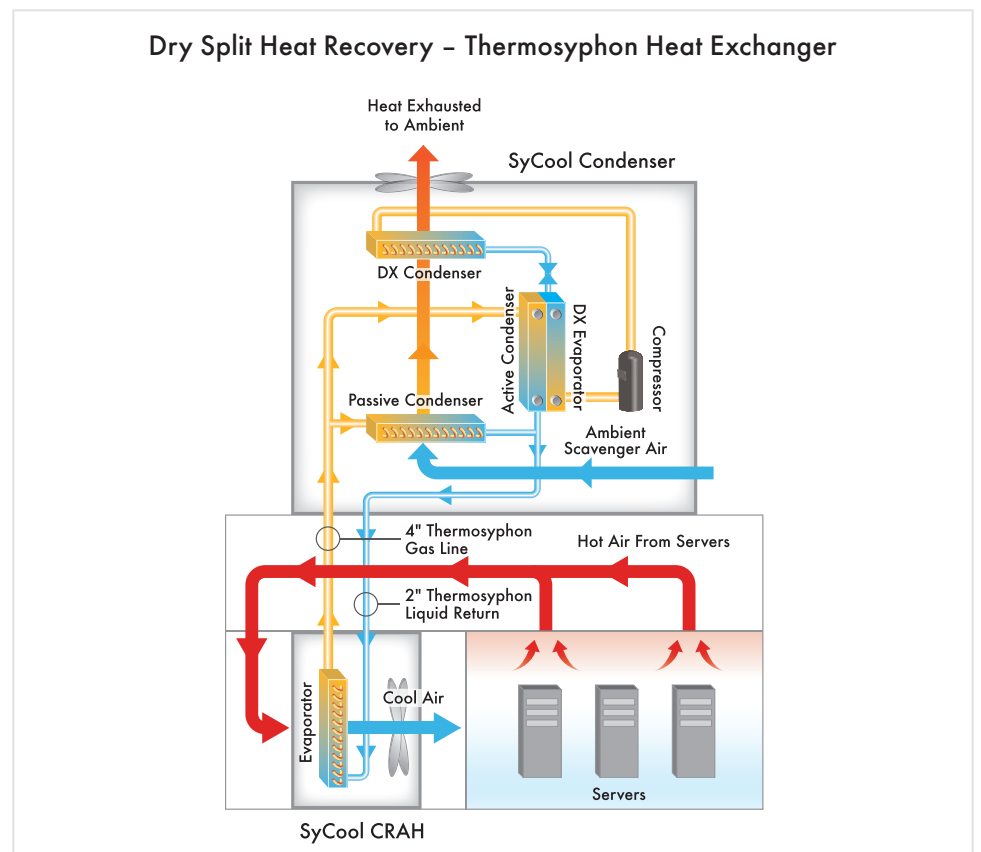
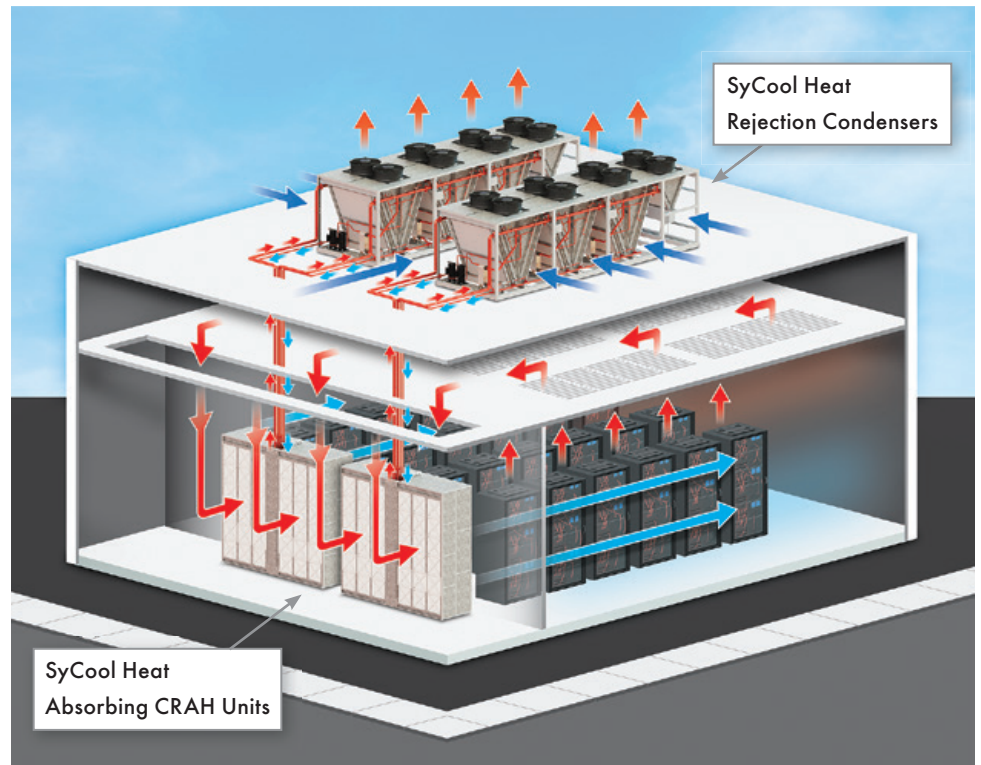
Thermosyphon Heat Exchanger (SyCool™ Split)

Thermosyphon heat exchangers move heat from the data center to ambient through the evaporation of liquid refrigerant in the SyCool CRAH, and condensing of the same refrigerant in the SyCool condenser. The CRAH is connected to the condenser with refrigerant piping allowing up to 175' of low pressure thermosyphon refrigerant piping. Heat is exchanged passively for "free cooling" of the data center when ambient conditions are favorable.

A simplified version of the system is schematically shown below right.

BENEFITS

- Split system eliminates duct penetrations through the building envelope
- No water consumption
- Typical operation with up to 70% approach to ambient temperature for best in class free cooling
- Transitions to full DX only as ambient temperature approaches the hot air temperature from the servers
- Low peak power
- Thermosyphon piping is low pressure allowing time saving mechanical pipe joining systems such as Victaulic to be used
- CRAH units can be installed side-by-side allowing maximum air flow required by higher density installations



Make-up Air Systems



DryCool® Standard

Munters manufactures make-up air systems that include variable airflow, efficient filtration, humidification, and dehumidification capabilities, either stand-alone or integrated with cooling units. Desiccant and mechanical refrigeration dehumidification options.

Direct Evaporative Air-Handling System



Munters DASE (Direct Air-Side Economizer)

Munters manufactures complete direct air-side economizing air-handling systems that utilize direct evaporative media for cooling data centers. These systems are usually installed in dry or mild climates with clean ambient air. During cooler ambient conditions, outdoor air is mixed with warm return air to achieve the desired supply condition. During such conditions, it is possible to use the evaporative media to provide the required humidification. During warm ambient conditions, these systems deliver 100% outdoor air to the data hall, cooled by the evaporative media, and all hot air from the servers is exhausted.

Cooling and Humidification Products



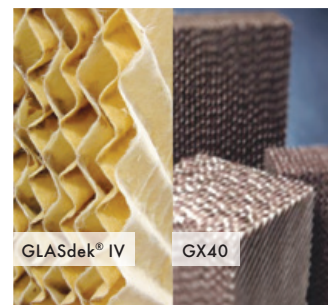
Munters **FA6™** Evaporative Humidifier/Cooler is available in a wide variety of sizes and is designed to provide easier maintenance.



Munters patented **MRM™** was invented to conserve water. Mineral Removal Media (MRM) is a disposable evaporative pad, installed upstream of the primary evaporative process. Bleed water is piped to the MRM where it evaporates into the airstream, providing beneficial cooling. Systems using MRM have nearly zero waste water sent to sewer.



Munters **Humimax™** is a series of stand-alone humidifiers. Units are available in (2) two different sizes for space or plenum mounting.



Munters Evaporative Media

GLASdek IV: Fire Rated (UL900), optional 1/2" TUFedg coating, available 4", 6", 8", 12", 18" deep, GREENGUARD Gold Certified

GX40: More resistant to high and low pH levels, excellent fire resistance, available media depth 8" only, suitable for higher face velocity requirements up to 800 ft/m.

Project Management & Service



“Munters takes a *project based* approach to managing data center accounts. A customer-focused project team, consisting of a Project Manager, Application Engineers, and Service Specialists, oversees each project. All members of the project team are experts with Munters equipment in data center applications and are committed to project success from conception to completion. Our team is focused on understanding our customer’s perspective in order to provide the highest quality support while adhering to Munters’ core values.”

– Michael Gantert, President - Data Centers



Project Management

A dedicated Project Manager (PM) is assigned to every data center project and serves as a single point of contact responsible for project delivery to our customer.

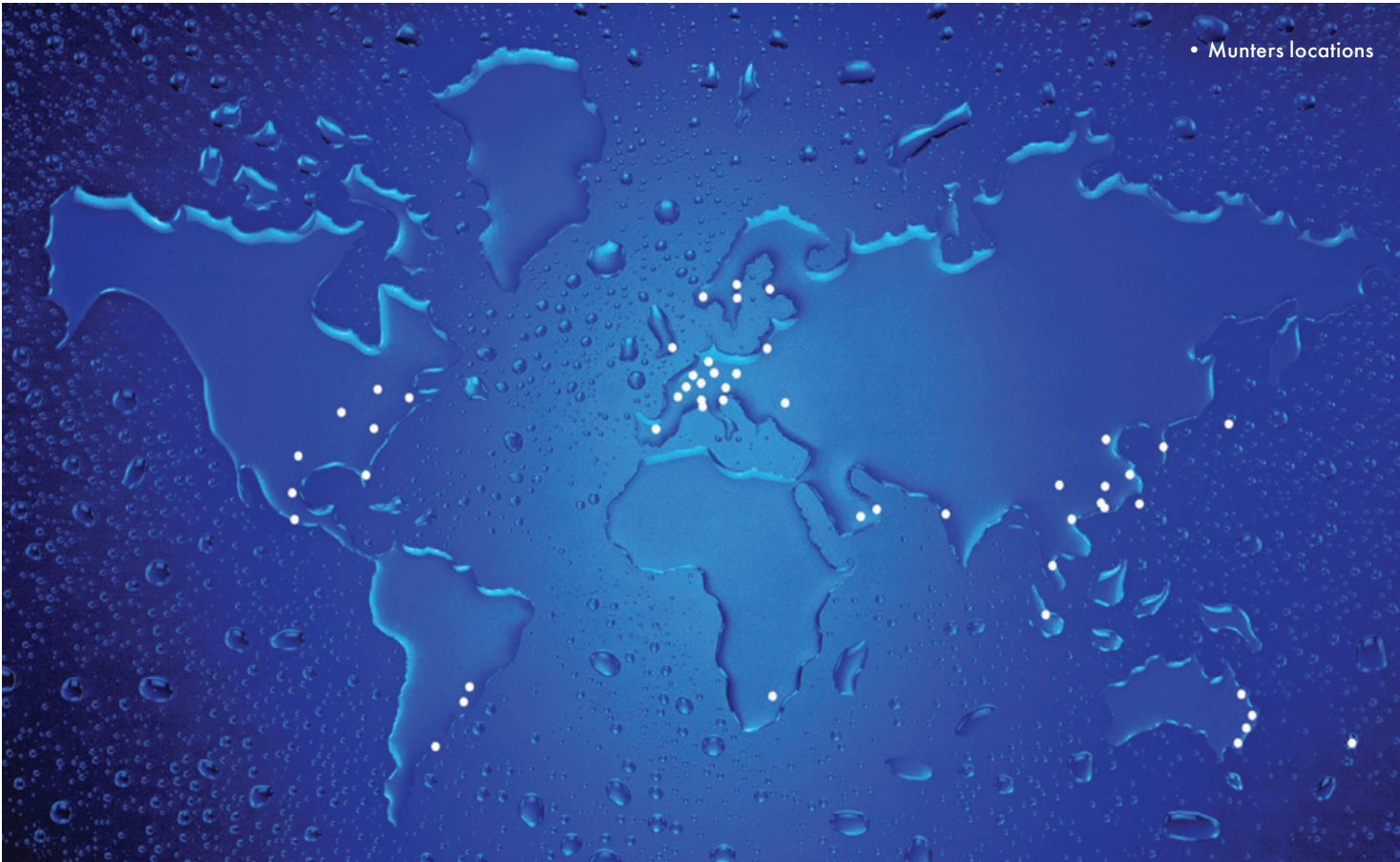
- Provides project specific schedule for customers to track manufacturing progress and plan factory visits, testing, and equipment delivery.
- Acts as customer liaison to Munters Engineering, Production, Quality, and Service to ensure project success.
- Creates project specific documentation including Factory Acceptance Test (FAT) scripts, rigging and installation instructions, IOM’s, Start-up checklists, and training plans (if necessary).
- Oversees the implementation of project field activities including equipment delivery and installation, levels 3/4/5 testing, training, and warranty work.



Service

The Munters Service Team consists of 75+ personnel, including a dedicated team of technical support, parts specialists, service sales, and field technicians to support data center projects.

- Project field support options include delivery/installation supervision, level 3 Start-up (required), level 4 commissioning support, level 5 Integrated Systems Testing (IST) support, and on-site training.
- Preventative maintenance options include extended warranties, routine maintenance and inspections, technical support with remote monitoring, retrofits, and critical spare parts packages.
- 24/7/365 technical support helpline available.



Munters manufacturing facility in Buena Vista, VA

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

Using innovative technologies, Munters creates the perfect climate for demanding industrial applications and has been defining the future of air treatment since 1955. Today, around 3,600 employees carry out manufacturing and sales in more than 30 countries. Munters has annual net sales of above SEK 7,2 billion and is listed on Nasdaq Stockholm.

For more information, please visit www.munters.com.

www.linkedin.com/company/munters

Australia Phone +61 2 8843 1588, dh.info@munters.com.au **Austria** Phone +43 1 6164298-0, luftentfeuchtung@munters.at **Belgium** Phone +32 1528 5611, info@muntersbelgium.be **Brazil** Phone +55 41 3317 5050, munters@munters.com.br **Canada** Phone +1 905 858 5894, dhinfo@munters.com **China** Phone +86 10 8041 8000, info@munters.com.cn **Czech Republic** Phone +420 544 211 434, info@munters-odvlhcovani.cz **Denmark** Phone +45 4495 3355, info@munters.dk **Finland** Phone +358 20 776 8230, laitemyynti@munters.fi **France** Phone +33 1 3411 5757, dh@munters.fr **Germany** Phone +49 4087 96900, mgd@munters.de **India** Phone +91 20 668 18 900, info@munters.in **Italy** Phone +39 0183 52 11, marketing@munters.it **Japan** Phone +81 3 5970 0021, mkk@munters.co.jp **Korea** Phone +82 2761 8701, munters@munters.co.kr **Mexico** Phone +52 722 270 40 49, munters@munters.com.mx **Netherlands** Phone +31 172 433231, vochtbeheersing@munters.nl **Poland** Phone +48 58305 3517, dh@munters.pl **Singapore** Phone +65 6744 6828, info@munters.com.sg **South Africa** Phone +27 11 997 2000, info@munters.co.za **Spain** Phone +34 91 640 09 02, marketing@munters.es **Sweden** Phone +46 8 626 63 00, avfuktning@munters.se **Switzerland** Phone +41 52 343 8886, info.dh@munters.ch **Thailand** Phone +66 2642 2670, info@munters.co.th **Turkey** Phone +90 216 548 1444, info@muntersform.com **UAE** +971 4887 6462, middle.east@munters.com **United Kingdom** Phone +44 1480 432243, info@munters.co.uk **USA** Phone +1 978 241 1100, dhinfo@munters.com **Vietnam** Phone +84 8 8256 838, vietnam@muntersasia.com



Munters Corporation
Tel: (800) 843-5360 E-mail: datacenters@munters.com
www.munters.com/datacenters