Rack Blanking Panels—To Fill or Not to Fill

A Dell Technical White Paper

Dell | Data Center Infrastructure

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Introduction

Blanking panels, also called closeout filler panels, provide a way to cover unused rack space in the front of a rack, resulting in improved airflow to the installed equipment and reducing internal hot-air recirculation within the rack. The use of blanking panels is considered a best practice. They help to complete the separation needed for a hot/cold aisle strategy and are an absolute necessity when deploying equipment in containment systems.

Cooling and Containment Overview

The most efficient way to use cooling air in a data center is to have all of the air travel through the IT equipment only once. ASHRAE introduced this concept in its third TC9.9 book as the "once-through concept."[1] If air passes through IT equipment more than once, the second piece of equipment receives preheated air. Internal fans are likely spinning faster to maintain internal temperatures, and even more heat is generated that must be removed by the facility's cooling system. If air bypasses the IT equipment, it is wasted and returned to the cooling system, lowering the return temperature. A cooling coil's capacity is directly related to the return air temperature. A cooler air return temperature means a lower cooling capacity for that unit.

Containment is a growing trend; it may eventually be considered a best practice like hot/cold aisles and blanking panels. Containment separates the air pathways to and from the rack. It is commonly done at the rack or aisle level and can be implemented on the cold or hot side. Containment, which can increase the pressure difference between the hot and cold sides of your rack, is incomplete without blanking panels. Air should never be allowed to recirculate within the rack or between racks. Energy savings associated with containment systems can be greater than 20%.[2] Blanking panels are necessary to achieve this type of savings.

Even without containment, blanking panels enable the rack enclosure to cool properly. The fans in the IT systems create a front cavity pressure that is lower than outside of the rack; this pressure differential drives air through the front perforated door. Similarly, higher back-cavity pressure drives air out of the back perforations. It is difficult to build up the pressures required to pull air in or push air out without closing off unused spaces.

Blanking Panel Material Choices

You may be wondering whether it is better to use plastic or metal blanking panels. From a cooling perspective, it does not matter what material your panels are made of, as long as they cover the open rack unit space and prevent hot air from recirculating to the front of the rack. However, there are options for panel materials which may have other advantages.

Dell offers blanking panels in a variety of sizes and materials to fit in the Dell™ PowerEdge™ rack enclosures and also in third-party racks. Plastic blanking panels are lightweight and toolless, providing easy and quick snap-in installation for square-hole racks. These are available in 1U and 2U sizes.

Steel blanking panels provide support for more types of racks, with tooled installation for square, round, or threaded holes. Multiple sizes are available to provide coverage in 1U, 2U, 3U, or 6U

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[1] "Design Considerations for Datacom Equipment Centers," ASHRAE, 2009.
[2] "The Energy Advantages of Containment Systems," David L. Moss, 2009. http://i.dell.com/sites/content/business/solutions/whitepapers/en/Documents/dci-energy-advantages-of-containment-systems.pdf

increments. With screws holding them in place, the steel blanking panels can provide some additional security for the rack. See Figure 1 for views of Dell's plastic and steel panels.

Plastic 2U Panel

Steel 2U Panel

Figure 1. Plastic and Steel Blanking Panels

Thermal Analysis

The most straightforward justification for using blanking panels is made by looking at the rack-level power usage when blanking panels are not used. A CFD (Computational Fluid Dynamics) model was constructed to predict temperatures resulting from a missing 1U server with no blanking panel covering the void. Without the blanking panel, hot exhaust was free to recirculate back through the rack and into the adjacent servers. Figure 2 shows the CFD model results, displayed as a side view of the rack. The model predicts that it affects the two servers above and below the gap. The increased temperatures experienced by the adjacent servers cause the internal fans in each server to speed up to compensate. This results in increased energy usage and lower efficiency.

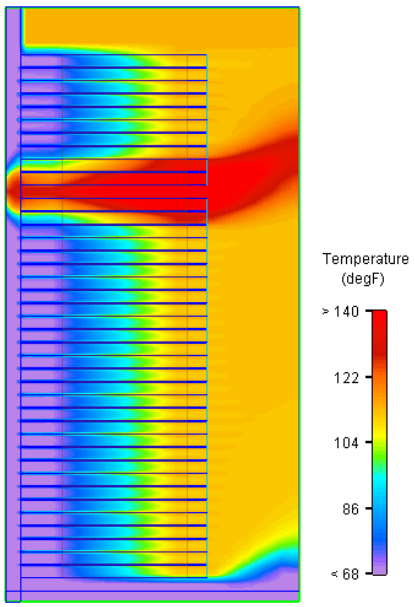

Figure 2. CFD Model (Rack Side View): Effect of Not Using a Blanking Panel

The additional fan power expected from four PowerEdge R610 servers is about 22 watts. Using a facility PUE (Power Usage Effectiveness) and with an energy cost of $0.10/kW-hr, the additional annual energy required to spin up these server fans is $39. This is more costly than a single blanking panel but might be surpassed if purchasing many blanking panels to fill unused slots. A similar analysis was done for an older Dell 1U server resulting in a much higher yearly cost (over $300).[3]

Other costs can be avoided as well. Without using blanking panels, the facility may be forced into operating at lower temperatures, which could cause dramatic energy increases that might be avoided by using the panels.

Other racks can be affected. If exhaust is allowed to leak out the front of a rack, it can get pulled into adjacent racks, increasing the inlet temperature for the equipment in them as well.

See Figure 3 for actual data center photos showing the thermal effect of the absence of blanking panels. Investigation showed that hot spots corresponded to missing blanking panels, resulting in hot aisle air coming through the rack into the cold aisle.

[3] "A Layman's Explanation of the Role of IT Racks in Cooling Your Data Center," David L. Moss, 2009. http://content.dell.com/us/en/enterprise/d/business~solutions~whitepapers~en/Documents~dci-Laymans%20Explanation-the-Role-of-IT%20Racks-in-Cooling-DC.pdf.aspx

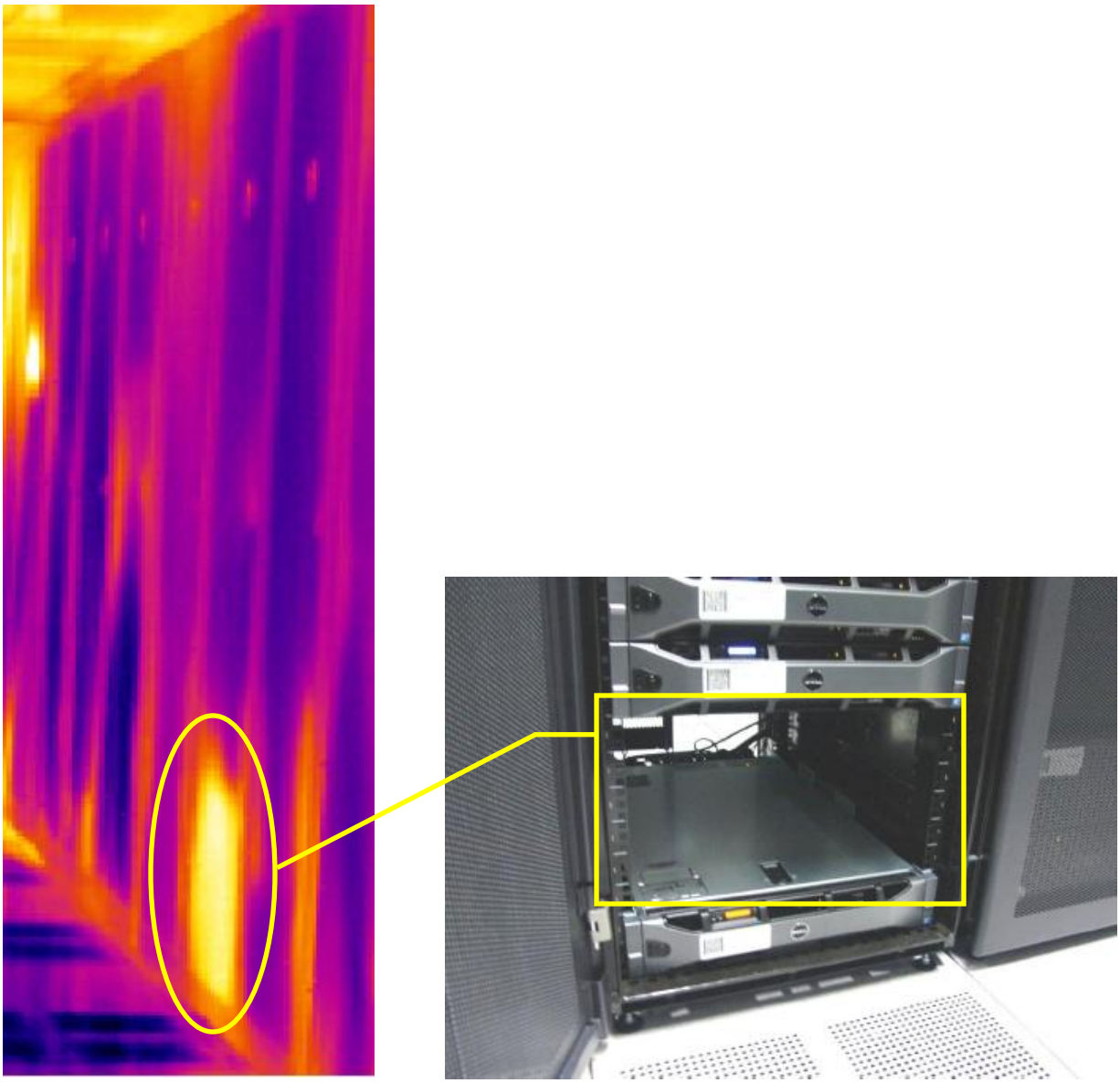

Figure 3. Thermal Effect of Not Using a Blanking Panel

Common Myths Associated with Blanking Panels

Myth: I don't need blanking panels. They don't seem to help my airflow.

Truth: This may depend on how effectively you are cooling your data center. You may not notice a large difference if you don't have hot/cold aisle orientation, for instance. Once you start separating the hot air from the cold air through aisle orientation and/or containment, the use of blanking panels becomes much more important.

Myth: Blanking panels are just a way for a vendor to make more money.

Truth: Blanking panels are necessary for managing airflow through IT systems in racks in a hot/cold aisle implementation. If you are worried about cost, you could consider using plastic panels, which are less expensive than metal panels. Dell offers both steel and plastic blanking panels, which are also

offered in multi-packs with a quantity discount. There are also perforated die-cut plastic sheets that are even less expensive. Some people have even resorted to their own creative blanking solutions (see Figure 4 for an example). Just cover those gaps!

Figure 4. Example of a Creative Blanking Panel

Myth: Blanking panels will provide a complete seal for my servers.

Truth: Even when using blanking panels, there is still a small gap around each piece of equipment and each panel due to the fit within the U envelope, which has a small leak factor. Percentage-wise, it's a minor issue; it may add a few degrees to the inlet temperature of equipment that is directly adjacent to the blanked gap, but that will vary depending upon the IT deployment.

Myth: I only need to use blanking panels in the large gaps. The smaller gaps don't matter.

Truth: Any gap in the front of the rack can impact the inlet temperature for rack-mounted equipment. A higher temperature going through the system makes the fans work harder. A 1U gap can leak temperatures that are just as hot and damaging as a larger gap.

Concerning 1U gaps, many people think that it improves cooling if they space servers by placing gaps between systems and cover those gaps with blanking panels. This is not recommended for Dell equipment. It is the higher pressure in the back of the rack that drives hot air toward the lower pressure in the front cavity. The pressure drives air through the gaps between servers and the gaps around blanking panels. In recent tests, we have noticed that the leaks between blanking panels have a more dramatic effect. Even if the gap size is the same, it is more restrictive for the air to flow the entire length of a server than the short distance it travels through a blanking panel gap.

Myth: Installing and removing blanking panels is a time-consuming hassle.

Truth: Although this may be true, it is still worth the effort. The plastic panels snap in and out of square-hole racks, making installation faster when filling 1U and 2U spaces. If you need extra security, the metal panels can be screwed into place. Dell steel blanking panels come in sizes as large as 6U, so you do not have to install multiple 1U panels if you have consecutive U-spaces to fill. As mentioned previously, it's better to mount your systems adjacent to each other rather than leaving small gaps between them, so the space you have left to fill should be easier to cover with a smaller number of panels in larger sizes.

Summary

At Dell, we understand that you need to invest wisely for improving data center efficiency. Blanking panels offer a low-cost method for preserving the integrity of your rack and data center cooling implementation. They are a must-have for a data center with a hot/cold aisle orientation. The efficiency impact is even greater when using tightly coupled containment solutions. Dell Power and Cooling professionals recommend implementing this best practice to improve efficiency in your rack cooling solution.