



TRANE®

Engineering Bulletin

**Application of Air-Cooled Series R™ Chillers
In Close-Spacing and
Restricted Airflow Situations**

RLC-PRB004-EN



General Information

Scope

This engineering bulletin covers application of the air-cooled Series R™ chillers in close spacing and restricted airflow situations. Included in the bulletin are:

General Information

Air-cooled chillers are frequently applied in situations where close spacing of multiple chillers is required. They are also applied in situations that result in restricted airflow due to walls and other obstructions. The air-cooled Series R™ chiller offers an advantage over competitive equipment in many of these situations. Performance is minimally affected in many restricted airflow situations due to its unique condensing coil geometry. Also, through its advanced Adaptive Control™ microprocessor logic, the chiller will attempt to stay on-line whereas competitors' chillers would usually shut down. Adaptive Control microprocessor logic describes the ability of the control system to understand the operating environment of the chiller and adapt to it by first optimizing its performance and second, attempting to stay on-line through abnormal conditions. For example, high ambient temperatures combined with a restricted airflow situation will generally **not** cause unit shutdown. Competitor's chillers would typically shut down on high pressure cutout in these conditions.

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General Information

The air-cooled Series R™ chiller has a unique coil configuration that minimizes performance effects in close spacing and restricted airflow situations. The modified “W” coil configuration, shown in Figure 1, has a number of distinct, engineered advantages. First, the coil face velocity is practically constant over the entire surface, optimizing heat transfer performance. Second, the subcooler is integrated into the condensing surface, again optimizing performance. Competitors’ coil configurations can produce uneven air distribution over the condenser coils and “pinch” the airflow to portions of the condenser and subcooler.

Relative to restricted airflow situations, the modified “W” shape produces a large open area under the inner coils, allowing air to freely enter on **either side** of the chiller and distribute itself as required to maintain performance.

An example of condenser air redistribution when the airflow is restricted is shown in Figure 2. A wall or other obstruction has been placed close to one side of the chiller and airflow is restricted. However, the vertical coil nearest the obstruction is able to get the air it requires to operate normally. The inner coil is able to get the air it requires from the **opposite side of the chiller**. Air enters from the unobstructed side and freely distributes itself to the inner condenser coils. Chiller performance is unaffected.

Figure 1 — Air-Cooled Series R™ Chiller Modified “W” Condenser Coil and Airflow

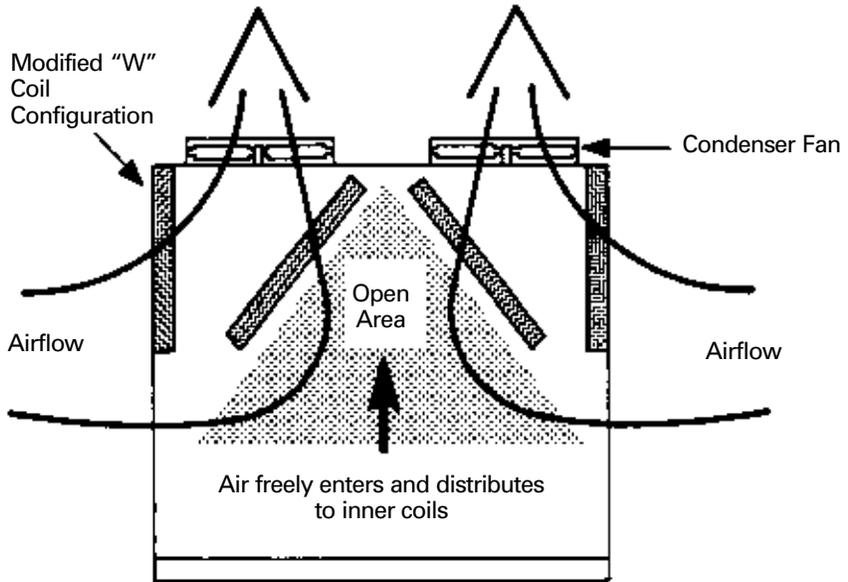
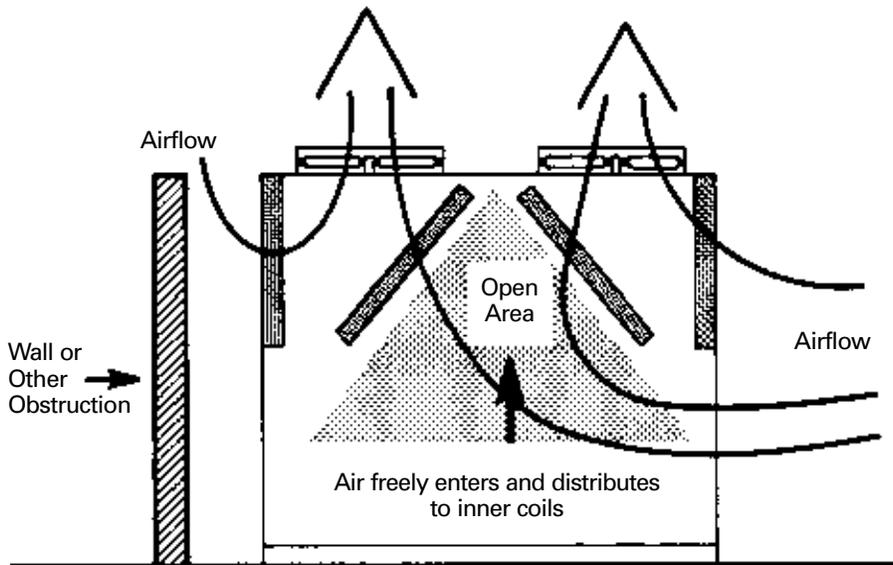


Figure 2 — Air Redistribution With a Wall Restricting the Airflow



General Information

The remainder of this engineering bulletin describes various commonly encountered close spacing and restricted airflow installations. The performance changes are in terms of % Capacity (Tons) reduction and % Compressor Power (kW) increase at **full load**. Adjust the performance given in the catalog or selection program using performance adjustment factors taken from the graphs. For example, assume that a chiller selection is made that gives a catalog capacity of 180 tons at 195 kW (compressor power). Because of the actual installed conditions, one of the cases given in this engineering bulletin applies. A 1% capacity reduction and a 2% power increase is taken from the graphs for that case. The adjusted performance would be:

Adjusted Capacity = $(1 - .01) \times 180 \text{ tons}$
 = 178.2 tons

Adjusted Compressor Power = $(1 + .02) \times 195 \text{ kW}$
 = 198.9 kW

After making the appropriate performance adjustments to capacity and power, check to make sure that the power limits given in Tables 1, 2, and 3 are not exceeded.

Table 1 — Compressor Power Limits For Model RTAA Chillers

Compressor		Compressor		Compressor	
Unit Size	Power Limit - kW	Unit Size	Power Limit - kW	Unit Size	Power Limit - kW
70	86	90	126	110	159
80	107	100	145	125	174

Table 2 — Compressor Power Limits For Standard Efficiency RTAC Chillers

Compressor		Compressor		Compressor	
Unit Size	Power Limit - kW	Unit Size	Power Limit - kW	Unit Size	Power Limit - kW
140	202	225	309	400	588
155	223	250	349	450	618
170	244	275	391	500	648
185	269	300	441		
200	295	350	471		

Table 3 — Compressor Power Limits For High Efficiency RTAC Chillers

Compressor		Compressor		Compressor	
Unit Size	Power Limit - kW	Unit Size	Power Limit - kW	Unit Size	Power Limit - kW
140	192	200	283	300	426
155	211	225	299	350	464
170	232	250	314	400	568
185	257	275	374		

In complicated installations, some uncertainty may exist relative to performance and control. Remember, Trane's unique Adaptive Control™ microprocessor logic will make as much chilled water as possible, given the actual installation, and avoid nuisance high pressure cutouts. Consult with the Screw Chiller and Compressor Business Unit Marketing for any unusual applications not covered by this bulletin.

General Information

Case 1 — Two Chillers Side By Side

The most common case is that of two chillers located side by side as shown in Figure 3.

The performance effect of chillers placed side by side is small, as shown in Figures 4a and 4b. As previously discussed, only *one* of the two condenser coils of *one* refrigeration circuit per chiller is affected by the air recirculation caused by close spacing. All air-cooled Series R™ chillers have *two* completely independent refrigeration circuits. The outboard coils are unaffected. Spacing of chillers **less than 4 feet is not recommended** due to service considerations and air recirculation.

Figure 3 — Two Chillers Installed Side by Side

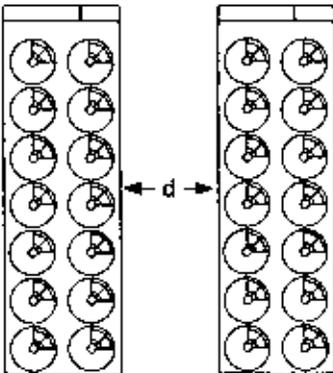


Figure 4A — Capacity Reduction @ Full Load

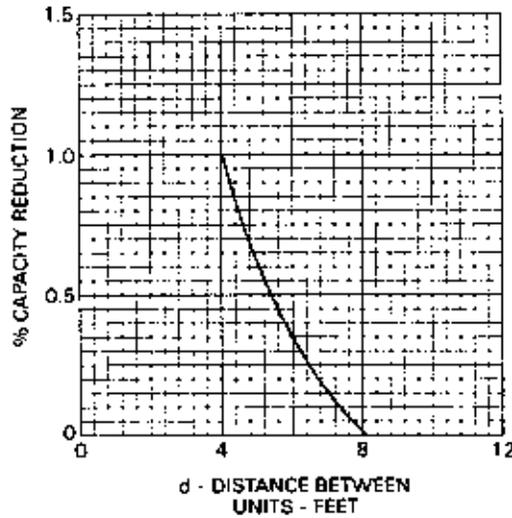
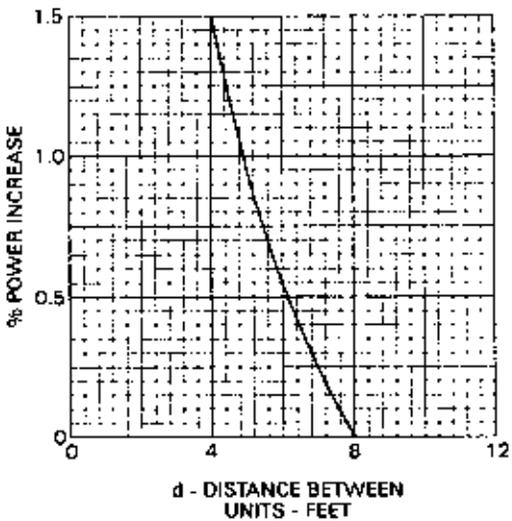


Figure 4B — Power Increase @ Full Load



General Information

Case 2 — Two Chillers End To End

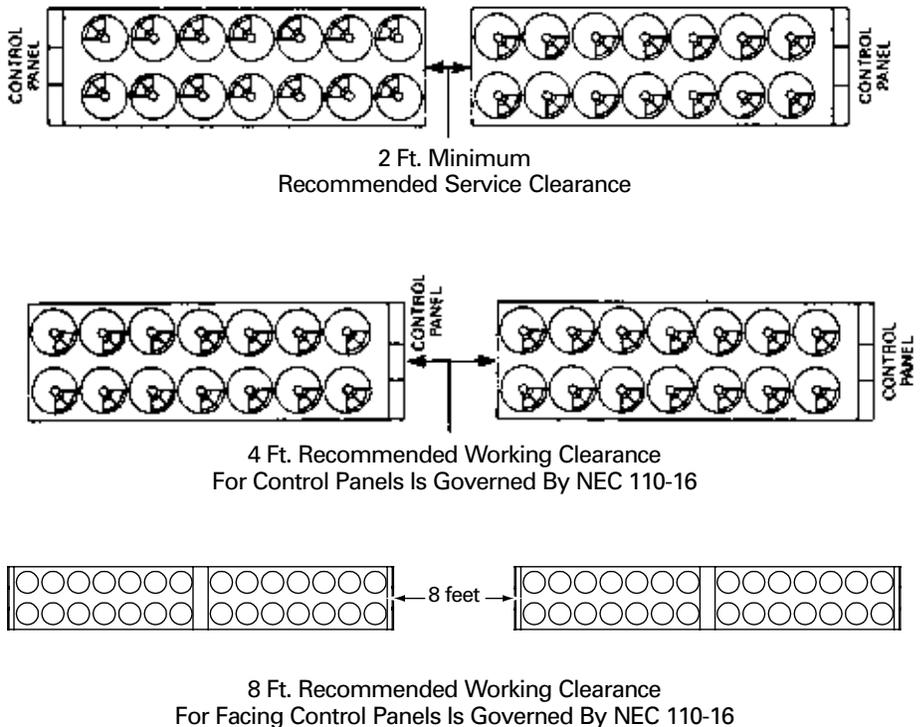
Two chillers may be installed end to end in various ways as shown in Figure 5.

There is **no** performance effect for any spacing of chillers end to end. However, minimum spacing is governed by 1) **service clearances**, and 2) the **working clearance** required by the National Electric Code (NEC) near control panels. A 2-foot clearance is recommended on the *end opposite the control panel*. Serviceable items, including the filter, sight glass, expansion valve and control sensors, are located on this end. These components are capable of being serviced from the side of the unit, leaving no service space on the end; however, it is more difficult than servicing them from the end.

Article 110-16 of the NEC requires 3 to 4 feet of working clearance, on the *control panel end* depending on the actual installed conditions. Refer to the NEC for a detailed discussion of requirements.

The large tonnage RTAC (275-500 ton, standard efficiency, and 200-400 ton, high efficiency) units have a control panel at both ends. Therefore, 8 feet of clearance needs to be allowed between the ends of the two chillers, for any arrangement.

Figure 5 — Two Chillers Installed End To End



General Information

Case 3 — Three Or More Chillers Installed Side by Side

Refer to Figures 6, 7A and 7B. The performance effect of Chillers A and C (**outside units**) is given in **Case 1**. The performance effect on Chiller B (**center unit**) due to close spacing is given in Figures 7A and 7B. The performance degradation of the *center unit* is due to recirculated air, which is unavoidable. Unlike the outside units, both condenser coils of both circuits of the *center unit* will see recirculated air.

Figure 6 — Three or More Chillers Installed Side By Side

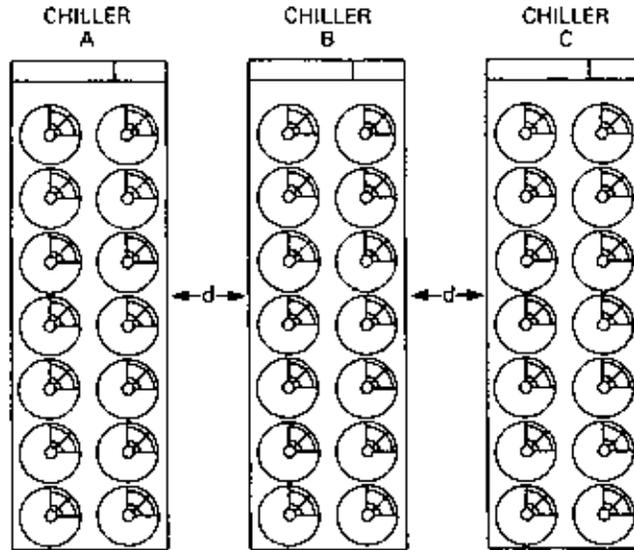


Figure 7A — Capacity Reduction @ Full Load Chiller B Only

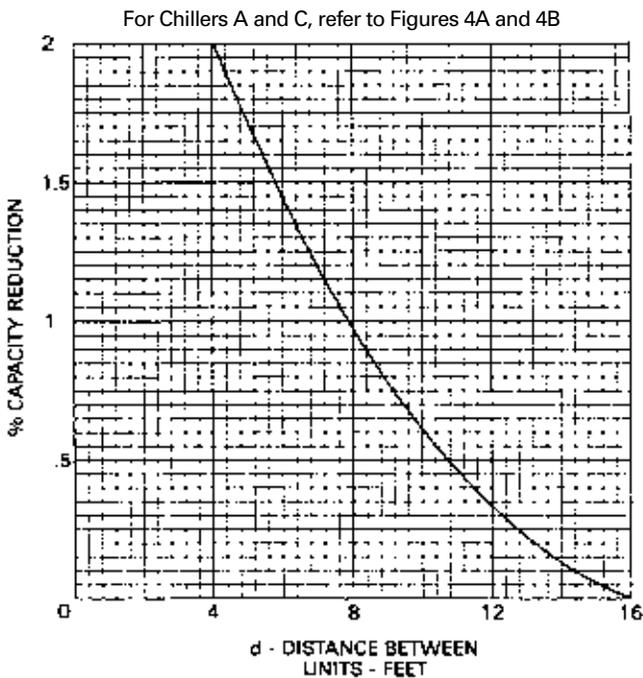
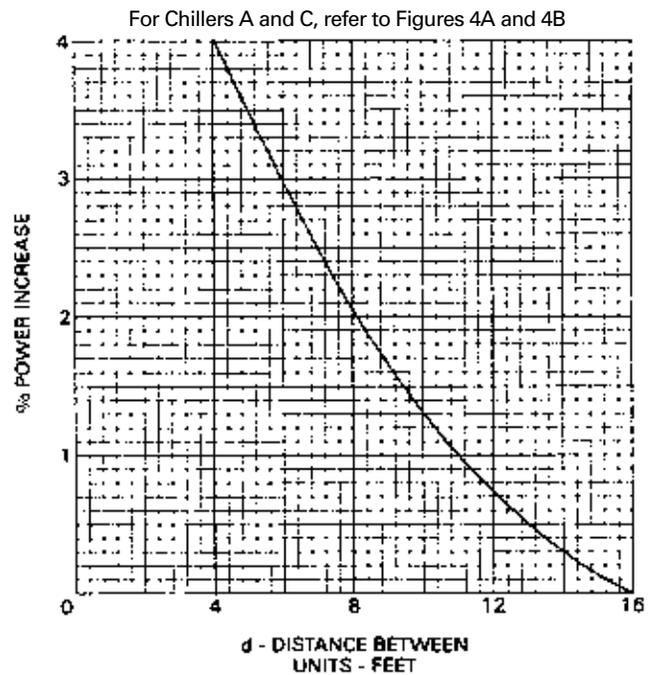


Figure 7B — Power Increase @ Full Load Chiller B Only

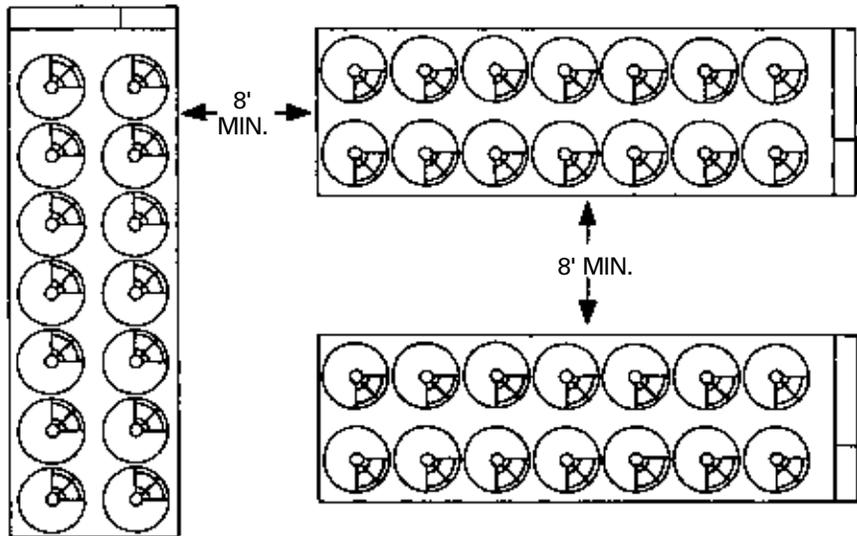


Recommended Installation

Recommended Installation of Multiple Chillers

Consideration of the performance effects shown in Cases 1 through 3 lead to the conclusion that locating multiple chillers side by side does not yield optimum performance. Rather, the installation shown in Figure 8 produces optimum performance of closely-spaced multiple chillers. In this installation, the performance effects are given in **Case 1** for all chillers.

Figure 8 — Recommended Installation For Multiple Chillers



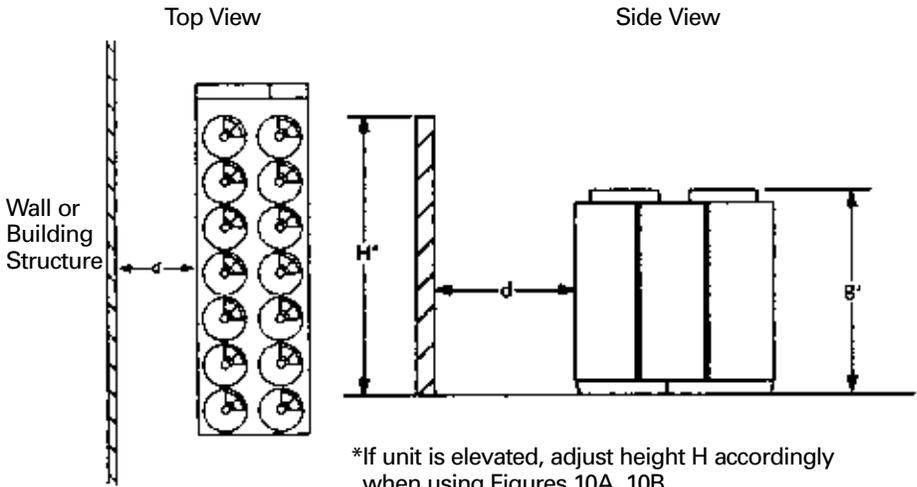
Recommended Installation

Case 4 — Restricted Airflow On One Side

Air-cooled chillers are commonly placed near building walls, decorative walls, sound barrier walls or other outdoor equipment that can restrict the airflow on **one side** of the chiller only. The effect of an obstruction or wall is dependent on both its height and the distance to the chiller. Refer to Figures 9, 10A and 10B.

Note that walls placed only at the **end** of the chiller have **NO** effect on performance. Also note that the performance effect for installations where the chiller is **completely surrounded** by solid walls is given in **Case 6**.

Figure 9 — Restricted Airflow On One Side of Chiller



*If unit is elevated, adjust height H accordingly when using Figures 10A, 10B.

Figure 10A — Capacity Reduction @ Full Load

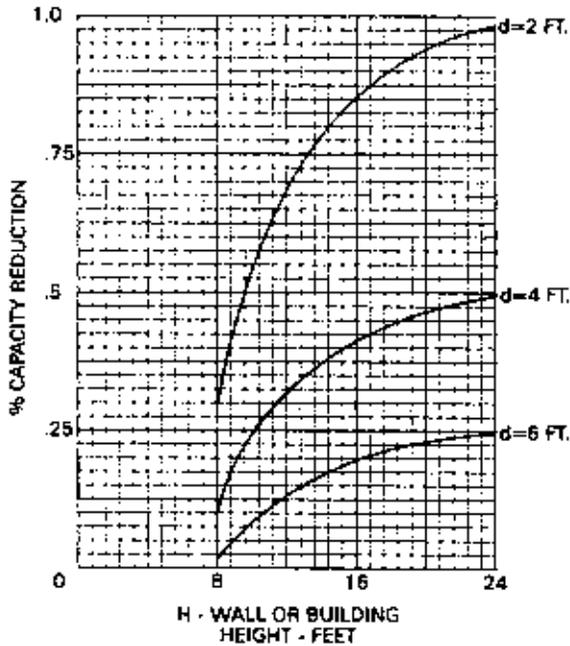
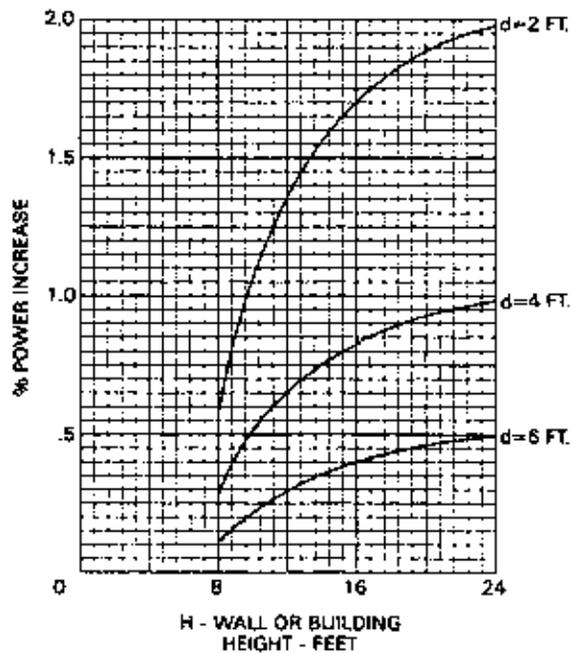


Figure 10B — Power Increase @ Full Load



Recommended Installation

Case 5 — Decorative Walls and Fencing

A special case is that of a decorative wall or fence, the **same height as the unit**, on all four sides. Figure 11 shows a unit surrounded by a decorative wall or fence. The wall can be constructed with a specific amount of open area such that a prescribed amount of air would pass through. Figure 12 gives the amount of open area such that there is a negligible performance effect.

Figure 11 — Decorative Wall or Fence On All Sides

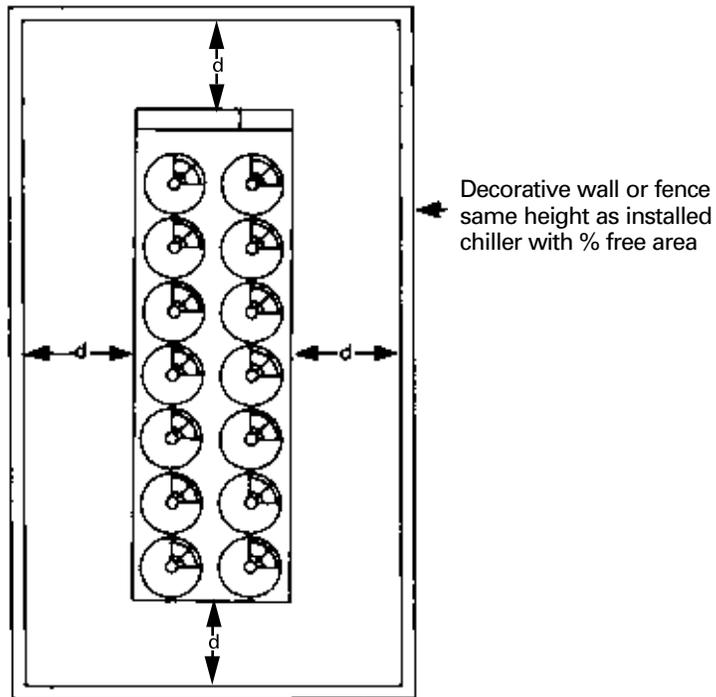
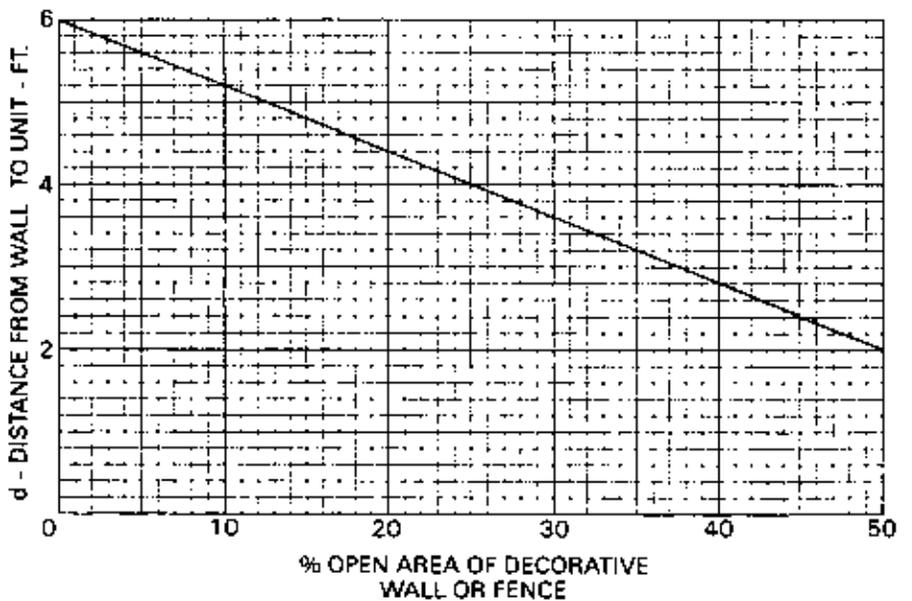


Figure 12 — % Free Area Required for Decorative Wall Or Fence

Negligible effect on chiller performance. Wall is the same height as the chiller.
% open area of decorative wall or fence.



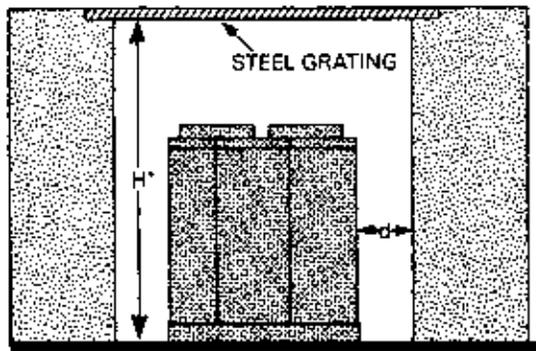
Recommended Installation

Case 6 — Pits or Solid Walls Surrounding Unit

The last case is that of a chiller installed in a pit of varying height and distance to the unit. The performance effect for a pit installation is the same as that of a solid wall completely surrounding the unit, of varying height and distance to the unit. These are potentially very severe installations due to the possibility of large amounts of recirculated air.

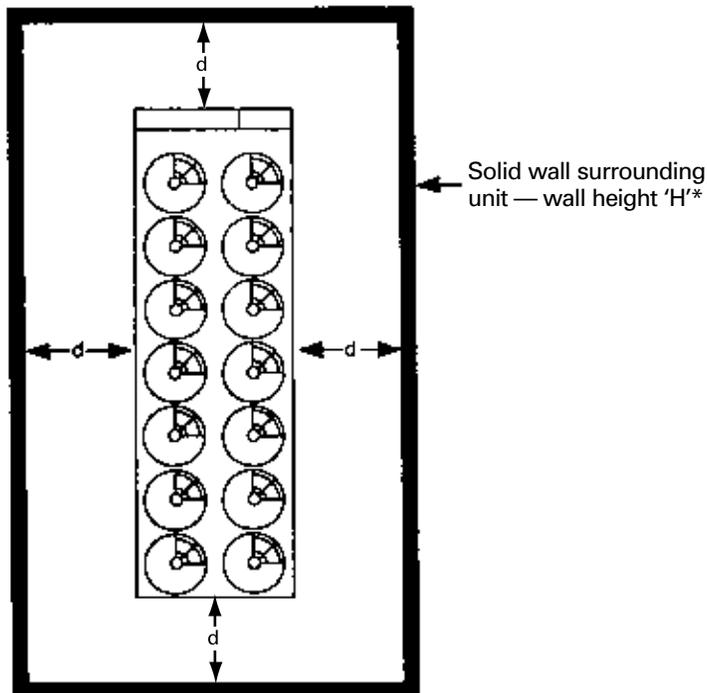
Maximum pit width and minimum pit depth are always recommended. Refer to Figures 13A, 13B, 14A and 14B.

Figure 13A — Pit Installation



*If unit is elevated, adjust H accordingly when using Figures 14A and 14B

Figure 13B — Solid Surrounding Wall



Recommended Installation

Figure 14A — Capacity Reduction @ Full Load

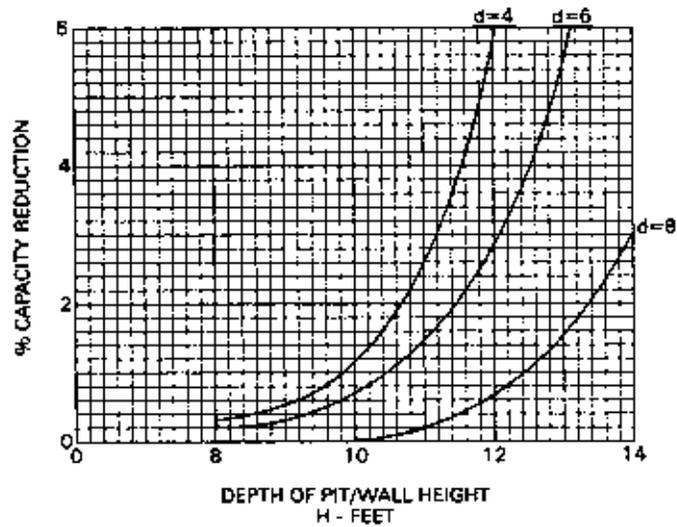
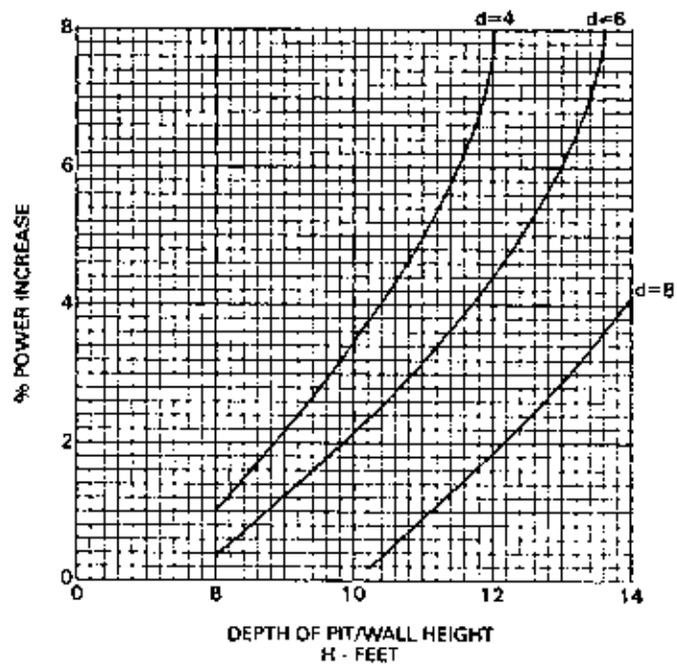


Figure 14B — Power Increase % Full Load



Recommended Installation

Recommended Installation for Walls or Obstructions

From Case 4, it can be seen that as long as **one side** of the chiller has free access to air, the performance effects are minimal. It is recommended that installations, whenever possible, take advantage of this fact. Figures 15A and 15B depict a hypothetical installation. Figure 15B is preferred because it gives the best unit performance.

Performance Decrease From External Static Pressure

Walls, obstructions, pit installations, fan stacks, etc. can cause static pressure burdens on the chiller's condenser fans. This additional external static pressure can cause chiller performance degradation. This degradation concerns an increase in the kW draw and a decrease in the tonnage achieved. The Trane Air-Cooled Series R chillers have excellent close-spacing capabilities, but it is still considered good practice to avoid installations that add excessive external static pressure. Figures 16a, 16b and 16c show predicted performance decreases for the different Trane air-cooled chiller options.

Figure 15A — A Hypothetical Installation

This arrangement is NOT recommended. See Figure 15B.

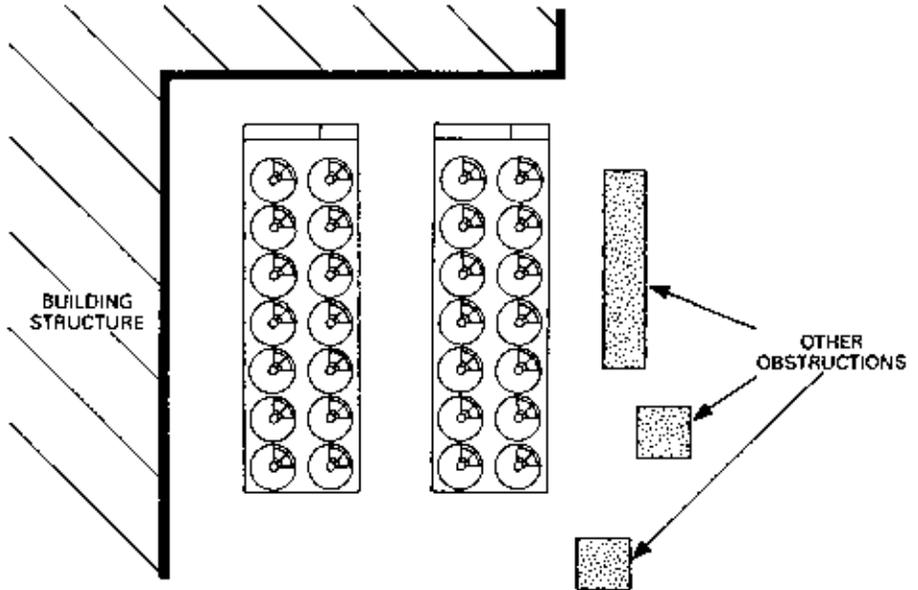
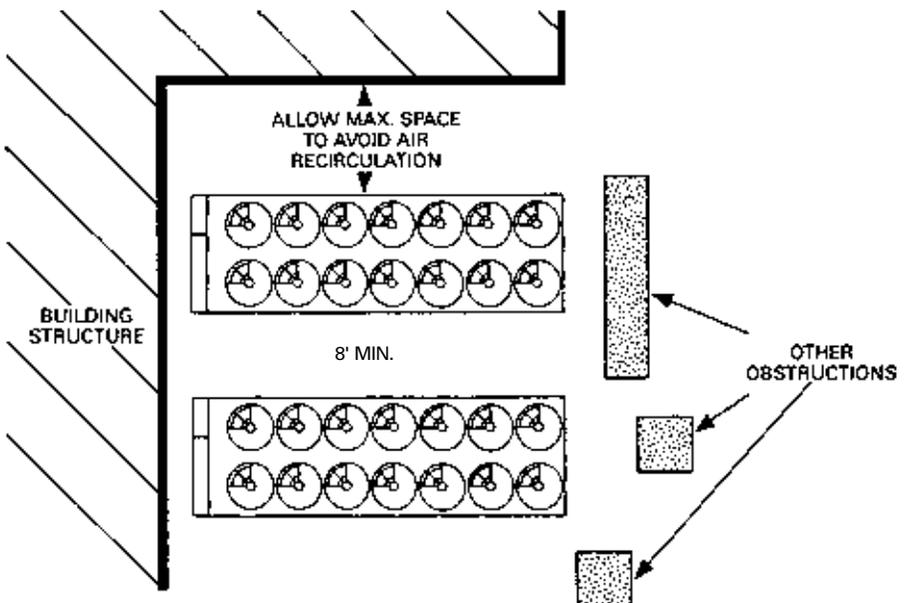


Figure 15B — Recommended Installation



Recommended Installation

Figure 16a – Affect of External Static Pressure on Capacity

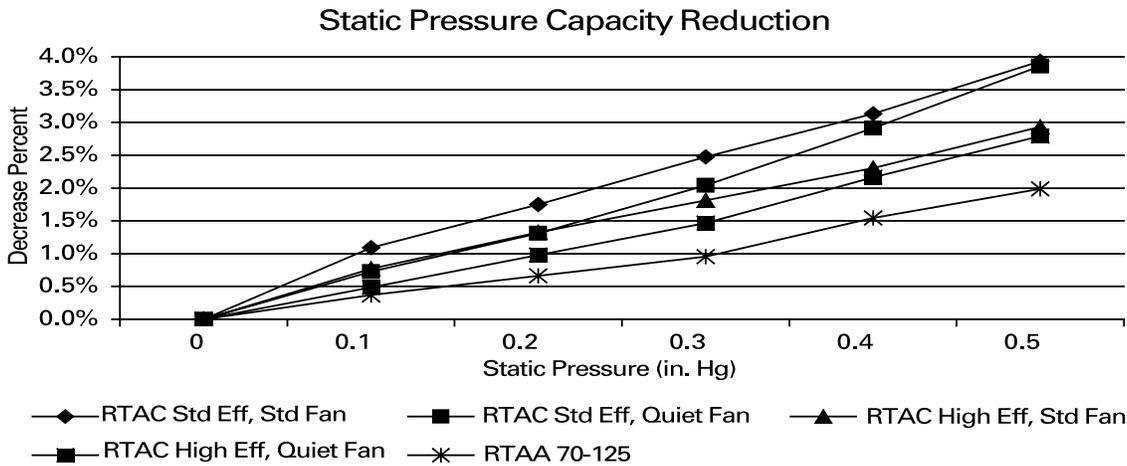


Figure 16b – Affect of External Static Pressure on Power Draw

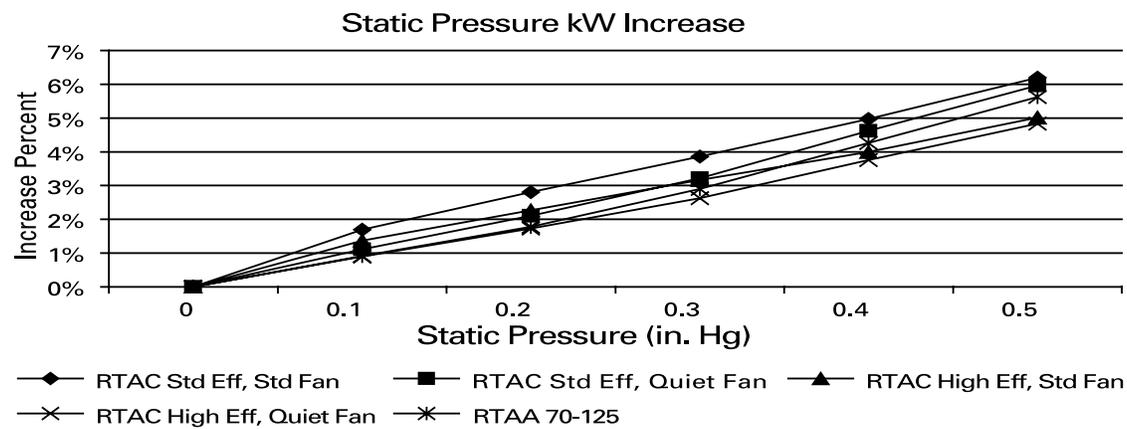
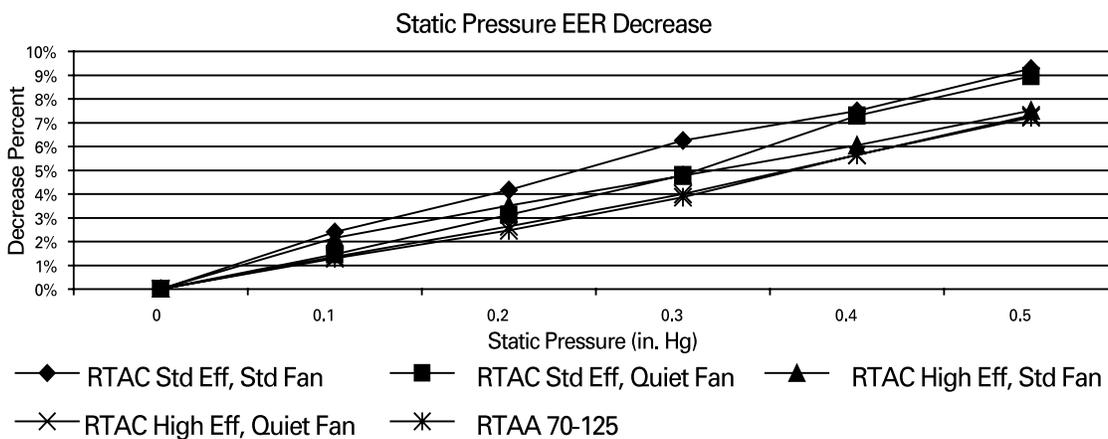


Figure 16c – Affect of External Static Pressure on Efficiency





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