

Application Note 2003: High Altitude Applications

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Introduction

This Application Note provides an overview related to the reduced operating capacity of CITY MULTI outdoor units at high altitudes.

Capacity Reduction

When air conditioners and heat pumps are installed in areas above sea level, operating capacity is reduced due to decreased air density. Because of this, equipment size may need to be increased to meet the load requirements. The following correction factors apply to CITY MULTI® systems for both heating and cooling operation. Both the indoor and outdoor units need to be sized based on the capacity reduction due to the decreased air density.

Table 1. Capacity Correction Factors

Altitude [feet above sea level]	Air-Source Systems		Water-Source Systems	
	Indoor Unit	Air-Source Outdoor Unit	Indoor Unit	Water-Source Unit
0	1.00	1.00	1.00	1.00
1,000	0.93	0.99	0.96	1.00
2,000	0.93	0.98	0.93	1.00
3,000	0.90	0.98	0.90	1.00
4,000	0.86	0.97	0.86	1.00
5,000	0.83	0.96	0.83	1.00
6,000	0.80	0.95	0.80	1.00
7,000	0.77	0.94	0.77	1.00
8,000	0.74	0.94	0.74	1.00
9,000	0.71	0.93	0.71	1.00
10,000	0.69	0.92	0.69	1.00

Air-Source Systems

For air-source systems installed at 5,000 feet above sea level, the indoor units would operate at 83% normal capacity when compared to its performance at sea level. The indoor units would need to have at least 17% more capacity to provide the same cooling and heating performance they would at sea level.

Air-source outdoor units installed at 5,000 feet above sea level would operate at 96% its normal capacity when compared to its performance at sea level. Therefore, the outdoor unit(s) would need to have at least 4% more capacity to provide the same cooling and heating performance as the units would at sea level. However, depending on the indoor units selected, the size of the outdoor unit may have to be increased to meet the maximum connected capacity requirement. The maximum connected capacity for Y, H2i, and S Series are 130%; the maximum connected capacity for R2 Series is 150%.

Water-Source Systems

For water-source systems installed at 5,000 feet above sea level, the indoor units would operate at 83% normal capacity when compared to their performance at sea level as shown in Table 1. The indoor units would need to have at least 17% more capacity to provide the same cooling and heating performance as the units would at sea level.

The water-source units can be sized based on their normal capacity at sea level. However, depending on the indoor units selected, the size of the outdoor unit may have to be increased to meet the maximum connected capacity requirement. The maximum connected capacity for WY Series is 130%; the maximum connected capacity for WR2 Series is 150%.

Using Altitude Correction Factors in Diamond System Builder

Diamond System Builder allows a user to easily incorporate correction factors, such as those in Table 1, into system design. The user can adjust these values on the Unit Config tab in Project Properties:

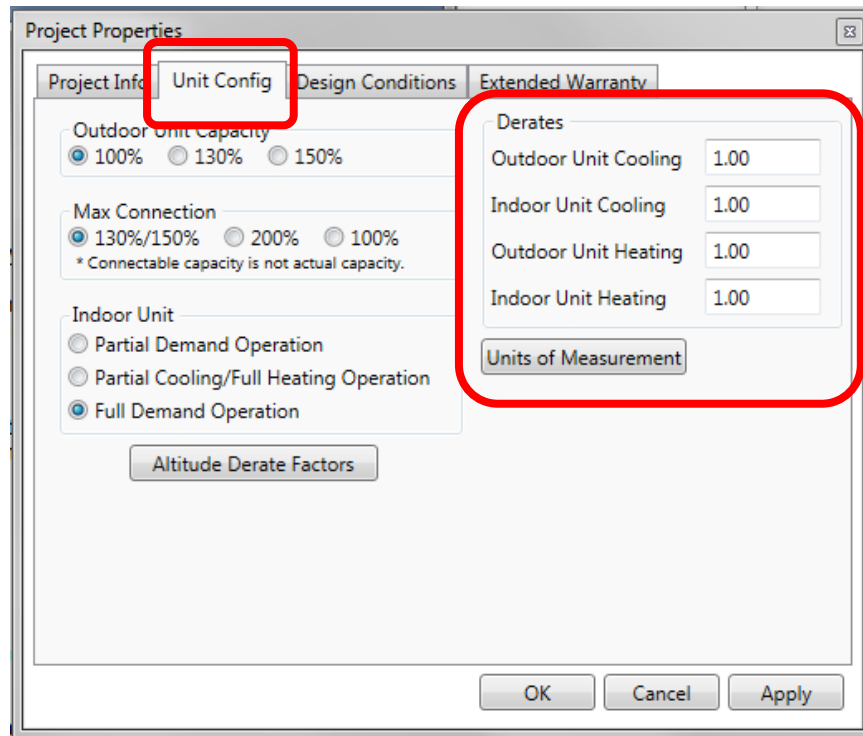


Figure 1: Unit Config Tab in Project Properties

Once the correction factors are applied in Diamond System Builder, the user can utilize the estimated performance provided by the program to appropriately size the system, matching the performance with the calculated loads for spaces.

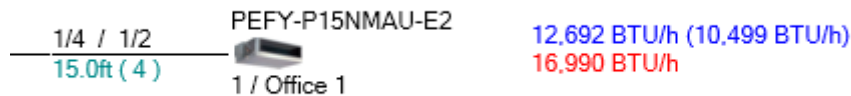


Figure 2: Example of Calculated in Diamond System Builder

No other adjustments are necessary for system design and application.

Applying Altitude Correction Factors Manually

The easiest way to apply the altitude correction factors by hand is to first adjust the building loads, and the size the equipment to meet the new numbers. A sample calculation is provided below.

EXAMPLE:

A small office building is located in a city where the altitude is 5,000 feet above sea level. The engineer plans on using an air-source CITY MULTI system. By referencing Table 1, the temperature correction factors are 0.83 for indoor units and 0.96 for outdoor units.

Using the indoor unit correction factor, the calculated loads are adjusted as shown in Table 2.

Table 2. Individual Zone Load Adjustments

Area	Calculated Zone Loads		Divide By	Altitude Correction Factor	Equals	Adjusted Zone Loads	
Office 1	Cooling	12,156	/	0.83	=	Cooling	14,646
	Heating	14,256	/	0.83	=	Heating	17,176
Office 2	Cooling	8,763	/	0.83	=	Cooling	10,558
	Heating	10,215	/	0.83	=	Heating	12,307
Office 3	Cooling	6,550	/	0.83	=	Cooling	7,892
	Heating	8,761	/	0.83	=	Heating	10,555
Break Room	Cooling	18,795	/	0.83	=	Cooling	22,645
	Heating	21,564	/	0.83	=	Heating	25,981
Conference Room	Cooling	22,000	/	0.83	=	Cooling	26,506
	Heating	26,000	/	0.83	=	Heating	31,325
Reception Area	Cooling	15,186	/	0.83	=	Cooling	18,296
	Heating	20,156	/	0.83	=	Heating	24,284

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Using the outdoor unit correction factor, adjust the block load as shown in Table 3.

Table 3. Block Load Adjustments

Area	Calculated Block Load		Divide By	Altitude Correction Factor	Equals	Adjusted Block Load	
Building	Cooling	89,675	/	0.96	=	Cooling	93,411
	Heating	118,245	/	0.96	=	Heating	123,172

Then, select the indoor units to cover these adjusted loads.¹ Diamond System Builder can be used to help select the appropriate indoor units.²

The indoor units may have been upsized more than the outdoor units. It may be required to increase the size of the outdoor unit in order to fall within the connected capacity guidelines mentioned in the sections on Air-Source Systems and Water-Source Systems.

Follow all standard guidelines when using Design Tool to assure all capacity corrections are included for such as, defrost, line length, design temperatures, or other factors.

¹ There may be other correction factors that affect the performance of an indoor unit such as air temperature and line lengths. For best results, use Diamond System Builder to assist in estimating equipment performance.

² If the zone loads are adjusted manually, the altitude correction factor should NOT be entered into Diamond System Builder.