HXV Layout Guidelines

Open circuit cooling towers, closed circuit cooling towers, and evaporative condensers all depend upon an adequate supply of fresh, ambient air to provide design capacity. Other important considerations such as the proximity to building air intakes or discharges must be taken into account when selecting and designing the equipment site. Included are the design layout guidelines for evaporative cooling products in several situations typically encountered by designers. These guidelines represent minimum spacing requirements; more open spacing should be utilized whenever possible.

As the size of an installation increases, the total amount of heat being rejected to the atmosphere and the volume of discharge air increase -- to the point where the units can virtually create their own environment. As a result, it becomes increasingly difficult to apply a set of general guidelines for each case. Such installations, and particularly those in wells or enclosures, will recirculate and the problem becomes one of controlling the amount of recirculation and/or adjusting the design wet-bulb temperature to allow for it.

Consequently, any job that involves four or more cells should be referred to your local BAC Representative for review.

Axial fan units are not generally suited for indoor or ducted applications. In such situations, a Series V centrifugal fan unit is recommended.

General Considerations:

When selecting the site for a cooling tower, closed circuit cooling tower, or an evaporative condenser, consider the following factors:

1. Locate the unit to prevent the warm discharge air from being introduced into the fresh air intakes of the building(s) served by the unit, intakes of neighboring buildings, or from being carried over any populated area such as a building entrance.

2. Consider the potential for plume formation and its effect on the surroundings, such as large windowed areas, and pedestrian or vehicular traffic arteries, particularly if the unit(s) will be operated during low ambient temperatures.

3. Provide sufficient unobstructed space around the unit(s) to ensure an adequate supply of fresh, ambient air to the air intake. Avoid situations that promote recirculation of unit discharge air, such as units located:
    a. Adjacent to walls or structures that might deflect some of the discharge airstream back into the air intake.
    b. Where high downward air velocities in the vicinity of the air intake exist.
    c. Where building air intakes or exhausts, such as boiler stacks in the vicinity of the unit, might raise the inlet wet-bulb temperature or starve the unit of air.

4. Provide adequate space around the unit for piping and proper servicing and maintenance, as shown in Figure 1.

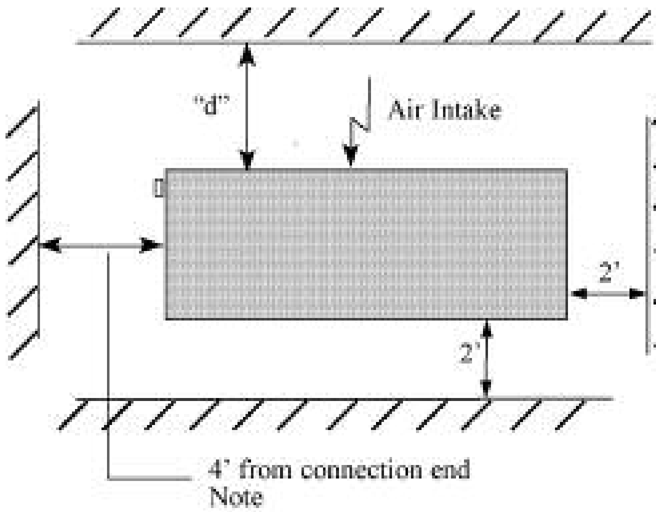

Figure 1: Plan View of Recommended Unit Servicing and Maintenance Spacing for Single Air Inlet Unit

5. The top of the fan discharge cylinder, velocity recovery stack, or discharge sound attenuation must be at least level with, and preferably higher than any adjacent walls or buildings.

6. When possible, orient the unit so the prevailing summer wind blows the discharge air away from the air intakes of the unit(s).

7. When the unit is installed with intake sound attenuation, the distances given in the tables below should be measured from the face of the intake sound attenuation.

8. On larger unit installations, the problem of ensuring an adequate supply of fresh, ambient air to the tower intakes becomes increasingly difficult. See the "Multi-cell Installations" Section for specific considera tions.

9. If the installation does not meet the recommended guidelines, the units will have a greater tendency to recirculate and the design conditions should be altered to include an allowance for the recirculation. For instance, if the design conditions are 95°F/85°F/78°F and it was estimated that the allowance for recirculation rate was 1°F, then the new design conditions would be 95°F/85°F/79°F and the units should be reselected based on the new design conditions.

The "Layout Guidelines" describe several typical site layouts for BAC's cooling towers, closed circuit cooling towers, and evaporative condensers. If these guidelines do not cover a particular situation or if the layout criteria cannot be met, please refer the application to your BAC Representative for review. Please indicate prevailing wind direction, geographic orientation of the unit(s), and other factors such as large buildings and other obstructions that may influence layout decisions.

Layout Guidelines:

1. Unit Orientation

When a unit is located near a building wall, the preferred arrangement is to have the unit situated with the cased end or blank-off side (unlouvered side) facing the adjacent wall or building.

2. Air Inlet Requirements:

Should it be necessary to install a unit with the air intake facing a wall, provide at least distance “d” between the air intake and the wall, as illustrated in Figures 2a and 2b.

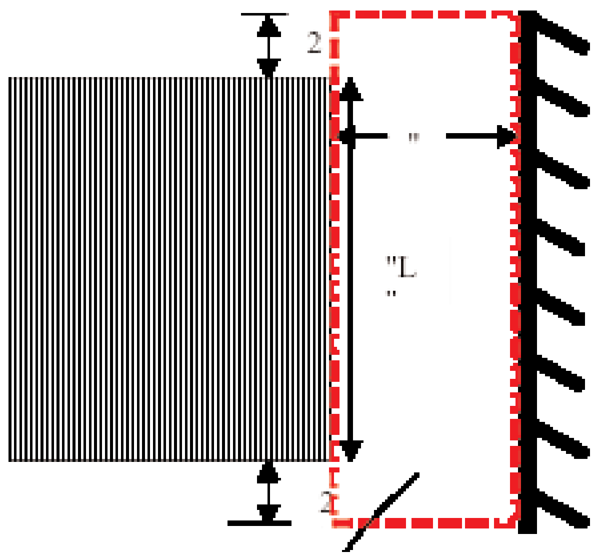

Figure 2a: Plan view of unit adjacent to a wall

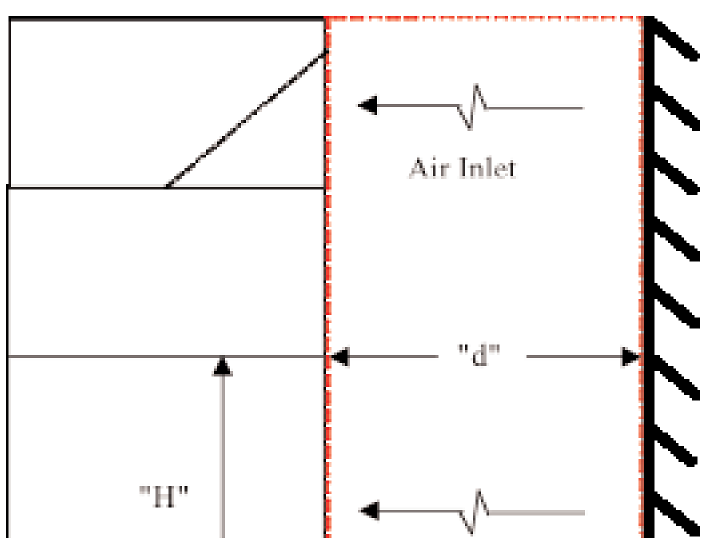

Figure 2b: Section view of unit adjacent to a wall

Below is the method for determining the minimum acceptable dimension "d" for a unit located with the air intake facing a solid wall:

The maximum acceptable envelope air velocity for all products except Series V with tapered hood is 300 FPM, as illustrated in the following equation:

$$\text{Envelope Velocity} = \frac{\text{Unit Airflow}}{\text{Envelope area}} < 300 \text{ FPM}$$

NOTE: The louver face CFM for the FXV and HXV Closed Circuit Cooling Towers and CXV Evaporative Condensers is 70% of the total unit airflow. The remaining 30% of the airflow entering the unit through the top of the coil section.

The Envelope area as illustrated on Figures 2a & 2b is [(L +2 +2) x d) + 2(H+h) x d)], where:

"H" - height of the air intake face in feet
“h” - elevation of the unit from the roof/ground/pad in feet. The maximum elevation is 4 feet.
"L" - length of the air intake in feet
"d" - minimum acceptable distance between the wall and the air intake face in feet

The minimum acceptable dimension "d" for the products is tabulated in Table 1. **The distance "d" was calculated using the largest horsepower model in the box size.**

Example: Model HXV-Q641 Adjacent to a Solid Wall

What is the minimum distance required between the air inlet of the 15176-3 when installed facing a wall?

Solution:
Unit Airflow = 80,094 CFM
H = 8’ 8-3/4” (8.73’)
h = 0'

As shown in Figure 2, the overall envelope length is L + 4' = 11' 10"+ 4' (15.83’)
300 FPM = maximum acceptable envelope air velocity with no hood.

Solving for "d"

$$d = \frac{\text{Unit Airflow}}{300 \times [2 \times (H + h) + (L + 4')]}$$

$$d = \frac{0.70 \times 80{,}094}{300 \times [2 \times (8.73 + 0) + (15.83)]}$$

$$d = 5.62 \text{ feet}$$

Therefore, the air intake should be no less than 6 feet from the wall.

Minimum Acceptable Air Inlet Distance "d" (feet) to Solid Wall

Table 1:

	One Cell		
Elevation	0'	2'	4'
HXV-64X	6	5.5	5
HXV-66X	7.5	7	6

Well Layout

The following method is used to determine the minimum acceptable dimension "d" for units installed in a well layout.

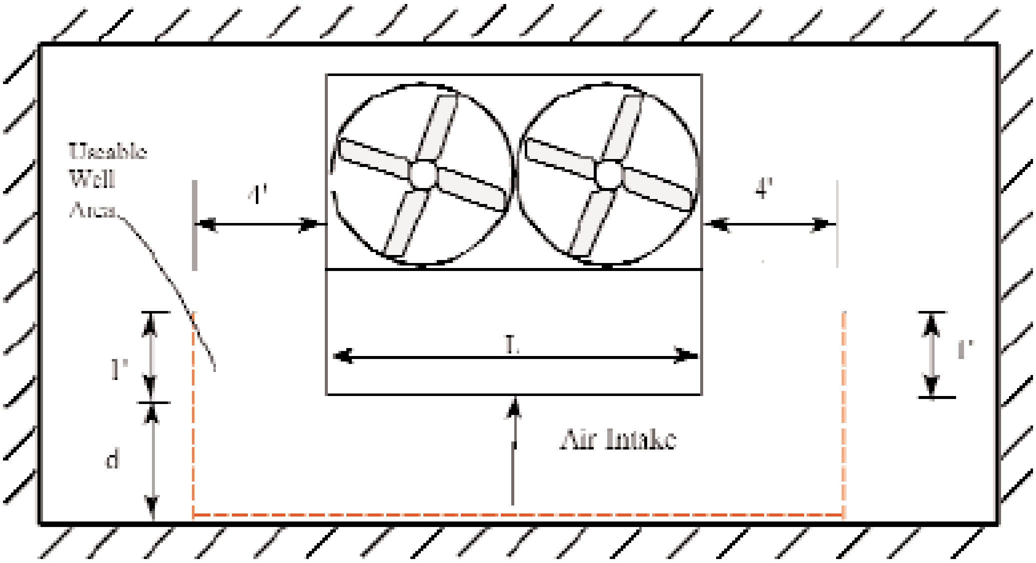

Figure 3: Plan view of single air intake units in a well enclosure

The maximum allowable downward air velocity for a well installation is 400 fpm. The downward velocity is determined using the following equation:

$$\text{Downward Air Velocity} = \frac{\text{Unit Airflow}}{\text{Useable Well Area}} < 400 \text{ fpm}$$

The usable well area at each air intake face is defined as illustrated in Figure 3.
Useable Well Area = [(d)(L+4'+4')]+[(4' x 1') + (4' x 1')], where

"d" - minimum acceptable distance between the air intake of the unit and the wall of the well in feet
"L" - length of the air intake of the unit in feet.

The minimum acceptable distance "d" for well installations is tabulated in Table 2.

Minimum Acceptable Air Intake Distance "d" (feet)

Table 2: HXV

Model Number	One Cell
HXV-64X	7
HXV-66X	8.5

Example: Model HXV-661-OM in a Well

Unit Airflow = 126,073 CFM
L= 18' 1-1/4" (18.10')
400 fpm = maximum allowable air downward velocity for a cooling tower

Downward Air Velocity = (Unit Airflow) / (Useable Well Area)

Solving for "d",

400 fpm	=	(126,073 CFM x 0.70) / [(d)(18.10+4+4)]+(4+4)]
[(d)(26.1)]+(8)	=	(88,251.1CFM) / (400 FPM)
d	=	[((88,251.1 CFM)/(400 FPM))-8]/26.1
d	=	8.14 feet

This is rounded up to the next 0.5' increment. Therefore, the air intakes should be no less than 8.5' feet from the enclosure walls.

Louvered Well Installation

Check to see if the layout meets the requirements for a well installation. If the criteria for the well installation are met, the layout is satisfactory. If the layout does not satisfy the criteria for the well installation, analyze the layout as follows:

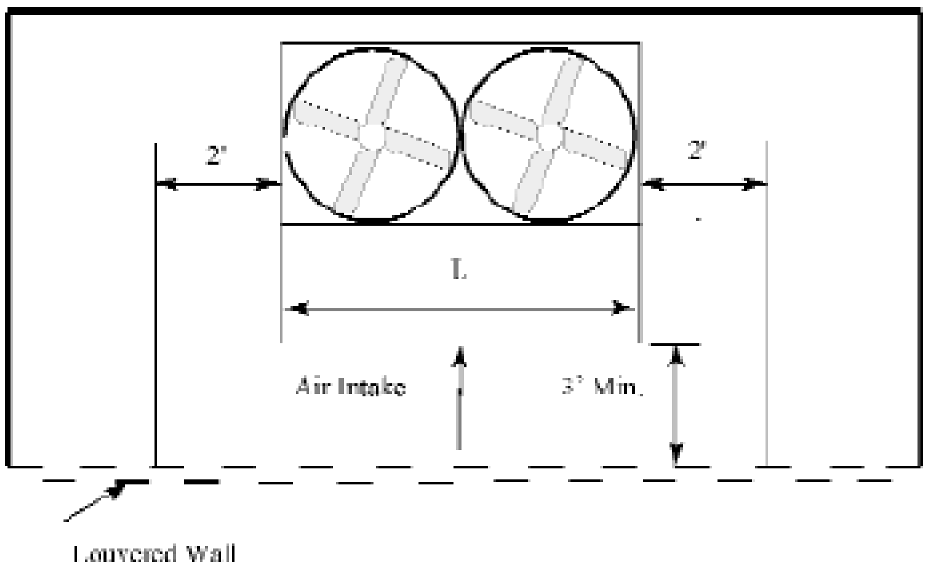

Figure 4: Plan view of single air intake unit in enclosure with louvered walls

1. Air intake requirements:

Units should be arranged within the enclosure such that:

a. The air intake directly faces the louver or slot locations as shown in Figure 4.

b. Maintain a distance of at least three feet (3'-0") between the unit air intake(s) and the louvered or slotted wall for uniform air distribution.

c. If the available space does not permit the unit can be arranged with the air intakes facing the louvered or slotted walls and the enclosure cannot be modified to permit such an arrangement, consider the alternative illustrated in Figure 5. This arrangement should be restricted to one-cell or two-cell installations. The effective area of the louvers is only the length extending beyond the width of the tower.

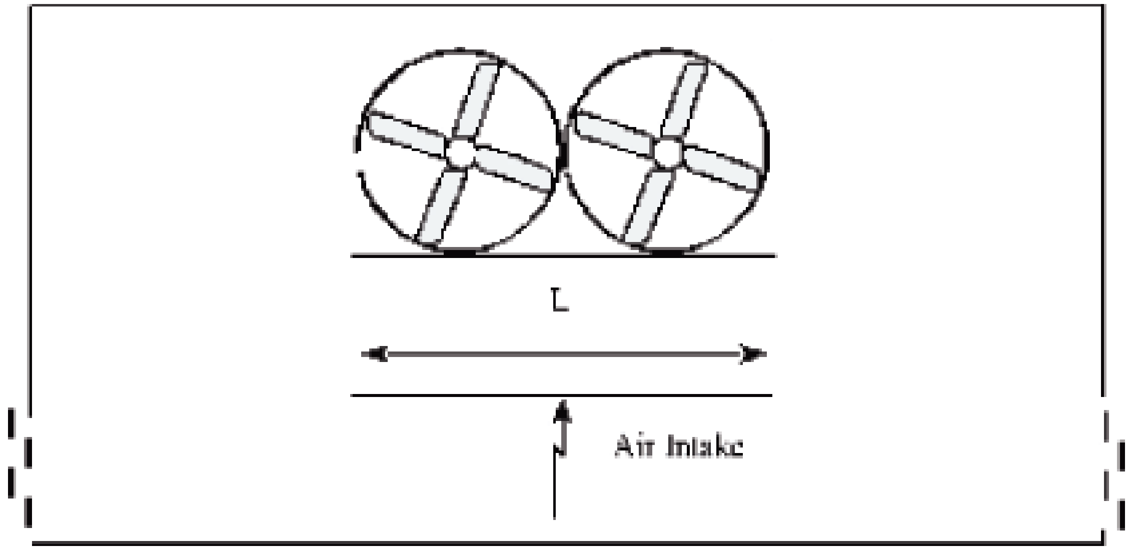

Figure 5: Plan view of single air inlet unit in enclosure with alternate louver arrangement

2. Louver Requirements:

a. Louvers must provide at least 50% net free area to ensure that the unit airflow is not reduced due to friction or dynamic losses and that sufficient air is drawn through the openings and not downward from above.

b. The required total louver or slot area is based on drawing the total unit airflow through the net free area of the louvers at a velocity of 600 FPM or less.

c. Locate the louver area in the walls of the enclosure such that air flows uniformly to the air intakes.

d. If the unit is elevated to ensure the discharge is at the same level or above the top of the enclosure, it is acceptable to extend the louvered or slot area below the base of the units up to 2 feet if needed to achieve the minimum gross louver area. To calculate air velocity through the louver, the useable louvered or slot area may extend beyond the ends of the unit, by 4' maximum.

Calculate the louver velocity as follows:

$$\text{Louver Velocity} = \frac{\text{Total Unit Airflow (CFM)}}{\text{\% Louver Free Area x Useable Louver Area (sq ft)}}$$

Example: HXV-641-OM in a Louvered Enclosure

The enclosure is 27.5' long x 38' wide x 10' tall. The enclosure walls are equal in elevation to the unit discharge height. The louvers are 70% free area and 3' from the air inlet of the unit. The louvers extend the full width of the enclosure (38') on both air intake ends and they extend 9' vertically of the 10' enclosure height.

Unit Airflow = 0.70 x 83,060 CFM = 58,142 CFM
Unit "L" Dimension = 11' 10" (11.83')
"d" max. = 4 feet per side
Useable Louver Length = 11.83' + 4' + 4' = 19.83' (of total 38' louver length)
600 FPM = Maximum Allowable Louver Velocity

Louver Velocity = Louver Face Airflow (CFM) / [(% Louver Free Area)x(Useable Louver Area)]
= (58,142 CFM) / [(70%) x [(11.83' + 4' + 4') x (9')]
= (58,142 CFM) / (124.9 sq ft))
= 465 FPM

Therefore, louver sizing is sufficient because 465 FPM < 600 FPM maximum allowable.

The "Layout Guidelines" describe several typical site situations involving evaporative cooling products. If these guidelines do not cover a particular situation or if the layout criteria cannot be met, please refer the application to the your local BAC Representative for review. Please indicate prevailing wind direction, geographic orientation of the unit(s), and other factors such as large buildings and other obstructions that may influence layout decisions.

Multi-cell Installations

Multiple cells create a "wall" of moist discharge air which could easily be swept into the air intakes due to prevailing wind. To minimize the potential of recirculation of the discharge air, the units should be situated with adequate spacing between air intakes.

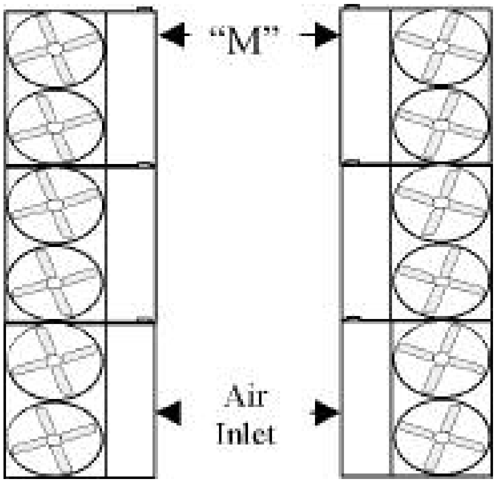

Figure 6: Plan view of multi-cell units with air intakes facing each other

When multiple cells are arranged with the air intakes facing each other, the distance between air intakes should follow the equation below:

M = (2 x d) + (number of cells per module), where "d" is obtained from the appropriate model in Section A, Table 1.

Example: Model 2-15201-3

There are two modules of three cells of units on a roof. There are no enclosures surrounding the unit installation. The two banks of units have air intakes facing each other. The minimum distance "M" between rows of units is determined as follows:

from Table 1, "d" = 9',

M = (2 x d) + (number of units per module)
= (2 x 9') + (3)
= 21 feet

The calculated "M" dimension of 21 feet will minimize the potential of recirculation of the discharge air.

Group the units in two cell or three cell groups, spaced at least one unit length between adjacent end walls to allow fresh air to circulate around each group, as shown in Figure 7.

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