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April 29, 2002

Mr. David S. De Lorenzo
Thermal/ Mechanical Engineer
Intel Corporation
TRL/ EAL
Advanced Systems Lab
DP3-315
2800 Center Drive
DuPont, WA 98327

RE: Tower of Cool

Dear David:

Baltimore
Dallas
Washington
Los Angeles
Chicago
Denver
Memphis
Houston
London
Tokyo
Hong Kong
Madrid

It is my understanding that there are questions as to the validity of the claims that the Tower of Cool can effectively cool 8 KW of electronic equipment in a single cabinet. As the co-inventor of the Tower of Cool, a registered mechanical engineer in 29 states and the District of Columbia, and a published expert in thermal management, I can state that the Tower of Cool has been designed and tested to cool 8 KW of electronic equipment.

A professional engineering license is only issued to registered professionals who have demonstrated proficiency in their field. My entire career has been dedicated to expertise in thermal management. Specifically, the last three years have been focused on mass air flow and heat transfer in the micro environment of the cabinet.

As a registered design professional, I subscribe to a code of conduct in each state that governs my actions. A primary tenet of each state's code of conduct is honesty and professionalism. Please be assured that the results of the white paper and comments in this letter reflect my required conduct.

Unlike any other product, the Tower of Cool uses conditioned air one time to cool each piece of electronic equipment. The front door delivers the cool air to the equipment, and the back door removes the hot air from the discharge of the electronic equipment. There is no "chimney effect", as has been the case in other cabinets in the past. Chimney effect allows the heat dissipated from the equipment at the bottom of the cabinet to enter equipment at the top of the cabinet creating a temperature gradient within the cabinet. This is the major shortcoming of all other air cooled products on the market.

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If you look at the data in the white paper, you will see that the Tower of Cool is designed to cool 8 KW of equipment with a 40 Deg. Delta T. Air enters the cabinet at 55 Deg. F, and leaves the cabinet at 95 Deg. F.

The equation to calculate air flow is:

Air Flow (CFM)= KW x (3,413 BTUH/ KW)/ 1.08 x Delta T

CFM= 8.0 KW x (3,413 BTUH/ KW)/ 1.08 x (95 Deg. F- 55 Deg. F)

CFM=632

This is the required air flow to remove 8 KW of heat. The fans in the Tower of Cool deliver 690 CFM at zero static pressure and 630 CFM at 0.10" static pressure (0.10" static pressure is the calculated pressure drop through the front door).

When we purchased the servers for the field testing, we attempted to get as close to 8.0 KW as possible. The best we could do was forty-two (42) 180 watt (nameplate) servers. One server was defective, so for the tests we had 41 in the cabinet (41 servers x 180 watts/ server= 7.4 KW at nameplate). The measured power draw was 107 watts (41servers x 107 watts/ server= 4.4 KW measured).

The "Steady State" temperature profiles in the white paper indicate a 20 degree rise through the cabinet.

Using the equation above as a check:

CFM= (41 servers x 107 watts/ server) x (3.314 BTUH/ watt)/ 1.08 x (85 Deg. F- 65 Deg. F)

CFM= 693

An obvious question is why is the actual air flow higher than the fan rating of 630 CFM at 0.10" static pressure? Since there is a slight positive pressure at the fan inlet due to the pressurized raised floor (approx. 0.10"), the fans deliver more air than their standard rating.

It is readily apparent to a design professional schooled in mass air flow and heat transfer that if the load imposed on the air stream doubles, so does the delta T. If you extrapolate the heat per server to 214 watts, and maintain the same air flow, the following equation will predict the delta T.

Delta T= watts x (3.413 BTUH/ watt)/ 1.08 x CFM

Delta T= (41 servers x 214 watts/ server) x (3.413 BTUH/ watt)/ 1.08 x 693 CFM

Delta T= 40 Deg. F.

With an entering temperature of 55 Deg. F, the temperature leaving the Tower of Cool would be 95 Deg. F. Please note that at 95 Deg. F, the discharge temperature from the Tower of Cool is the same as the published data by a major manufacturer of computer equipment for maximum allowable maintained inlet temperature for their electronic devices (at 95 Deg. F inlet, the temperature on the outlet of these devices would be between 115 deg. F and 125 deg. F).

In this example, the actual heat dissipation that can be effectively cooled by the Tower of Cool is 8.8 KW! However, we are listing the capacity at 8 KW.

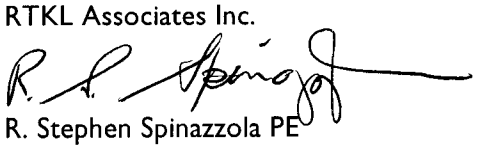
I hope this addresses the concerns of which you have been made aware.

Also, RTKL and the Tower of Cool have been invited by two prestigious research universities to participate in a two year program that will investigate state of the art technology in reducing energy consumption in data center type facilities. This program will commence June 1, 2002.

Anyone interested in monitoring this program should contact me for additional information.

Results from this research program will be posted at ***www.rtkl.com*** as they become available.

Sincerely,
RTKL Associates Inc.



R. Stephen Spinazzola PE
Vice President