Cheatography

Calculating Cooling Capacity Cheat Sheet

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Introduction

This is where the rubber meets the road. Capacity planning is part mathematical calculations: adding up all power which will be consumed then calculating what kind of cooling will be needed to remove the heat waste, and is also part art: guessing what the facility will require in the future as technology and requirements change. Since the “art” part of planning can get a little wonky, let’s start with the math.

The best place to start when calculating required cooling is power draw. With very few exceptions (like POE) all power consumed by IT equipment is turned into heat. Since the electrical signals coming into and leaving the datacenter are negligible, and IT equipment doesn’t output any kind of mechanical work, it is safe to assume that all power is being turned into waste heat. This means if you know how much power each device will consume, then you know how much heat it will produce. Face it, your datacenter is nothing but a big, expensive heater..

Credit: https://packetpushers.net/back-basics-cooling-part-2/

Calculations

Figuring out your total wattage (power) draw can typically be done by looking at the capacity of your UPS system. If your UPS can only output 10,000 Watts/VA (there is a difference, but suffice it to say: it is negligible for IT equipment), then you can start at 10,000 watts (10kW) for your cooling calculation. We will use this as a starting point in the example calculation

UPS Max Output = 10kW

Expected UPS utilization: 50%, or 5kW of draw by equipment

After determining we only expect to draw 5kW of power, we can add in some additional metrics:

(1) UPS Inefficiencies: (.04 × UPS Max Watt Rating) + (.05 × expected wattage draw)

(2) Power Distribution: (.01 × UPS Max Watt Rating) + (.02 × expected wattage draw)

(3) Lighting: (22 Watts × Floor Area in m^2) or (2 Watts × Floor Area in ft^2)

(4) People: (100 Watts × max number of people)

Saving you the long form math, considering 100ft^2 of space and no people, we end up with 6050 Watts of heat production.

Cooling Power Requirements

The “Art”

Now we get into the “art” and the more elusive metrics. It is obvious that much of the heat gained or lost by a facility is due to the environment around it. Depending on the insulation in the external walls and the climate, this factor can be orders of magnitude higher or lower. Since this factor is, by itself, very complex and tricky, we will leave it out of the discussion for now. It is also important to note that if your datacenter is an air conditioned room inside of an already climate controlled building (like a data room in an office building), then you can, for the most part, ignore this metric.. The other evasive metric is utilization change or “room for growth”. We scoped a 10kW UPS but only expect to use 50% of that max capacity. If we scope a cooling system which perfectly matches the expected 6050 watts of heat production, then we have no room for growth in regards to cooling. We can scope a cooling system which matches the UPS, but that can get expensive. This metric varies widely depending on the particular installation. My advice is to calculate the cooling needed for initial expected consumption, then calculate the cooling for the max capacity of the power systems, and pick a size in the middle based on your best guess of required headroom..

Converting Units

The cooling cycleNow we have determined we need to account for 8000 Watts of heat production (6050 + some growing room), we can convert this to a number which is meaningful to a HVAC engineer. Using the conversion tables above, we can determine we need 26296 BTUs or 2.272 tons of refrigeration capacity. Since refrigeration units come in integer sizes of tons, or factors of 12,000BTU, we have to round up to a 3 ton or 36000 BTU unit. And there you have it.

Item	Data required	Calculation	Subtotal kW
Power requirement – electrical			
Critical load-sizing calculator value from Schneider Electric website	Rating of each IT device	(Calculator total in VA x 0.67) / 1000	# 1____________kW
For equipment not listed in the sizing calculator, critical load nameplate	Subtotal VA (include fire, security and monitoring systems)	(Subtotal VA x .67 / 1000)	# 2____________kW
Future loads	VA of nameplate of each anticipated IT device	[(Add VA rating of future devices) x .67] / 1000	# 3____________kW
Peak power draw due to variation in critical loads	Total steady state critical load power draw	(#1 + #2 + #3) x .1.05	# 4____________kW
UPS inefficiency and battery charging	Actual Load + Future Loads (in kW)	(#1 + #2 + #3) x .32	# 5____________kW
Lighting	Total floor area associated with the data centre	0.002 x floor area (sq ft), or 0.0215 x floor area (sq m)	# 6____________kW
Total power to support electrical demands	Total from #4, #5 and #6 above	#4 + #5 + #6	# 7____________kW
Power requirement – cooling			
Total power to support cooling demands	Total from #7 above	For Chiller systems #7 x 0.7 For DX systems #7 x 1.0	# 8____________kW
Total power requirement			
Total power to support electrical and cooling demands	Total from #7 and #8 above	#7 + #8	# 9____________kW
Size of electrical service estimate			
Requirements to meet NEC and other regulators	Total from #9 above	#9 x 1.25	# 10____________kW
Three phase AC voltage provided at service entrance	AC voltage		# 11____________VAC
Electrical service required from utility company in Amps	Total from #10 and AC voltage in #11	(#10 x 1000) / (#11 x 1.73)	____________Amps
Size of standby generator estimate (if applicable)			
Critical loads requiring generator backup	Total from #7 above	#7 x 1.3*	# 12____________kW
Cooling loads requiring generator backup	Total from #8 above	#8 x 1.5	# 13____________kW
Size of generator needed	Total from #12 and #13 above	#12 + #13	____________kW

http://www.datacentrepowermag.com/features/18252-calculating-total-power-requirements-for-data-centres