WhiteSpace Field Guide

Finding and Fixing the Top Ten Causes of Unwanted Heat in the Data Centre

WhiteSpace
Critical Infrastructure Solutions™

Heat can cause all kinds of problems in the data centre.

Or to be more specific, we should say unwanted heat – the kind that reaches excessive levels or builds up in places you don't want it to. Wherever you find unwanted heat, you will inevitably encounter problems at some point, including downtime, equipment failure and increased cooling costs.

In this guide, we will take you through the top ten causes of unwanted heat in the data centre and share solutions to keep your facility running at the right temperature and at optimal efficiency.

Do I have heat-related issues in my facility?

We'll start with a quiz.

- Do you feel "hot spots" as you walk through your facility?
- Are you getting high temperature readings near equipment intake or exhaust?
- Are you experiencing frequent equipment alarms or sudden shutdowns?
- Are you having to set your Control Room Air Conditioner (CRAC) at lower and lower temperatures in order to achieve the desired temperature in your facility?

If you answered "yes" to any of the preceding questions, chances are that you have issues with unwanted heat. However, before jumping to conclusions, it is important to keep in mind that heat isn't always a bad thing in the data centre. Many data centres operate at ambient temperatures very close to the maximum recommended by ASHRAE . In other words, cooler doesn't always mean better.

The bad kind of heat is the kind that builds up and starts to recirculate into equipment intakes rather than being channeled back into the CRAC unit. This is where the real problems begin, and unfortunately, heat acts as something of a "silent killer". Many facilities operate with unwanted heat for years before it is detected and corrected.

Whether you have positively identified your heat issues or not, there is no question that their impact is being felt. If they aren't causing shutdowns or outright equipment failure, they are certainly an indicator of inefficiencies that are driving up your cooling costs.

The Top 10 Causes of Unwanted Heat

As we look at the common causes of unwanted heat, what you'll notice is that heat problems are rarely caused by insufficient cooling. The vast majority of facilities we survey have more than enough air conditioning to cool their facility. In fact it's not uncommon to find cooling capacities that are two or three times what's required for the installed equipment. What this means is that heat problems are in fact airflow management problems. This is worth keeping in mind as we go through the list.

1 Placing equipment too close to the CRAC unit.

It would seem to make sense to move your highest-density, mission-critical equipment closest to the CRAC unit. This way, they will benefit from the maximum supply of cool air. Right?

Unfortunately, it doesn't always work like that. Cool air leaves the CRAC at very high velocities, and as it does so, it will often entirely bypass the perforations in the tiles nearby. Instead of being forced through those openings, the high velocity air creates negative pressure that actually sucks in hot air from above the raised floor – the very opposite of what you are looking for. This is what's known as the Venturi effect. The result is that the high-density equipment placed closest to the CRAC is actually getting starved of cool air.

The easiest way to test for this effect is to place a small, light piece of paper over the perforated tiles closest to the CRAC. If there are no problems, the cool air coming up through the perforations should cause the paper to float. If the Venturi effect is active, the piece of paper will actually get sucked down against the tile.

If you find that this is the case, the good news is that you won't have to relocate the equipment. There are a few solutions that you can employ, including higher-CFM perforated tiles and airflow directors beneath the raised floor to counteract the Venturi effect.

2 Obstructions under the raised floor.

In facilities that use a raised floor to circulate cool air, the airways must be kept free of obstructions in order to maximize airflow. Unfortunately, the raised floor often acts as the proverbial "rug" under which all kinds of things get swept over time. The usual culprits are DC power and network cables, which can seriously impede airflow when they collect in high densities. It's usually fairly easy to spot these obstructions by carrying out an inspection of the area beneath the raised floor.

These obstructions can cause a number of unpredictable and unwanted airflow behaviours. Pressurized cool air will always follow the path of least resistance and escape through cracks and other openings in the floor. In extreme cases, entire sections of the raised floor may end up starved of air. Both of these behaviours can lead to localized hotspots that can hamper equipment performance and reduce their lifespans.

If the obstructions can't be removed, the simplest solution is to install baffles underneath the raised floor in order to bypass obstructions. The net effect is to deliver an evenly balanced supply of cool air across your facility.

3 Air leakage through the raised floor.

Unsealed openings in your raised floor are an invitation for unwanted heat. As we mentioned earlier, cool air tends to make its way up through your raised floor wherever it can. The two most common culprits here are improperly installed floor tiles and improperly sealed cable openings.

To see if this issue is affecting your facility, start by checking that your floor tiles all fit snugly together. Seal any gaps that you find, and consider reinstalling the tiles if they are worn or broken.

In locations where cables are running into the raised floor, be sure that you have sealed any openings around the cables. If you are using brush strip grommets, be sure that they are installed correctly and suitable for the job. In our experience, neoprene gaskets provided a more effective sealing solution. If you don't intend to add or remove cables in a given opening, a foam sealant provides a more permanent and effective solution.

4 Floor tiles... wrong kind, wrong place, or too few.

Getting the cool air up from the raised floor is all about having the right openings in the right locations. Are your perforated tiles located in close proximity to your equipment? Are you using the right kind of tiles with the right size openings? Do you need to add more perforated tiles? In some facilities, we see perforated tiles deployed in hot aisles in an effort to make the environment more comfortable for workers. This lowers the pressure of air in other locations where it is needed to cool equipment.

The optimal quantity, style and placement of your perforated tiles will vary depending on the density and location of equipment in your facility. However, tile issues are often easy to identify and relatively easy to fix. The solution may be as simple as adding another perforated tile next to a new enclosure, or increasing the size of the openings. Or, you may want to swap your perforated tiles for vented, louvered, or fan-assisted tiles that provide higher air volumes. Sometimes though, issues with tiles aren't as easy to spot. It helps to periodically measure the volume and temperature of air coming out of your tiles to ensure they are providing the right quantity of cool air.

5 Racks with open u-spaces.

Poor management of airflow within the rack is a very common cause of hotspots and equipment issues. The goal is to have cool air pass through the equipment at the front of the rack and be exhausted out the back, away from the enclosure. Open u-spaces prevent this from happening by causing two unwanted airflow behaviours: cool air bypass and hot-air recirculation.

With cool-air bypass, the cool air at the front of the rack travels through rack openings instead of through the equipment itself. With recirculation, hot exhaust air returns to the front of the enclosure through open u-spaces. This raises the temperature of air flowing through the equipment, which can affect its performance and shorten its lifespan. While there are various ways to test for it, you can generally expect one or both of these behaviours whenever there are open u-spaces in a rack. The good news is there is an easy solution. Blanking panels are an affordable and effective way to seal the open u-spaces. By sealing the gaps, more cool air flows through the equipment and less hot air makes it way to the front of the rack. Of all the fixes in this guide, blanking panels offer the biggest return for the smallest investment.

6 In-rack airflow blockages.

When air is prevented from flowing efficiently through the enclosure, air temperatures within the rack can rise to very high levels. One of the main reasons this happens is due to poor cable management. In high-density racks, especially those used for network applications, a lot of cable ends up in the back of the rack. If this cable isn't managed properly, it can block the equipment exhaust. The hot air simply has nowhere to go, which causes a build-up that can affect the equipment. Another cause of cable-related blockages is the use of power whips that are longer than needed. We have seen 10-foot long power cables used in racks when one-foot lengths would have been sufficient. All that extra cabling has to be bundled up in the back of the rack, which impedes airflow.

A quick inspection is usually enough to reveal whether your cables are impeding airflow. If they are, it is almost certain that the equipment inside the rack is running hotter than it should be. If the issue can't be addressed by your existing cable management solution (for example, traditional cable management arms), you can explore alternatives such as horizontal strain relief bars. These are commonly used to prevent cable stress and breakages, but they can also be used to bundle and secure cables away from the equipment exhaust.

7 Poor exhaust airflow at the back of the rack.

Assuming your equipment exhaust isn't blocked by cables, it still needs a free run out the back of the rack in order to prevent heat build-up and recirculation. This can be a challenge in racks that use perforated rear doors.

Despite the perforations, rear doors still impede airflow to some extent. This partial blockage may not have a huge impact in low-density scenarios, but it can be a big issue in high-density installations. When the air volume gets to a certain point, the perforations just can't cope, and the air is once again left with nowhere to go.

These kinds of issues can be easily diagnosed with thermal imaging and CFD modeling techniques, which will clearly show any hotspots in the rear of the rack. If you are having these issues, the solution may be as simple as removing your rear door, or replacing it with one that has larger perforations.

8 Poor management of hot air coming out of the rack.

When air leaves the rack, what happens to it? If you leave that to chance, the hot air is guaranteed to find its way into places you don't want it to, such as the front of the enclosure or a nearby enclosure. In most cases it will also mix with the cool air supply, reducing the effectiveness of your CRAC output. These kind of issues are usually easiest to spot with thermal imaging and CFD modeling techniques.

The solution is to better manage the flow of exhaust air. The best method for doing so is to install a chimney at the top of the enclosure to channel hot air into the ceiling plenum. This allows it to return to the CRAC without mixing with cool air. In these cases, you will need to seal the enclosure to ensure that the 100 percent of the hot air exits via the chimney. You will also need to fit the CRAC with a collar that allows it to pull hot air from the plenum.

9 Improper rack/row layout.

One of the most common sources of unwanted heat over the past 10 to 15 years is the improper layout of racks and rows. Ideally, the hot exhaust from racks will all be directed to the same place, allowing you to better contain and manage the hot air. Unfortunately, we still see layouts in which the hot air from one row exhausts into the cool-air intake space of another row. It's a bit like what happens in a traffic jam. Some of the exhaust from the vehicle in front of you makes its way into your vehicle; your exhaust makes is way into the vehicle behind you, and so on.

The ideal solution is to arrange your facility in a hot aisle / cool aisle configuration. In this layout, two rows are placed back to back (with space in between) so that they both exhaust into the same space. The front of those rows face the front of other rows, and so on, ensuring that the space between any rows is only used for hot or cool air, never both.

Cooling and airflow can also be impeded when the space between rows is too narrow. In the past, data centres were set up with relatively narrow aisles. This made it harder to supply enough cool air into the equipment. Today, the minimum suggested width between rows is 48 inches, which allows plenty of room for cool air to supply the equipment.

10 Short circuiting of cool air.

Short circuiting (or short cycling) is a phenomenon in which cool air leaves the CRAC and returns to it without passing through any of the equipment. Short-circuiting occurs to some extent in most facilities, and it isn't always a problem. However, by some estimates, the amount of short-circuited air can be as high as 60 percent, which is a major problem.

Diagnosing a short circuiting problem is not always easy, but the signs will usually be there. For example, if your overall cooling supply is sufficient but areas further removed from the CRAC are persistently hot, this is usually a good sign that short circuiting is occurring. We will often hear that the fans are on full, the CRAC is set as low as possible, yet it is still impossible to get enough cool air to those distant corners.

There are usually multiple causes for short-circuiting (many of which we have covered already), but the general, overriding cause is the practice of "chaos cooling". Chaos cooling describes the approach of pumping cool air into the facility (with no containment or isolation) and hoping it gets where it is supposed to go. Naturally, this approach is rife with inefficiencies.

The solution is to direct the cool air exactly where it needs to go. If the preceding recommendations aren't sufficient to make this happen, the next solution to explore is cool-air containment. Under this approach, the air around the equipment intakes is physically isolated from the air in the rest of the facility, usually by creating "cold rows". The cool air from the CRAC is then pumped only into these cold rows, ensuring the 100 percent cool air is reaching equipment. This approach vastly improves the efficiency of your CRAC unit and the longevity of your equipment.

Get in touch.

If you are struggling with unwanted heat, WhiteSpace can help. We offer world-class products and consulting services to help you implement the recommendations outlined in this guide.

If you need a hand diagnosing your heat issues and determining the best solutions, let our experts conduct a cooling assessment. We'll perform a systematic inspection of your facility and provide a detailed set of recommendations to help you solve your heat issues.

WhiteSpace
Critical Infrastructure Solutions™

Contact WhiteSpace for more information

whitespacecis.ca • 1-800-667-4020