

Topic: Cooling Systems within the ClearCube Solution
Component(s) Affected: All ClearCube Blades, BackPacks, and Cages
Date: December 22, 2004

OVERVIEW / ENVIRONMENT

This bulletin describes the cooling systems that are utilized to maintain optimal operating temperatures for ClearCube Blades installed in R Series Cages using BackPacks (both 8x8 Switching and Direct Connect).

DETAILED DESCRIPTION

The ClearCube solution uses a compact and dense architecture in order to house a large number of Blades in a very small area. The density of the current R Series system allows installing 112 Blades within 14 Cages in a standard 42U cabinet, which typically occupies a 2' x 3' (approximately 70 cm x 100 cm) footprint. However, one of the challenges with such a dense solution is appropriate cooling of the system, especially when using the higher heat generating processors such as the Intel Pentium 4 hyperthreading chips.

The optimal temperatures that the systems operate under vary from system to system, however, the current temperature readings for the R1150 Blades, R Series Cages, and BackPacks are:

- Heat Generation—1200 to 3300 BTU/hour for a fully loaded Cage (eight Blades)
- Maximum Temperature—35° Celsius (95° Fahrenheit)

The ClearCube solution provides three ways to cool the Blades, Cage, and BackPacks:

- Fan or blower at the processor
- Exhaust fans on the rear of Cage
- Air flow channels within the Cage structure

Blower

Every Blade has a fan or blower that directs air across the heatsink connected to the processor. On the R1150 and R1200 Blades, for example, this fan has a shroud that directs the air through the heat sink fins, allowing only minimal air dissipation outside the heatsink. By moving air more efficiently through the heat sink in this way, ClearCube can increase the cooling capacity of the Blade.(see *Figure 1*).



Heat sink, shroud, and processor structure

Figure 1 Blower and Heatsink Structure (Typical)

Fan Packs

A fan pack on the back of each BackPack contains four fans with a combined ability to move 340 CFM of air. These fans draw air through the front of the Cage and move it along the surface of the Blade and

through the BackPack at a high volume. This rapid movement of air wicks heat off of high-heat generation components such as the processor, hard drive, and power supplies. *Figure 2* shows the fan pack.



Figure 2 Fan Pack on Switching BackPack

It is imperative to maintain at least 4" (10 cm) of clearance behind the exhaust fans so that air can be effectively exhausted from the Cage. This includes clearance between cable bundles, cabinet doors, walls, etc. Failure to this clearance could cause the Cages, Blades, and BackPacks to overheat.

Air Flow Channels

The third structure that ClearCube uses to maintain proper operating temperatures in the ClearCube system is to utilize the space between the individual Blades in a Cage to channel air along the Blade surface that generates the most heat—the circuit board and its components. Additionally, tunnels are installed in the Cage to focus the airflow even more when the air hits the Blade power supply. This targets the power supply as a major component for cooling within the Cage.

Data Center Infrastructure

Despite all these advances that ClearCube has made in cooling the solution, it is important for the customer to address environmental needs for their data center. Areas that must be addressed are:

- HVAC capacity for the data center—is there enough to cool the additional heat generation?
- Exhaust out of a data center—is there some way to exhaust the warm air?
- Air flow in the data center—is there enough air movement in the data center?

ClearCube recommends that all customers refer to our *Site Preparation for ClearCube Installation* document for detailed information on the heat generation of Cages (single or multiple) as well as the additional HVAC capacity required to maintain ambient temperatures in a data center. This document can be downloaded from the ClearCube support website at <http://support.clearcube.com/>

Rack Requirement – R1100								
Units Per Rack			Power Requirements		Typical Current Draw		Thermal	
Cages	Max No. Blades	Rack Space (U)	Peak Power (kVA)	Peak Current at 120V (A)	Low Current at 120V (A)	High Current at 120V (A)	Generated Heat Load (Btu/hr.)	Required Cooling Capacity (tons)
1	8	3	1.2	10	4.5	6.5	2,700	0.2
2	16	6	2.4	20	9.0	13.0	5,400	0.5
3	24	9	3.6	30	13.5	19.5	8,100	0.7
4	32	12	4.8	40	18.0	26.0	10,800	0.9
5	40	15	6	50	22.5	32.5	13,500	1.1
6	48	18	7.2	60	27.0	39.0	16,200	1.4
7	56	21	8.4	70	31.5	45.5	18,900	1.6
8	64	24	9.6	80	36.0	52.0	21,600	1.8
9	72	27	10.8	90	40.5	58.5	24,300	2.0
10	80	30	12	100	45.0	65.0	27,000	2.3
11	88	33	13.2	110	49.5	71.5	29,700	2.5
12	96	36	14.4	120	54.0	78.0	32,400	2.7
13	104	39	15.6	130	58.5	84.5	35,100	2.9
14	112	42	16.8	140	63.0	91.0	37,800	3.2

Rack Requirement – R1150								
Units Per Rack			Power Requirements		Typical Current Draw		Thermal	
Cages	Max No. Blades	Rack Space (U)	Peak Power (kVA)	Peak Current at 120V (A)	Low Current at 120V (A)	High Current at 120V (A)	Generated Heat Load (Btu/hr.)	Required Cooling Capacity (tons)
1	8	3	1.2	10	4.5	7.5	3,070	0.25
2	16	6	2.4	20	9.0	15	6,140	0.5
3	24	9	3.6	30	13.5	22.5	9,210	0.75
4	32	12	4.8	40	18.0	30	12,280	1
5	40	15	6	50	22.5	37.5	15,350	1.25
6	48	18	7.2	60	27.0	45	18,420	1.5
7	56	21	8.4	70	31.5	52.5	21,490	1.75
8	64	24	9.6	80	36.0	60	24,560	2
9	72	27	10.8	90	40.5	67.5	27,630	2.25
10	80	30	12	100	45.0	75	30,700	2.5
11	88	33	13.2	110	49.5	82.5	33,770	2.75
12	96	36	14.4	120	54.0	90	36,840	3
13	104	39	15.6	130	58.5	97.5	39,910	3.25
14	112	42	16.8	140	63.0	105	42,980	3.5

Rack Requirement – R1200								
Units Per Rack			Power Requirements		Typical Current Draw		Thermal	
Cages	Max No. Blades	Rack Space (U)	Peak Power (kVA)	Peak Current at 120V (A)	Low Current at 120V (A)	High Current at 120V (A)	Generated Heat Load (Btu/hr.)	Required Cooling Capacity (tons)
1	8	3	1.2	12	4.5	9	3,685	0.31
2	16	6	2.4	24	9	18	7,370	0.62
3	24	9	3.6	36	13.5	27	11,055	0.93
4	32	12	4.8	48	18	36	14,740	1.24
5	40	15	6	60	22.5	45	18,425	1.55
6	48	18	7.2	72	27	54	22,110	1.86
7	56	21	8.4	84	31.5	63	25,795	2.17
8	64	24	9.6	96	36	72	29,480	2.48
9	72	27	10.8	108	40.5	81	33,165	2.79
10	80	30	12	120	45	90	36,850	3.1
11	88	33	13.2	132	49.5	99	40,535	3.41
12	96	36	14.4	144	54	108	44,220	3.72
13	104	39	15.6	156	58.5	117	47,905	4.03
14	112	42	16.8	168	63	126	51,590	4.34

Rack Requirement – R2100								
Units Per Rack			Power Requirements		Typical Current Draw		Thermal	
Cages	Max No. Blades *	Rack Space (U)	Peak Power (kVA)	Peak Current at 120V (A)	Low Current at 120V (A)	High Current at 120V (A)	Generated Heat Load (Btu/hr.)	Required Cooling Capacity (tons)
1	4	3	1.2	10	4.2	8.1	3,315	0.28
2	8	6	2.4	20	8.4	16.2	6,630	0.56
3	12	9	3.6	30	12.6	24.3	9,945	0.84
4	16	12	4.8	40	16.8	32.4	13,260	1.12
5	20	15	6	50	21	40.5	16,575	1.4
6	24	18	7.2	60	25.2	48.6	19,890	1.68
7	28	21	8.4	70	29.4	56.7	23,205	1.96
8	32	24	9.6	80	33.6	64.8	26,520	2.24
9	36	27	10.8	90	37.8	72.9	29,835	2.52
10	40	30	12	100	42	81	33,150	2.8
11	44	33	13.2	110	46.2	89.1	36,465	3.08
12	48	36	14.4	120	50.4	97.2	39,780	3.36
13	52	39	15.6	130	54.6	105.3	43,095	3.64
14	56	42	16.8	140	58.8	113.4	46,410	3.92

* R2100 Blades are double-width, and fit four per Cage.