



Intelligent Airflow

Engineered for Data Centers

Measurement • Management • Mastery

- *Overcooling & Hotspot Mitigation*
- *Aisle Containment Pressure Balancing*
- *Rack-Level Airflow Controls & Supply Optimization*
- *Cooling Infrastructure (CRAC) Performance Diagnostics*
- *Rack or Inlet Airflow Measurement (CFM)*
- *Airflow Design for Capacity Planning*
- *Automated, Facility-Scale Thermal & Airflow Control Solutions*
- *Total Cooling & Airflow Infrastructure Software Platform*



Why degreeC?

Degree Controls' objective is to be recognized as the world's leading source of engineered airflow solutions for the most demanding applications. We strive to design, produce, and deliver products and services that meet or exceed specific customer expectations. Turn to your industry leader in air velocity measurement and management to benefit from:

- *Decades of Air Velocity & Engineered Airflow Expertise*
- *Diverse Instrumentation & Design Solutions*
- *Excellent Customer Service & Quality Commitments*
- *Full Production & World-Class Manufacturing Capabilities*
- *International Reach with Our Global Partners*
- *ISO 9001 Certified Processes*
- *NIST-Traceable Calibration Standards*
- *RoHS & Certified European (CE) Products*



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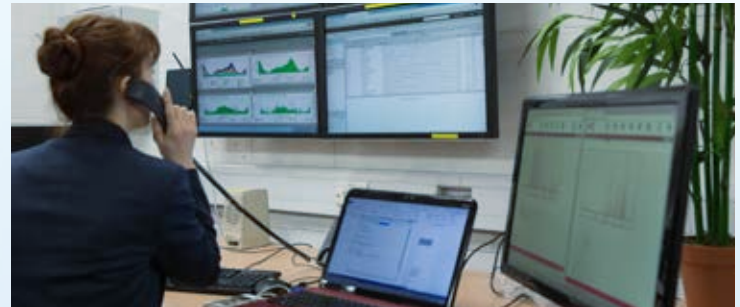
MEASUREMENT

In the dynamic environments of data centers, airflow is difficult to track as it moves from the CRAC to the RACK as it cools the PCB surfaces of increasingly dense servers. With our multiscale airflow measurement instruments, however, air volume and flow paths can be logged, analyzed, and visually mapped with unprecedented ease. We have engineered specialized airflow sensors and instruments for use in data centers at all levels of the flow cycle:

- Perforated tile rack airflow output (CFM) measurement and visualization
- Coefficient of Performance (CoP) Real-time or trending CRAC airflow (CFM) output
- Airflow pattern modeling and performance trending
- Rack inlet temperatures, rack/server exhaust temperatures, CRAC Delta Δ temperatures
- Computational Fluid Dynamics (CFD) model verification and testing
- Underfloor air volume and pressure calculation

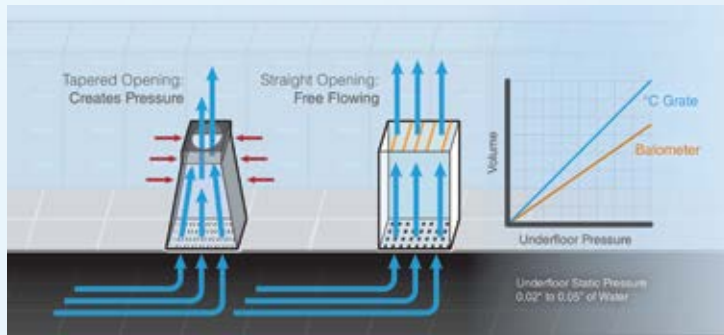
°C OP™: Real-Time Performance Diagnostics & Controls for CRAC Infrastructure

The airflow cycle begins with cooling infrastructure. Without sufficient insight into the real-time performance and air volume output of CRAC units, any CFD model or capacity decision is reliant on nameplate performance values supplied by CRAC manufacturers. In the field, CRAC operating conditions can fluctuate significantly as an effect of wear and tear or ΔT imbalances, resulting in nameplate figures that are largely unreliable. With the °C OP™ solution by degreeC, real-time performance values of CRAC units in data centers can be logged, visualized, and relayed to DCIM or BMS systems. °C OP™ has a touchscreen interface that displays live CRAC flow (CFM) output and efficiency ratings on-screen. Contact our application engineers to get started.



°C Grate™: Rack Airflow Measurement Instrument Designed for Data Centers

Balancing airflow supply at the rack-level is critical for realizing efficiency goals, achieving capacity gains and protecting assets from thermal outages. To achieve these ends, data center technicians often resort to balometers or flow hoods - instruments designed for HVAC applications - to measure rack air supply volumes. With the specific complexities of airflow design in data centers in mind, the °C Grate™ instrument by degreeC achieves real-time measurement of airflow and temperatures over perforated tiles without imparting any backpressure to floor tiles during testing. Alongside the gains in accuracy and repeatability afforded by its zero-impedance architecture, the °C Grate™ includes a proprietary software suite for data logging, flow gradient visualization, and actionable analytics. Contact our application engineers to get started.



Sensor Network: Facility-Scale Thermal Visualization & Airflow Intelligence

Without comprehensive visibility of thermal and pressure conditions in your data center, capacity planning and cooling asset management can feel like guesswork. With the AdaptivCOOL Sensor Network solution, these visualization challenges can be met with unprecedented ease. The AdaptivCOOL Sensor Network provides actionable insights into CRAC/CRAH performance, rack inlet temperatures and airflow pressure distribution. Not only does our environmental monitoring system provide granular intelligence (historical and real-time), it goes one step further by enabling users to configure condition-based alerts and trigger redundant cooling assets in the event of an outage or failure. Contact our application engineers to get started.



MANAGEMENT

Airflow optimization in data centers is best achieved through an ensemble of passive and active airflow management techniques to channel airflow supply. The AdaptivCOOL portfolio features the HotSpotr™ product line of active, thermally-automated fan controllers to resolve thermal issues and augment cooling efficacy at the rack-level. For facility-scale airflow controls, our total cooling infrastructure software platform dynamically automates networked cooling assets to respond to changes in thermal conditions, including CRAC outages, and ensure air is flowing to critical areas at all times.

HotSpotr™: Automated Rack Airflow Controls & Supply Optimization

With the HotSpotr™ active airflow management platform, data center airflow is augmented at the rack-level or facility scale to yield capacity gains, conserve energy expended on cooling, and serve as an automated redundancy measure to protect IT assets from thermal spikes or CRAC/CRAH failures. Our HotSpotr™ assets are the only networkable products on the market configured for seamless integration with existing cooling infrastructure and building system control architectures in the data center. Colocation and enterprise managers from every segment of the data center industry turn to this robust, hassle-free solution platform for maximum airflow control and thermal safety, with demonstrated capacity improvements of 30% or greater in mission-critical facilities.

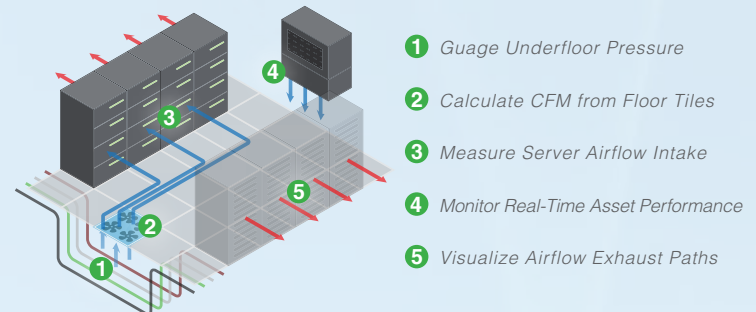


Containment Optimization: Real-Time, Thermostatic Aisle Pressure & ΔT Balancing

Over the past few decades, Aisle Containment setups have helped Data Center Operators reduce TCO by improving cooling efficiency and limiting cold and hot air mixing. By limiting airflow draw to perforated tiles, containment aisles foster competition among assets by constraining air supply. This constraint subtly shifts the air pressure in a containment aisle, taxing on-board server fans and creating thermally imbalanced conditions that lead to energy waste and long-term performance issues. With AdaptivCOOL Aisle Pressure Management (APM), turbulent airflow and pressure conditions can be mitigated with an airflow control solution automated to respond to pressure and temperature changes. APM adds true N+1 redundancy to mission-critical facilities and has demonstrated efficacy in increasing capacity, supplying uninterrupted cooling during CRAC outages and reducing TCO through energy savings.

Demand Based Cooling: Total Cooling & Airflow Infrastructure Management Software

Demand Based Cooling (DBC) is a total systems level approach to optimizing Data Center Airflow. Computational fluid dynamics (CFD) analysis and best practices are coupled with an advanced active airflow management system which monitors and manages CRAC units and adds networked adaptive airmovers to improve data center cooling efficiency and redundancy. Since many data centers are overcooled but have airflow distribution issues, by actively controlling airflow and cooling, both efficiency (PUE) and cooling capacity are radically transformed.

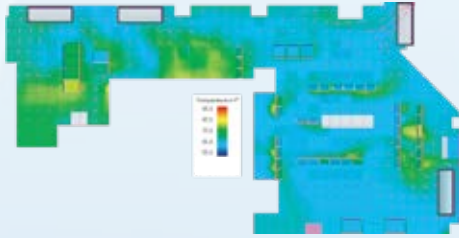


MASTERY

Airflow mastery can only be achieved with the right tools for the job. The AdaptivCOOL portfolio represents decades of unmatched tried and true airflow and thermal engineering expertise. We offer purpose-built instruments for measurement of air at every juncture in the flow cycle. With enhanced measurement capability, management of airflow can be achieved with greater precision and confidence. These enhancements can be realized with our automated airflow delivery and control solutions for rack and aisle flow optimization. Mastery is embodied by our total software solution, Demand Based Cooling, which brings together our airflow measurement and management expertise to bring you facility-wide, site-specific, automation of cooling assets and airflow infrastructure. Our results speak for themselves.

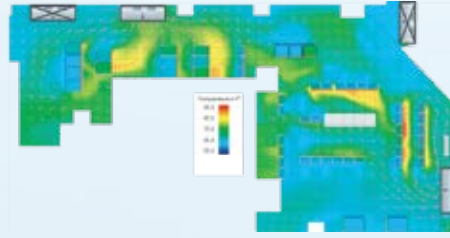
IT Capacity Gains Through Cooling Optimization (Financial Sector)

Before:



The data center was using all 4 CRACs to overcool the room in order to mitigate hot spots in the server racks.

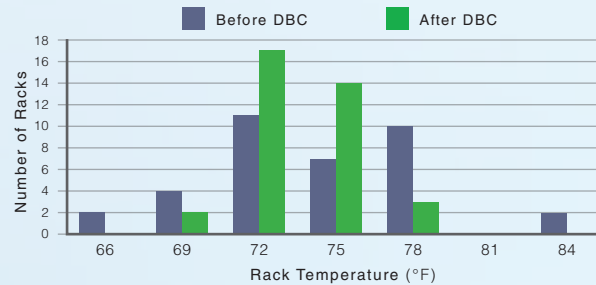
After:



After DBC, 2 CRACs were able to be put into standby through the use of networked air movers allowing the servers to run at safe temperature levels. The red areas are exhaust air at the racks that were allowed to run at higher temperatures while maintaining proper inlet temperatures.

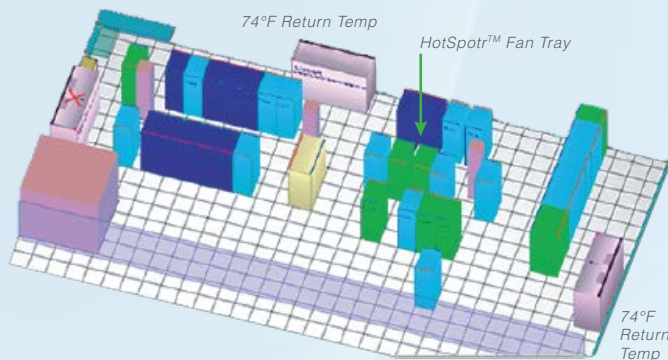
TCO Reduction through Energy Savings of 30% or Greater

| Site | Manufacturing | | |
|-----------------------------------|---------------|-------|-------------|
| Size sq ft | 2000 | | |
| | 87 | | |
| Avg CRAC Return Setpoint °F | Before | After | Improvement |
| CRAC Return Range °F (Note 2) | 71° | 74° | 3° |
| Avg Rack Top Intake Temp °F | 2° | 1° | 1° |
| Temperature Range (TMax - TMin) | 73.6° | 70.6° | 53% |
| Max Rack Top Intake Temp °F | 17° | 8° | 9° |
| Operating CRAC Tonnage | 83° | 60 | 0 |
| Cooling Energy Reduction (Note 3) | 18% | | |



Note 1: Measured at UPS output • Note 2: Return temp of CRAC with Max temp - one with min temp • Note 3: Energy savings from Cooling loop efficiency and humidity control

IT Thermal Safety & Uptime Protection



The Solution:

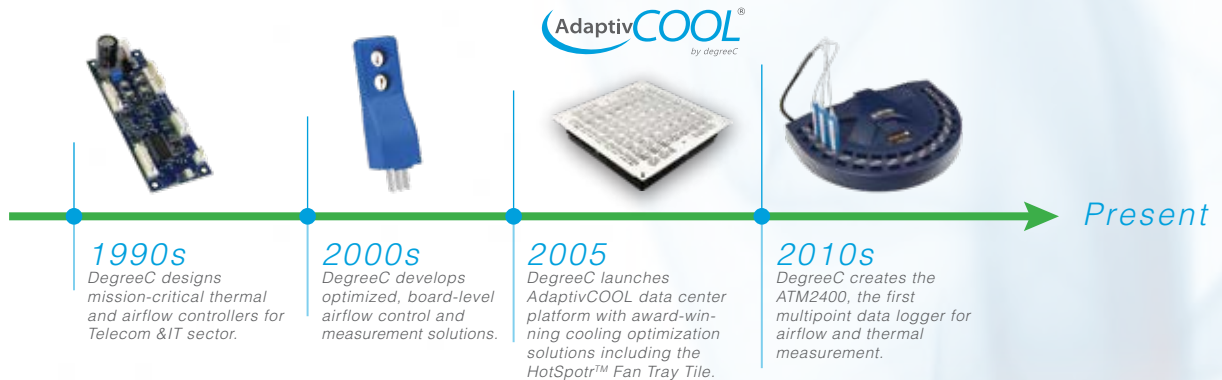
CFD simulations showed significant wasted cooling and insufficient airflow from some tiles near high density racks. Redistribution of underfloor airflow and installation of Demand Based Cooling system controlling two HotSpot underfloor air movers eliminated hot spots and brought maximum rack temperatures below 77F. Overcooled areas were eliminated. Additionally, a CRAC failsafe device was installed to lead/lag 2 of the 3 CRACs and provide automatic failover in the event of a CRAC failure on any running CRAC. Energy usage for cooling was reduced by 24%. The return on investment was less than 12 months.

<69°F 69-72°F 73-77°F 78-82°F <82°F

Airflow Design Expertise From Chip to CRAC to Rack

DegreeC draws from decades of thermal design expertise in a range of mission-critical industries in the development of airflow control infrastructures for data centers of diverse scale, IT density, and facility layout. We approach data centers with the same engineering principles and scalar vision that lead us to unprecedented efficiency and thermal safety gains in the IT market space with our board-mount sensor portfolio, where we achieved the smallest, form-factor airflow sensing and control solution available today. Alongside our board-mount sensors, designed for real-time measurement and optimization of thermal and flow conditions in PCB environments, we also have a history designing custom airflow controllers for the Telecom sector and for critical Medical equipment such as MRI scanners. We employ a holistic approach in the development of data center solutions, drawing from our successes and the past design challenges we have overcome, to provide a robust and versatile array of airflow control and optimization solutions for data centers of all varieties.

Our Airflow Genealogy



Holistic Approach to Airflow Optimization

Unlike other players in the data center market, the AdaptivCOOL portfolio by DegreeC employs a holistic approach to Data Center airflow measurement and management. Our products and solutions address airflow management from Chip to CRAC to Rack. Whether you are trying to diagnose cooling failures or deficiencies in your CRAC units, seeking to mitigate a hot spot or thermal anomaly in your facility, or you are trying to calculate the airflow exhaust or intake at the server-level, our solutions will help you realize your performance goals. Contact our engineering team for a free consultation and site-specific assessment of airflow performance in your facility.