BUSINESS CASE ANALYSIS
EXECUTIVE SUMMARY

Improving Data Center Reliability and Efficiency by Recovering Cooling Capacity with KoldLok® Raised Floor Grommets

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Abstract
The trend toward higher heat densities in new IT and telecommunications equipment (and the presence of reduced cooling unit capacity and airflow) leads to hotspots, a debilitating data center issue. The higher ambient temperatures (typically measured at the top of server racks) can reduce IT equipment reliability and increase operating costs, negatively impacting business operations—particularly mission-critical applications that rely on ”24 by forever” availability.

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Developed with 10 years of field research, KoldLok Raised Floor Grommets are designed to improve precision cooling to specific heat loads by increasing the volume of conditioned airflow available to the areas most challenged by the increasing heat densities of new equipment. This design also improves the return-air conditions which can lead to recovery of lost cooling unit capacity due to latent cooling.

Extensive measurements at targeted data center sites have shown that approximately 60 percent of the conditioned air flows through unmanaged openings rather than through the perforated floor tiles. This condition is known as Bypass Airflow and it impacts computer room cooling in three significant ways:

- Hotspots: IT Equipment Intake Air Temperature Above Recommended Condition For Reliable Operations.
- Cooling Unit Incapacity: Sensible Cooling Unit Capacity Is Reduced.
- Latent Cooling Penalty: Moisture Removed From Bypass Airflow Must Be Replaced to Maintain a Reliable Computing Environment.

Business Case Description

This analysis examines a newly built data center with KoldLok Integral Raised Floor Grommets installed during construction. This analysis calculates the reduced number of cooling units required based on sealing unmanaged openings that waste cooled air. Using the calculations, data centers can easily determine the financial impact to their business. This same calculation can also be used in data centers that operate with chilled water systems.

By sealing cable cutouts, data centers can reduce the number of cooling units in operation. This number can be determined using simple calculations involving bypass airflow and thermal cooling demand. Previously lost bypass air is recovered and forced to flow to the perforated floor tiles that should be located at the computer cabinet air intakes, thus delivering increased airflow where it is needed most.

Operating assumptions are outlined below:

- Data center consists of 10,000 ft^2 of raised-floor space with an underfloor cooling plenum of 18” or higher for distributing cooled air.
- Data center has 400 equipment cabinets averaging 2’ X 3’ at the base and 6’ high.
- Data center consumes 600 kilowatts (kW) of power for an average of 1.5 kW per rack and 60W/ft^2. All power consumed by computer equipment within the racks is converted to heated air.
- Electrical energy, including demand charges, costs $0.06 per kilowatt hour (kWh).
- Liebert Model VH267W 20-ton cooling units are used to cool the data center. Each cooling unit uses a 5 horsepower (Hp) fan to deliver 10,000 cubic feet per minute (CFM) of airflow and consumes 3.73 kW for airflow demand and 16.7 kW for thermal demand (liebert.com).
- Field measurement of airflow in numerous data centers has determined that 50 to 80 percent of the CFM discharged from cooling units into the underfloor plenum escapes through unsealed openings. Lost air through cable openings can be verified by simple measurements of actual perforated tile and grate openings (ft^2) compared to measurements of cable cutouts and perimeter penetrations (ft^2). Air lost through floor, sidewall, or ceiling penetrations can also be verified by simple cross-sectional area measurements. If the air returns to the computer room, these penetrations can be treated the same as cable cutout bypass air. If the air fails to return to the computer room, cooled air has been permanently lost and must be replaced, which increases the total thermal cooling demand.
- KoldLok Integral Raised Floor Grommets are installed to seal cable cutouts as the floor tiles are installed. All 400 cabinet cable cutouts are sealed.
- Alternating hot-aisle and cold-aisle equipment configurations are implemented.
- Twenty-five percent open perforated floor tiles are installed one per every two racks at the rack air intake for a total of 200 perforated floor tiles.
- All perimeter penetrations in the subfloor, walls, and ceiling are sealed.
- The supply temperature is 57°F, exhaust temperature is 74°F, and the temperature increase of the air as it passes through the computer equipment is an average of 17°F.
- Without sealing the cable cutouts, 30 percent of available cold air bypasses the perforated floor tiles through cable cutouts averaging 5” x 6” in size (use of larger openings increases bypass air and its negative environmental effects). Thirty percent bypass air results in a return air temperature of 70°F/48 percent relative humidity (Rh). At this condition, each cooling unit provides 219,700 British Thermal Units per hour (BTU/h) of total cooling, of which 93 percent or 203,400 BTU/h (59.7 kW) is sensible

cooling. This yields 16,300 BTU/h (4.8 kW) of latent cooling (capacity data provided by Liebert).

- By sealing the cable cutouts, only 10 percent of available cold air bypasses the perforated floor tile openings resulting in a return air temperature increase to 72˚F/45 percent Rh. For this return air condition, each cooling unit provides 229,900 BTU/h of total cooling, of which 100 percent or 229,900 BTU/h (67.0 kW) is sensible thermal cooling (capacity data provided by Liebert). There is no latent cooling.
- Humidification is via electric canister type humidifiers. The energy consumed by these canisters to vaporize the necessary replacement water is assumed to be the same as the latent energy required to remove the moisture (4.8 kW from above). This assumes 100 percent efficiency. In reality, actual efficiency is significantly less than 100 percent and the energy consumption will be greater than assumed.

Cooling Unit Summary

	Cooling Units Required to Meet Airflow Demand	**Cooling Units Required to Meet Thermal Demand**
Without KoldLok Products	16	10.1
With KoldLok Products	13	8.9
Cooling Unit Savings	3	1.2

Savings Summary

- Capital cost savings from installing three fewer cooling units ($90,000)
- Electrical energy savings due to running three fewer cooling units for airflow ($5,880 annually)
- Electrical energy savings due to running of 1.2 fewer cooling units for thermal demand ($10,534 annually)
- Electrical energy savings due to avoiding the latent cooling penalty on 10.1 cooling units ($25,482 annually)
- Maintenance savings due to running three fewer cooling units ($9,000 annually)

Summary Recommendation

Given the potential for (1) quick financial return, (2) reduction in business risk, and (3) data center hardening, Upsite's family of KoldLok products is recommended for data center facilities experiencing or expecting heat-density problems.

Data Sources and Validation

Additional information regarding the effects of increasing heat densities is presented in Uptime Institute, Inc.® white paper, *Heat Density Trends in Data Processing, Computer Systems, and Telecommunications Equipment*. All referenced papers are available on the Institute's website at: uptimeinstitute.org

Financial Impact Summary

Cash Flow Analysis for Installing KoldLok Integral in a 10,000 ft² New Data Center

Item	Initial	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Reduction of Cooling Units for Airflow Demand	3	3	3	3	3	3	3
Reduction of Cooling Units for Thermal Demand	1.2	1.2	1.2	1.2	1.2	1.2	1.2
KoldLok with Installation ($82.50 each)	($33,000)						($33,000)
Cooling Unit Acquisition Cost Saved		$90,000					$90,000
Airflow Demand Energy Saved		$5,880	$5,880	$5,880	$5,880	$5,880	$29,400
Thermal Demand Energy Saved		$10,534	$10,534	$10,534	$10,534	$10,534	$52,668
Latent Cooling Penalty Saved		$25,482	$25,482	$25,482	$25,482	$25,482	$127,412
Maintenance Saved		$9,000	$9,000	$9,000	$9,000	$9,000	$45,000
Net Cash Flow	($33,000)	$140,896	$50,896	$50,896	$50,896	$50,896	$311,480
Cumulative Cash Flow	($33,000)	$107,896	$158,792	$209,688	$260,584	$311,480	$311,480

About Upsite

Upsite Technologies, Inc.™ develops energy-efficient, high-availability solutions specifically designed to optimize your data center's critical physical infrastructure and ensure site uptime, reliability, and flexibility.

As the innovator of engineered sealing solutions, Upsite continues to research and develop products and services to complement and enhance the already extensive lines of patented KoldLok® products and KoldWorks℠ services. Our inventions optimize thermal load capacity, target hotspot remediation, reduce intermittent equipment failures, improve equipment reliability, minimize bypass airflow, and diminish capital costs associated with installing additional cooling equipment.

Upsite's well-engineered solutions are employed by data centers worldwide to help reduce their carbon footprint and minimize energy and operating costs. Upsite's products and services currently optimize more than 6 million ft^2 of data center space.

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