



HOT-AISLE / COLD-AISLE CONTAINMENT: PUTTING A LID ON RISING DATA CENTER COOLING COSTS



DAMAC
PREMIUM DATACENTER PRODUCTS

EXECUTIVE SUMMARY

As U.S. energy costs continue to rise, organizations are becoming increasingly aware of power consumption within their data centers. As recently as five years ago, 36 percent of IT managers surveyed by SearchDataCenter.com were unaware of the cost of data center power. Since that time, more IT departments have become responsible for paying their energy bill, and IT managers are justifiably concerned with minimizing that line item in their budgets.

Any effort to reduce data center power costs should focus on cooling, which accounts for about 30 percent of the typical data center energy bill. More powerful equipment and greater data center densities have increased the heat generated in each rack, causing computer room air conditioning (CRAC) units to work harder than ever.

Longstanding best practices call for data center racks to be arranged in hot-aisle / cold-aisle configurations; the fronts of racks in one row face the fronts of racks in an adjacent row so that hot air exhausted from the back isn't drawn into nearby equipment. Air mixing still occurs, however, resulting in hot and cold spots within the data center.

An aisle containment solution can minimize hot and cold air mixing by effectively capturing the air within a given aisle. Chilled air within the cold aisle is recirculated while exhaust air in the hot aisle is vented out of the data center environment. This allows IT managers to raise data center temperatures without harming equipment, resulting in significant energy savings.

Of course, this scenario presupposes that the data center is made up of uniform rows. In reality, many data center layouts vary from row to row and often have empty spaces where racks have been removed. Aisle containment systems must be carefully designed and engineered to accommodate these variations.

This whitepaper will discuss the cost benefits of aisle containment and key considerations in designing an effective aisle containment solution. It will then examine why DAMAC's emphasis on customized data center products enables organizations to gain maximum value from their aisle containment strategies.

THE IMPACT OF COOLING REQUIREMENTS ON DATA CENTER COSTS

According to the U.S. Environmental Protection Agency, data centers consume about 2 percent of all electricity used in the U.S. at a cost of billions of dollars. As other IT costs have decreased, energy expenses have risen to account for as much as 70 percent of data center operational budgets. Analysts with 451 Research estimate that a U.S.-based data center with a 2MW peak load and a 50 percent base load racks up an annual energy bill in excess of \$600,000.

In the typical data center, as much power is used for non-computing overhead — such as cooling — as for running servers and other IT gear. Thus, reducing cooling costs can play a major role in reducing overall energy consumption. The U.S. General Services Administration reports that organizations can save 4 percent to 5 percent in energy costs for every one-degree increase in data center temperatures.

The latest data center equipment can handle higher temperatures, leading the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) to raise the recommended intake air temperature from 77 degrees to 80.6 degrees. However, experts at the Uptime Institute warn that higher temperatures increase the risk of equipment failure, and do not recommend raising thermostats to those limits.

Hot-aisle / cold-aisle configurations have long been used to improve data center cooling efficiency, enabling IT managers to maintain lower temperatures at reduced costs. Aisle containment systems further increase the benefits of such configurations by isolating chilled air from hot exhaust air.

With cold-aisle containment, the cold row is capped at the tops of the cabinets and across the aisle, and doors are installed at the ends of the row to contain the cold air. With hot-aisle containment, a physical barrier is constructed to prevent hot and cold air mixing and to direct exhaust airflow into the AC return. These techniques are proven to provide significant reductions in energy costs.



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THE DAMAC DIFFERENCE

DAMAC's aisle-containment systems utilize a twin-wall polycarbonate material that is 8mm thick. The twin-wall material serves as a natural insulator, yet it is lightweight, clear and supports fire suppression. It is formed into panels that are fitted into lightweight aluminum frames, with mounting brackets that bolt to the tops of the racks. DAMAC can manufacture the mounting brackets to any length needed to attach to DAMAC and non-DAMAC racks.

The standard panel is 24 inches by 48 inches because most racks are the width of one floor tile (24 inches) and most aisles are the width of two tiles (48 inches) to meet code requirements. However, DAMAC can fabricate polycarbonate panels up to 5 feet wide to create highly customized systems. In addition, the mounting brackets are adjustable to accommodate aisles that are slightly larger or smaller than 48 inches. Blanking panels are used where racks are missing within a row. Containment doors are installed at the ends of the rows to seal the whole aisle. Door frames are constructed of tubular steel for durability, while the doors themselves are sheet metal with an insert of the clear polycarbonate material.

DAMAC's hot-aisle containment system takes a similar approach, but includes vertical panels that install at the rear of the racks. These panels direct hot exhaust air into the hot air return or a drop-down ceiling grid. This design takes advantage of the natural properties of hot airflow, minimizing the need for exhaust fans and hot-air ducting.



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FACTORS TO CONSIDER IN IMPLEMENTING AN AISLE CONTAINMENT STRATEGY

The question of hot-aisle versus cold-aisle containment is far from arbitrary. Choosing the right aisle-containment solution depends upon a number of factors, including:

- whether an existing data center must be retrofitted;
- data center density;
- uniformity of racks and aisles;
- whether “raised floor” cooling is employed;
- availability of a ceiling plenum to accept hot air

The goal of a cold-aisle containment system is to create a smaller area to cool and focus the cooling on the fronts of the systems. As a result, a cold-aisle system is typically used in high-density data centers because it is more efficient to direct cold air onto densely populated racks than to cool the entire room. As high-density architectures gain popularity, cold-aisle containment systems are becoming increasingly common.

Although cold-aisle containment does not require conventional raised-floor cooling, it is often used in environments in which cold air is generated outside the containment area and brought in through the floor. Most existing data centers employ this type of cooling system, which can be retrofitted for cold-aisle containment with minimal impact on operations.

Cold-aisle containment with an internal cooling system can be implemented on a raised floor or slab. The CRAC units are positioned within the containment area, enabling even more focused cool airflow and greater CRAC unit capacity and efficiency. Less energy is required for air movement, and air temperatures can be set higher. Both types of cold-aisle containment use the same design approach.

The goal of hot-aisle containment is to trap exhaust air at its hottest point and provide it with a direct path into the AC return. Hot-aisle containment reduces energy costs by improving cooling efficiency. It also increases the cooling capacity of CRAC units, which is measured as the ratio of the difference between supply and return air temperatures.

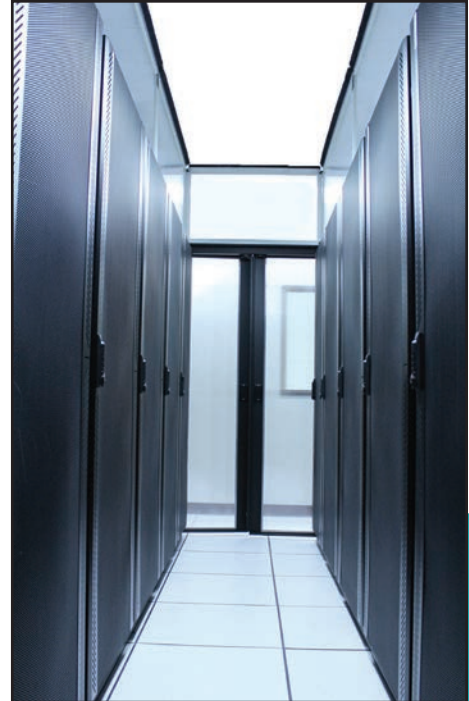
Hot-aisle containment can be used with either external or internal cooling systems with or without a raised floor, although significant data center modifications may be required if a hot-air plenum or ductwork must be added. Another drawback is that the hot aisle can be unpleasantly warm for data center personnel; however, the remainder of the data center can be set at more comfortable temperatures than with cold-aisle containment. And while hot-aisle containment does not provide directed cooling, the “room volume” of cold air is available to protect equipment in the event of a CRAC unit failure.

THE DAMAC DIFFERENCE

DAMAC enables organizations to focus their hot-aisle / cold-aisle containment strategy on the desired benefits with less concern for the cost and downtime associated with retrofitting the data center facility. DAMAC understands that every data center is different and applies its engineering expertise to producing highly flexible products as well as cost-effective customized solutions.

The DAMAC team meets with each customer to analyze the data center facility, take measurements and fully understand the customer’s aisle-containment requirements and goals. DAMAC engineers will note inconsistencies in the layout of the data center, rows that are missing racks and other variations. In the most extreme cases, each row may require a different design.

After developing the design, DAMAC creates an assembly drawing so the customer can view and approve the aisle-containment system. The products that are ultimately delivered to the customer will precisely conform to those specifications, making installation easy for data center maintenance personnel.



At DAMAC, we understand that the smallest details make the difference.

CONCLUSION

Data center densities continue to increase to meet growing demand for IT services within the confines of limited space and resources. At the same time, organizations are taking a hard look at the power used by these “web-scale” data centers amid rising energy costs and a growing emphasis on green initiatives. Power consumes an increasingly large portion of the data center operational budget, with compute and non-compute loads accounting for nearly equal shares.

The efficiencies gained by high-density environments come with the tradeoff of greater heat, and traditional air cooling techniques become prohibitively expensive as power densities increase. Organizations need new strategies for effectively cooling high-density equipment to reduce the risk of downtime and keep a lid on rising power and cooling costs.

The benefits of hot-aisle / cold-aisle configurations can be augmented by aisle-containment systems that control air mixing, improve cooling efficiency and CRAC unit capacity, and direct chilled air for equipment intake. However, many existing data centers have variations that limit the applicability of “standard” aisle-containment systems.

While most vendors offer generic products in a limited number of sizes and configurations, DAMAC provides versatile aisle-containment systems with the flexibility to accommodate inconsistencies in data center layouts. DAMAC takes a consultative approach to each project and delivers aisle-containment products that are capable of meeting each customer’s precise requirements.



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