6 Reasons to Specify Air-Sealing Grommets in the Design of a New Data Center

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The use of raised-floor grommets to prevent bypass air from escaping the underfloor plenum is a well-known airflow management best practice. Elimination of bypass airflow improves the cooling capacity and efficiency of any data center. Despite this, best practices are often not followed. Grommets are not installed for long periods after operation begins and usually not until there is a desire to increase capacity or reduce operating costs. Designing and specifying grommets in the construction documents so they are installed during the initial construction, or expansion, of the data center helps to ensure the facility performs as intended from the moment the data center goes live so that PUE goals are met, and operating costs are minimized.

This paper will explore the benefits of including air-sealing grommets in the design and specification of a new data center. The paper will show how standard cutout locations can be used to properly align the grommets regardless of the rack dimensions and the significant energy savings and increased capacity that can be achieved by including grommets.

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Best Practice Design Techniques to Improve Cooling Capacity & Efficiency.

Bypass airflow can have a significant impact on the cooling capacity and efficiency of a data center. One key part of best practice design for raised floor data centers is to minimize bypass air loss from the raised floor plenum. Bypass air is any conditioned air delivered into the data center that does not pass through the IT equipment before returning to a cooling unit. Common practices to reduce bypass air include the use of containment systems, blanking panels, directional air delivery, variable-air-volume controls and air-sealing grommets for any penetrations thorough the floor.

The use of floor grommets to stop bypass air from the underfloor plenum has become a well-known strategy. However, they are not typically installed during the construction of the data center and as a result often never get installed.

Detailing and specifying grommets in the architectural design documents so they will be installed during the initial construction of the data center has several key advantages.

1) Raised floor grommets ensure cooling capacity is not compromised, from the beginning.

Specifying the type and performance of air-sealing grommets in the design documents for a new facility, or raised floor expansion, can ensure that the cooling capacity of the data center will not be compromised by the use of inferior sealing techniques. Below is a sample specification which should appear in the raised floor section 09 69 00 since they will be installed at the same time as the raised floor installation. Using this specification helps to insure the grommets will actually be installed and eliminates the risk of reduced reliability and the reduction in cooling capacity that comes with unsealed cutout holes in a raised floor data center.

Sample Specification for the cutout location in Section 09 69 00

Air-sealing grommet shall be installed in the interior or the edge of a panel with a factory placed cutout located in one of the two following position. The cutout location shall allow the air-sealing grommet to be located in such a way that regardless of rack position or overall dimensions, that the unit will be positioned beneath the rack allowing for cable penetrations to enter the rack footprint.

Option 1: Interior Opening:

4" from the left edge of the panel and 7.375" from the top and bottom edge of the panel.

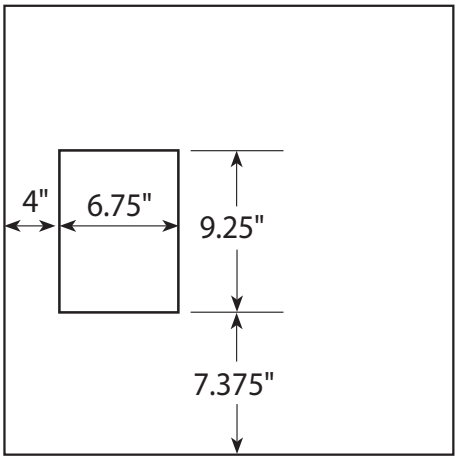
a. The opening in the panel shall measure 6.75" x 9.25" and shall be a punched penetration, saw cutting is not acceptable

Option 2: Edge Opening:

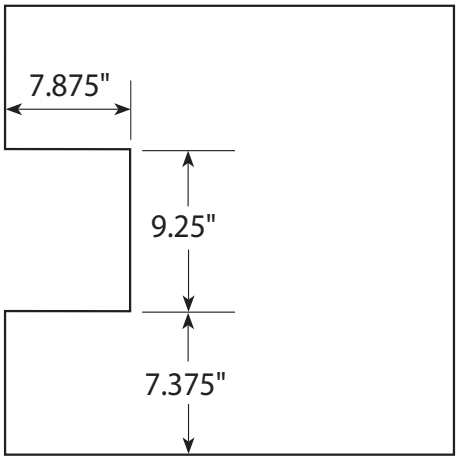
The flange shall align with the left edge of the panel and 7.875" from the top edge and bottom edge of the panel.

a. The opening in the panel shall measure 7.875" x 9.25" and shall be a punched penetration, saw cutting is not acceptable

Details like the ones below should be used in construction documents to specify the location of a standard cutout in raised floor panels.



Option 1: Interior Cut



Option 2: Edge Cut

Sample Specification for the air-sealing grommet in Section 09 69 00

The air-sealing grommets shall meet the following performance criteria for air leakage at 0.05" inches of H20 static pressure.

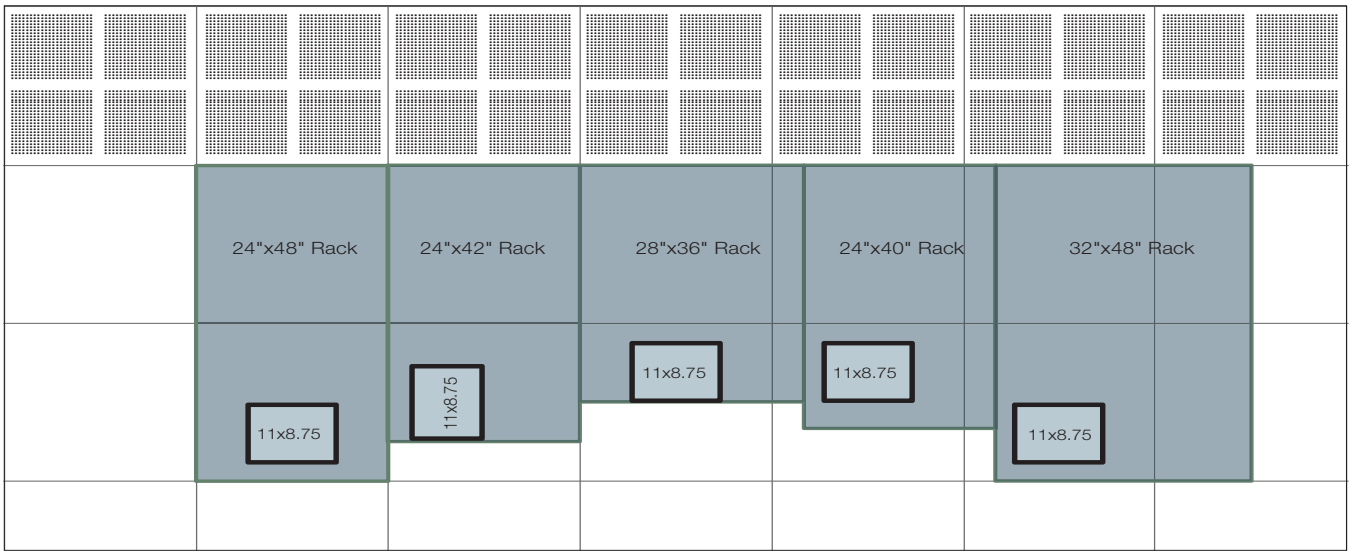
1. Less than or equal to 3.3 CFM with no penetrating cables, but without cover/lid
2. Less than or equal to 5.2 CFM with a single bundle of 42 data cables installed in the horizontal centerline of the grommet.
3. Less than or equal to 4.1 CFM with a single power cable measuring 9/16" in diameter installed in the center of the grommet.
4. Less than or equal to 5.3 CFM with four power cables measuring 9/16" in diameter installed in the horizontal centerline of the air-sealing grommet

The air sealing grommet shall completely cover the cut edge of the panel to ensure the wires are protected during installation and any future deployments and changes to the IT equipment. This satisfies the National Fire Protection Association (NFPA) code requirement NFPA 75 Section 5-4.4

2) Using a standard cutout location ensures grommets are always in the right place under the rack.

One perceived limitation of installing grommets in new sites is that the exact location of the racks and cutouts is not always known when the raised floor is installed. The specification above identifies a standard cut-out location in a raised floor panel that works with any rack size to ensure that the cutout is always in the proper location inside the rack's back door. Using a standard rectangular shape cutout located 4" from the edge and centered on the panel will enable equipment and racks to be easily deployed and later upgraded without the need for replacing panels.

A cutout location through the edge of the panel will also work for the majority of rack sizes however, it is important to note that cutting through the edge wall of the raised floor panel can impact the amount of weight the panel can support.



Tate has identified and offers a standard factory cut-out location that works with most imperial and metric sized racks and ensures that the cutout is always in the proper location inside the back door of the rack.

3) Factory cut-out tiles save time & eliminate the mess.

When specified as a factory cut-out, both the time and mess associated with field cutting is eliminated. Since cutting raised floor panels can generate dust they need to be removed from the data center and cut outside or in a sealed cutting room then reinstalled in the floor once they are cleaned. Using the standard cutout location the holes can be factory punched so that the dust is handled at the factory and not on-site. This eliminates the time and mess associated with installing the grommets after the initial build-out.

4) Improve Efficiency and Capacity

If air-sealing grommets are not installed during the initial construction then data center efficiency, capacity, and cooling performance will be compromised from the beginning. An unsealed raised floor cutout measuring 6" x 9" leaks approximately 392 CFM at 0.05" of water column. That is approximately 3kW of cooling capacity that could be used to cool IT equipment, assuming a typical delta T through equipment of 25°F. Not only are unsealed openings directly wasting cooling capacity but they also limit the efficiency of the cooling units. When capacity is wasted cooling unit set points have to be kept low so that supply air can overcome mixing with warm exhaust air. Once all of the cable openings are sealed, cooling unit set points can be raised, thereby increasing their efficiency and capacity. The following table shows how just the wasted fan energy alone could result in over $54,000 of wasted annual cooling energy costs for a typical 10,000 square feet data center.

Cost/Energy Model - Air-sealing Grommets	No Air-sealing Grommet	Air-sealing Grommet with Four Power Cables
Number of Cable Cutouts	250	250
CFM Leakage Per Cutout	392	5.3
Total CFM Leakage	98,000	1,325
kW/kCFM Fan Energy	0.64	0.64
Power Wasted (kW)	62.72	0.848
Energy Wasted Annually (kWhr)	549,427	7,428
Cost per kWhr	$0.10	$0.10
Annual Energy Cost	$54,943	$743

5) Safe to install during construction and easy to relocate in the future.

Tate has partnered with Upsite Technologies to bring you the most advanced air-sealing grommet available. These grommets are available with a domed lid that keeps equipment from being rolled over so that sealing cutouts during the initial build is easy and cost effective. The lid allows the raised floor installers to place the cut-out in the floor as they build-out the facility. The tile and grommet can be precisely positioned in relationship to the master floor plan for cabinet locations or placed in a special holding area of the floor to later be moved into the final position as equipment is deployed.

Furthermore since the standard location works with any size rack the factory cut panels and grommets can be stored in reserves at your facility for future moves/adds/changes.

6) Protect cables and wire passing through the floor as equipment is deployed.

Without using a grommet to cover, or dress, the edges of the cut panel, cables and wires can get cut by the sharp edges of the cut panel. It is best to install a grommet that completely covers the cut edge of the panel to ensure the wires are protected during installation and any future deployments and changes to the IT equipment. This is both a best practice for reliability and a National Fire Protection Association (NFPA) code requirement. Upsite grommets satisfy NFPA 75 Section 5-4.4 requirement by self-dressing the raw metal edges of cable cutouts in raised floor panels.

Conclusion

Installing air-sealing grommets during the initial installation of the raised floor in a data center is a best practice technique that will ensure the efficiency, capacity and reliability of the facility. As a designer, by specifying and detailing air-sealing grommets in the construction documents, you are protecting the integrity of the raised floor plenum and the airflow through the space. From a cost and time management perspective the facility manager will be able to speed up deployment of equipment without having to remove panels for cutting. And over the life of the building technicians will be able to add and move new equipment without the worry of snagging cables or affecting the airflow management within the space.

To download a complete set of construction submittals and specification language for the full range of air-sealing grommets please visit our website at www.tateinc.com/koldlok_air_sealing_grommets.aspx.

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