

# DRY & ADIABATIC COOLERS AND CONDENSERS

## EQUIPMENT LAYOUT MANUAL



for LIFE

Commercial HVAC | Industrial Refrigeration |  
Power Generation | Industrial Process



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## Introduction

The location of dry and adiabatic cooling equipment is an important consideration when reviewing system design. Since air cooled equipment requires large quantities of air, adequate spacing around the unit must be provided for each unit to perform properly. An equally important consideration when laying out the equipment is to locate the unit so that recirculation is minimized.

This technical manual has been written by EVAPCO engineers to provide recommended layout criteria for EVAPCO induced draft dry and adiabatic equipment installations.

### Recirculation

During unit operation, recirculation occurs when some of the heated discharge air flows back into the entering air inlet area. The higher temperature, heat-laden discharge air stream, can have significant temperature difference in comparison to the entering air dry bulb temperature. Therefore, any recirculated air amount will increase the unit's entering air dry bulb temperature which in turn will decrease its heat rejection capability. In extreme cases where the entering air dry bulb temperature is increased by more than 2.78°C (5°F) the unit's heat rejection capability may be reduced by more than 50%.

### Equipment Layout Planning

Proper equipment layout is essential to ensure that the cooling equipment will operate at its rated capacity. The objective is for the cooling equipment to be located such that entering air is allowed to enter the unit without restriction. The first step in achieving this goal is to consider the many factors that may affect the unit installation. During system layout, special attention needs to be given to space limitations, surrounding structures, existing units, proximity of neighbors, prevailing winds, piping, and any possible future expansion plans. Once this information is obtained, the guidelines contained in this bulletin can be used to determine the best layout for the equipment.

The layout criteria presented in this manual are based on years of successful experience with cooling installations coupled with laboratory testing. Following these guidelines will provide the best equipment layout which will ensure proper air flow to the unit.

## eco-Air Series Unit Layout

### Single Unit Installations

The recommended place to locate any dry or adiabatic unit is open to the air, by itself. However, when this is not possible, correct layout guidelines must be followed to provide a satisfactory installation.

The first item to consider is the position of the unit with respect to other structures. The top of the unit must be equal to or higher than any adjacent walls, buildings or other structures. When the top of the unit is lower than the surrounding structures (Figure 1 & 2), recirculation can occur. If the unit is on the windward side, as shown in Figure 1, the discharge air will be forced against the building and then spread in all directions, including downward, toward the unit's air inlets.

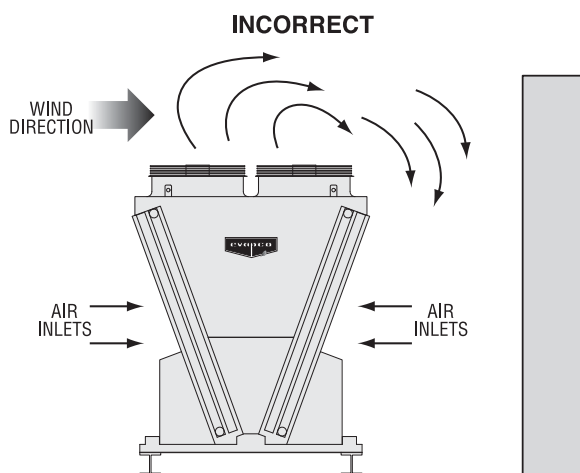


Figure 1 - Installation with Top of Unit Lower than Top of Wall

When the wind comes from the opposite direction, the resulting negative pressure area created by the wind passing over the building will cause the discharge air to be forced back into the unit's air inlets, as shown in Figure 2. If neither of these conditions occurs, the presence of much taller structures can potentially inhibit the dissipation of hot discharge air.

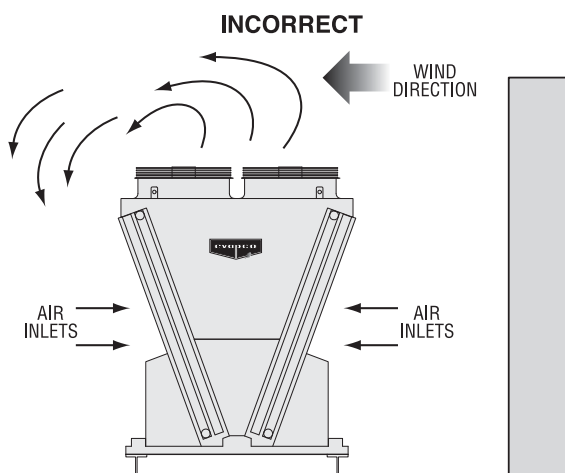


Figure 2 - Wind Effect with Top of Unit Lower than Top of Wall

The conditions shown in Figures 1 & 2 can be corrected by elevating the unit on structural steel such that the top of the fan cowl is equal to or higher than the adjacent structures, shown in Figure 3. **For installations where this option is not possible, an experienced engineering decision must be made regarding the potential impact to thermal performance.**

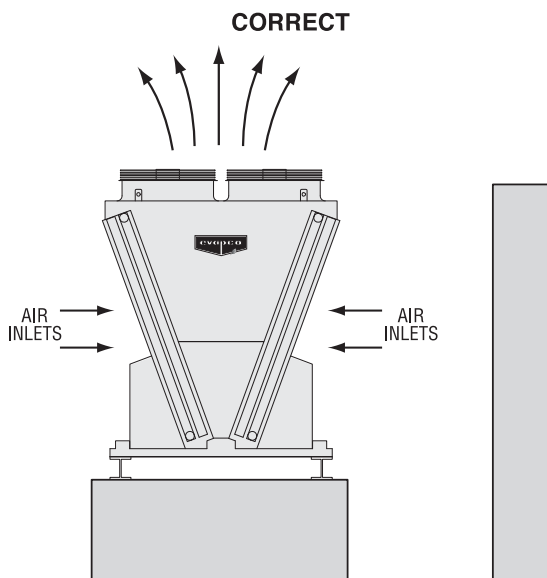


Figure 3 - Installation Elevated so Top of Unit Is Higher than Top of Wall



## Single/Multiple Unit Installations

EVAPCO's induced draft, dry and adiabatic units may draw in air on all four sides. When the unit is located near a wall or other structure that blocks surrounding ambient air from entering the unit, consideration must be given to the measured distance between the air inlets of the unit and this blockage. In this type of layout, air will be drawn in through the space between the unit and the wall or other structure as well as down from above. It is important to provide adequate space in front of each air inlet to ensure proper airflow.

When more than one EVAPCO dry or adiabatic unit is installed at the same location, the potential for air recirculation increases. For installations with two or more units, they may be placed in a variety of locations depending on site conditions and available space.

EVAPCO has developed recommended distances for various cases regarding induced draft layouts. These distances have been developed to ensure that these units are provided with adequate airflow. Space must also be provided for piping, accessories, removal of adiabatic pads and for maintenance of the mechanical equipment.

Extensive laboratory testing and years of field experience have allowed EVAPCO to develop minimum required distances from the unit and the surrounding walls as well as between units†. In addition, the distances shown in the following tables are dependent on the number of surrounding walls and the number of units. Therefore, the data presented in Tables 1 and 2 show the minimum dimensions  $D_1$  through  $D_8$  required for a variety of installation cases. See the following figures that illustrate these various cases.

For layouts of multiple units similar to Figures 15 and 17, or any installation having more than 4 units, please contact your local EVAPCO representative for confirmation of layout design (see page 5).

### CASE 1 - Single Wall/Single Unit

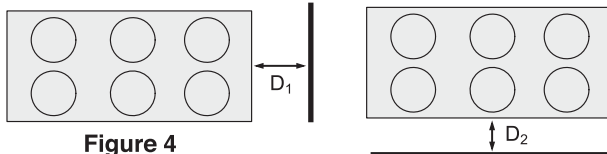


Figure 4

Figure 5

### CASE 2 - No Obstructions

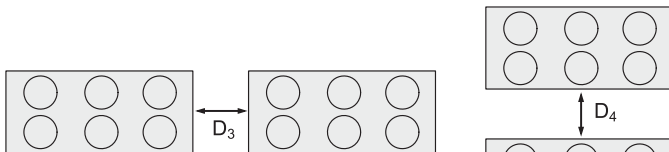


Figure 6

Figure 7

### CASE 3 - Two Walls/Single Unit

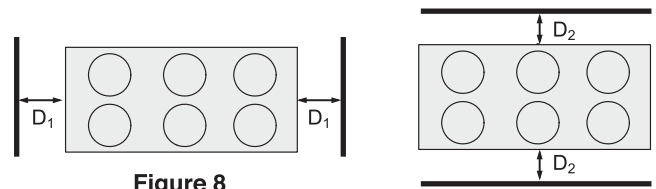


Figure 8

Figure 9

### CASE 4 - Two Walls/Two Units

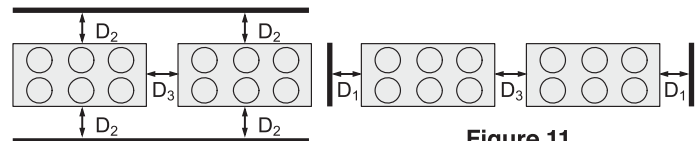


Figure 10

Figure 11

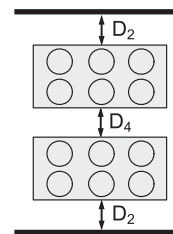


Figure 12

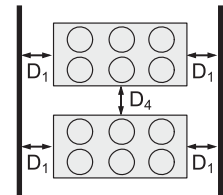


Figure 13

### CASE 5 - Two Walls (Corner)

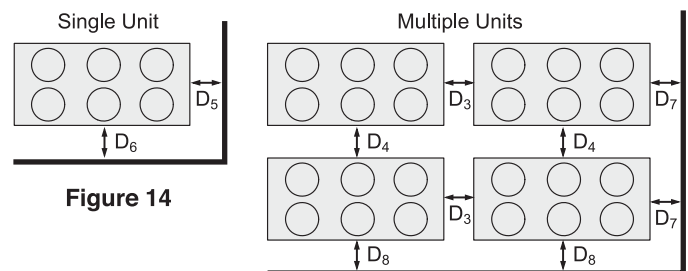


Figure 14

Figure 15

### CASE 6 - Three Walls

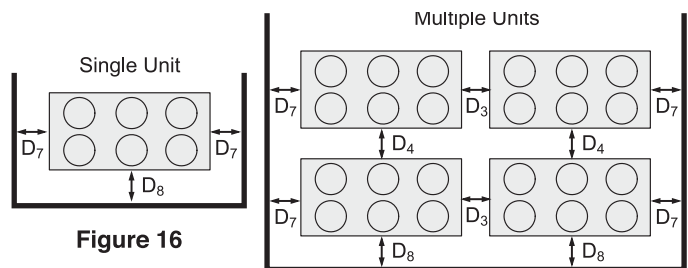


Figure 16

Figure 17

† The guidelines set forth in Tables 1 & 2 are to be used exclusively for EVAPCO equipment. Data from factory testing is based on air discharge velocities and air intake areas that are specific to EVAPCO equipment. Therefore, this data is NOT to be applied to other manufacturers' cooling equipment. However, any nearby equipment that is either intaking or discharging air will affect the overall layout. Please contact the factory with any questions on how to space around other manufacturer's equipment.

**Table 1 - Dimensions D<sub>1</sub> – D<sub>4</sub>****1.3m, 2.2m & 2.4m Wide V Configuration**

Unit Length	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>
All Units	0.9m	1.5m	1.8m	3m

**1.8m Wide Flat Models**

Unit Length	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>
All Units	0.9m	0.9m	1.8m	1.8m

**2.2m & 2.4m Wide Flat Models**

Unit Length	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>
All Units	1.2m	1.2m	2.4m	2.4m

**Table 2 - Dimensions D<sub>5</sub> – D<sub>8</sub>****1.3m, 2.2m & 2.4m Wide V Models**

Unit Length	D <sub>5</sub>	D <sub>6</sub>	D <sub>7</sub>	D <sub>8</sub>
All Units	0.9m	1.5m	0.9m	1.5m

**1.8m Wide Flat Models**

Unit Length	D <sub>5</sub>	D <sub>6</sub>	D <sub>7</sub>	D <sub>8</sub>
All Units	0.9m	0.9m	0.9m	0.9m

**2.2m & 2.4m Wide Flat Models**

Unit Length	D <sub>5</sub>	D <sub>6</sub>	D <sub>7</sub>	D <sub>8</sub>
All Units	1.2m	1.2m	1.2m	1.2m

**DIMENSION KEY**

D <sub>1</sub> , D <sub>5</sub> & D <sub>7</sub> – From Ends of Unit	D <sub>3</sub> – Units End to End
D <sub>2</sub> , D <sub>6</sub> & D <sub>8</sub> – From Sides of Unit	D <sub>4</sub> – Units Side by Side

**Large Installations**

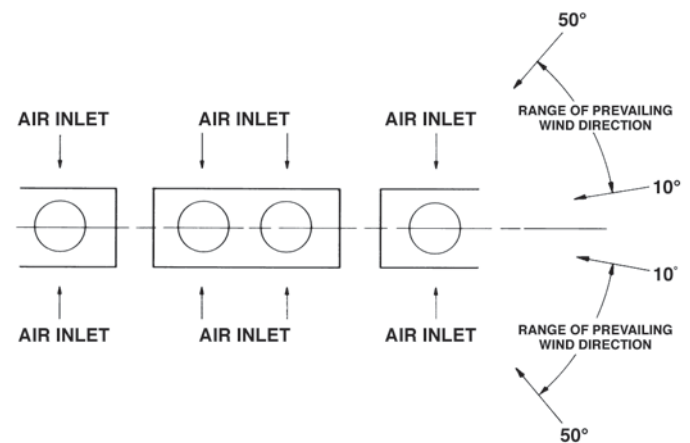
For large dry and adiabatic unit installations that have 4 or more units, it is imperative that the unit layout be carefully examined during the design of the system.

Very large multiple unit installations, can create their own environment. Under certain weather and atmospheric conditions, the large quantity of discharge air will cause the dry bulb temperature in the immediate area to be higher than the local design data. The minimum dimensions shown in Tables 1 and 2 should be increased whenever possible in order to allow for an additional safety factor. The potential increase in temperature is dependent on the number of units, type of installation, existing equipment and unit surroundings.

The surrounding area plays an important part in the design of a large installation. Locating a large installation in a valley or between buildings will increase the chance that air will recirculate, thereby raising the entering dry bulb temperature. If it is determined that the surrounding conditions could cause recirculation, the units must be spaced properly and sized at the anticipated entering dry bulb conditions.

Another important consideration when dealing with larger multiple unit installations is prevailing winds. Although prevailing wind conditions generally change with the season, the wind direction during the hottest part of the year is of utmost importance. To minimize the potential for recirculation, it is recommended to locate the units so that the prevailing wind is oriented as shown in Figure 18.

Consult your local EVAPCO representative for recommended layout guidelines for very large multiple unit installations.

**Figure 18 - Prevailing Wind****Special Enclosures**

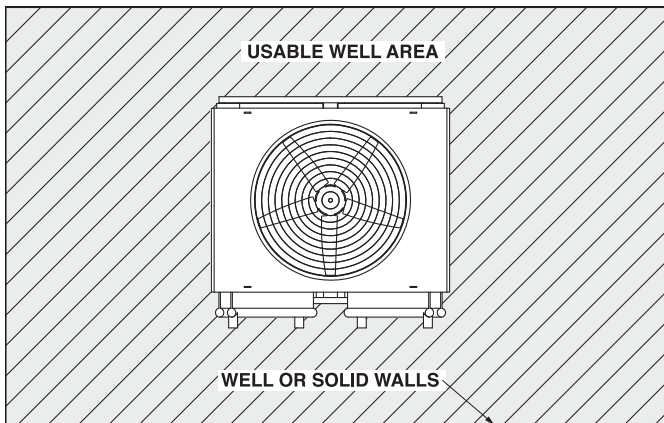
Occasionally, dry and adiabatic units are installed in an enclosure. These installations require special consideration of the unit layout to ensure trouble free operation. Typical installations consist of units installed in solid wall or louvered enclosures or units that are located in a well.

## Solid Wall Enclosures or Wells

One typical enclosure is a unit installed in a well (Figure 19). When considering a single unit adjacent to a solid wall enclosure or located in a well, the clearance dimensions, found in Tables 1 & 2, page 5, should be used. **In many cases, the minimum clearance dimensions MUST be increased to ensure that the unit performs to its rated capacity.** The unit should be oriented so that the air flows uniformly to the air inlets on all four sides of the unit. The air discharge of the unit must be level with or higher than the surrounding walls. Additionally, required clearance for all unit accessories must also be taken into account.

In the well type enclosure, all the air must be brought down from above and can be susceptible to recirculation. Field experience has demonstrated that the downward velocity of the supply air into the well must be kept **BELOW 2m/s** to avoid the effects of recirculation.

To calculate the downward velocity, the total air flow for the unit is divided by the usable well area. The usable well area (shaded portion of Figure 19) is the space between the four sides of the unit and the walls of the well. See the example shown below.



**Figure 19 - Well Installation**

**Example:** A 2.2m x 2.2m EAVWD (2.2m wide V-Configuration dry cooler) is centered in a 6m x 7.3m well enclosure with the unit's discharge even with the top of the surrounding walls. Is this an acceptable equipment layout?

Unit Area =  $4.84\text{m}^2$        $D_1 = 2.55\text{m}$   
 Unit Air Flow =  $18.3\text{m}^3/\text{s}$        $D_2 = 1.9\text{m}$   
 Well Area =  $6\text{m} \times 7.3\text{m} = 43.8\text{m}^2$   
 Net Usable Well Area =  $43.8\text{m}^2 - 4.84\text{m}^2 = 38.96\text{m}^2$   
 Downward Velocity =  $18.3\text{m}^3/\text{s} \div 38.96\text{m}^2 = 0.48\text{m/s}$

Since the downward velocity of 0.48m/s is less than 2m/s **AND** dimensions  $D_1$  and  $D_2$  are above the recommended minimums, this **IS** an acceptable layout.

In some cases the well area includes space so far away from the unit as to create a point of diminishing returns.

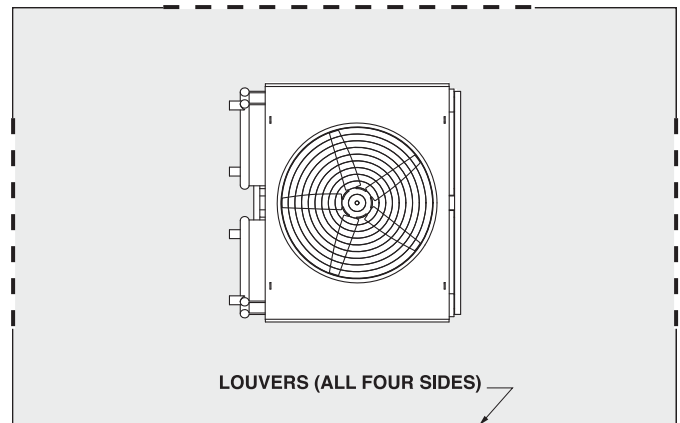
Note: The top of the unit must be equal to, or higher than, the top of the well.

## Louvered Wall Enclosures

Dry and adiabatic units can also be installed in enclosures with louvered or slotted walls (Figure 20). With this type of enclosure, the air flow patterns will be a mixture of the open type and well installations. The inlet air will be drawn from the top and through the louvers or slotted openings.

Since the air will follow the path of least resistance, the pressure drop across the louvers will determine how much air is drawn through them. To minimize the potential for recirculation, it is better to draw most of the air through the louvers. Therefore, it is important that the louvers are designed for minimum pressure drop. **To achieve this goal, the velocity through the louvers should be maintained at or below 3m/s, the louvers should have a minimum of 50% net free area, and the air inlets should face the louvers.**

The first step in checking a louvered type enclosure is to treat it as a well enclosure and calculate the downward air velocity assuming that all the air must enter from the top. If the downward air velocity is equal to or less than 2m/s, then the louvered enclosure will work regardless of the size of the louvers.



**Figure 20 - Louvered Wall Enclosure**

If the downward air velocity into the enclosure is greater than 2m/s, then another formula must be used. This formula assumes that **ALL** the air is drawn through the louvers. The total air flow ( $\text{m}^3/\text{s}$ ) for the unit is divided by the net free louver area ( $\text{m}^2$ ). The resultant air velocity must be **BELOW 3m/s**. In addition to meeting this minimum louver velocity, the installation must also meet the following requirements. The minimum air inlet to louver dimension must be 0.9 meters and the minimum space requirements, for maintenance and unit accessories.

## Expansions to Existing Systems

Expansions to existing systems present the same concerns as multiple unit installations. However, there are additional concerns that must be evaluated when planning a system expansion. Since in an expansion the new unit may not be identical to the existing one, it is important to examine the heights of the new and the existing units. Whenever possible, the tops of ALL of the units should be at the same level to avoid recirculation from one unit to another. If the unit discharge heights are different one or a combination of the following should be implemented. Either structural steel should be used to raise the air discharges of both units to the same level as shown, or the units should be spaced further apart than normally recommended.

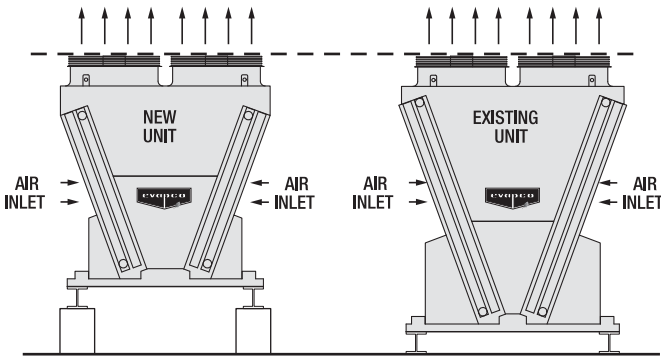


Figure 21 - Expansion to an Existing Installation

**NOTE:** For installations where the minimum recommended distances cannot be maintained, contact your local EVAPCO representative.

## Other Layout Criteria

### Space Requirements for Maintenance

When a unit is located in close proximity to other structures, walls or equipment, there are minimum clearances required for periodic maintenance. Proper access must be provided for the removable inspection panel located on both ends of the V configuration units.

Also, in addition to the periodic maintenance items, unit drawings must be reviewed to ensure there is room for any future major repair work. Space should be provided to allow for the replacement of a fan motor, or even a complete coil.

### Additional Space Requirements

Additional space may be required beyond those provided herein for system piping connection, control panels or other obstructions. These additional space requirements are usually project specific and therefore not covered in this manual.

If there are questions please contact your EVAPCO Sales Representative.

## Elevated Unit Considerations - Flat Configuration

Flat configuration units can be elevated for those layouts where they must be placed closer together than this manual allows. Note the Z is elevation distance beyond standard leg height.

Y	2.4m	1.8m	1.2m	0.6m	0m
Z	0m	0.15m	0.3m	0.6m	1.2m

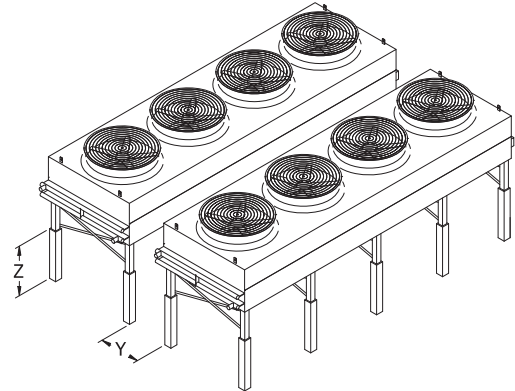


Figure 23

For example, if Y = 1.2m, an additional 0.3m of elevation is needed beyond standard leg height.

## Elevated Unit Considerations - V Configuration

V configuration units can be elevated for those layouts where they must be placed closer together than this manual allows. The chart below shows minimum elevation for a given distance between units.

For example, if Y = 2.1m, the units must be elevated 2.3m. **The recommended minimum distance between units regardless of elevation is 2.1 m.**

Y	3m	2.7m	2.4m	2.1m
Z	0m	0.8m	1.5m	2.3m

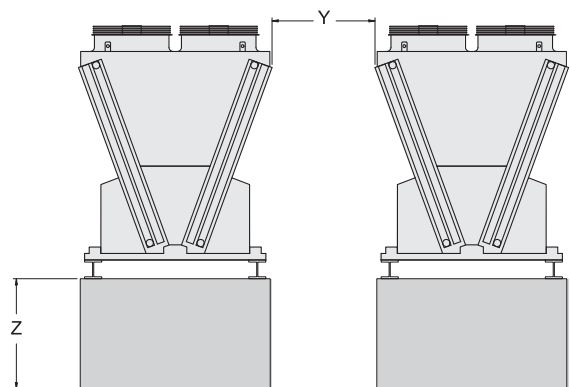


Figure 24

Adiabatic closed circuit coolers and condensers can be elevated, but grade level layout guidelines apply. They cannot be elevated in lieu of spacing. This also applies to any dry cooler or condenser that would be retrofitted with adiabatic pad systems.





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