Engineering Bulletin

Sound Data and Application Guide For Air-Cooled Series R™ Chiller

Model RTAG

85-205 Tons (50 Hz)

⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

November 2017 **RTAG-PRB001A-EN**

Introduction

The New, Quieter Air Cooled Series R™ Chiller – Model RTAG

The sound levels of the air-cooled Series R™ Model RTAA chillers have been steadily improved since their introduction in 1990. With the advent of the Model RTAG, sound levels are reduced significantly by addressing three major sources: the compressor, the refrigerant piping, and the condenser fans.

The compressor has been designed to minimize sound at its point of creation. This was accomplished by conducting finite element analysis on the compressor housing to find areas that would amplify the frequencies generated from compression. These areas were then redesigned to reduce sound transmission.

The refrigerant components and piping have been optimized to reduce vibration and sound propagation throughout the system.

Another source of sound originates from the condenser fans. Fan sound power can be as much as half of the overall unit sound power levels. Careful consideration was taken when designing and selecting the next generation condenser fans to be engineered into the Model RTAG. The sound levels achieved on the Model RTAG represent the lowest sound levels ever on Trane air-cooled screw compressor water chillers.

When installing any chiller, forethought should be given to the chiller and its relationship with the structure. Issues such as sound and vibration should be considered and factored into the building design and chiller location within a given structure. These issues are not unique to chillers but should be considered when any mechanical device is located in or on a structure.

This bulletin is not intended to be a replacement for a sound consultant, but rather a tool for you to advise owners, engineers and contractors of useful tips when designing and installing chiller installations. This engineering bulletin provides guidelines for addressing both unit location and airborne sound when installing air-cooled Series R™ chillers.

Contents

Unit Location

Outdoor HVAC equipment must be located to minimize noise and vibration transmission to the occupied spaces of the building structure it serves. Also, the equipment must be located to prevent objectionable noise levels at adjacent property lines or building structures. When choosing a location for the equipment, consider the following application material for both ground level and roof mounted equipment.

An additional concern for the designer is the resulting noise level at adjacent property lines. When commercial size equipment is installed near a residential lot line, there is potential for a sound problem. In this situation, the problem is not the commercial equipment but rather locating the equipment too close to a quiet zone! For equipment operating adjacent to residential areas, zone ordinances require maximum lot line dBA levels of 50-55/45 (day/night). In commercial areas 60-65/55-60 (day/ night). In industrial areas typical levels mandated by local code authorities are 65-70/65-70 (day/night). The reader is cautioned that the foregoing values listed are those typically seen across major cities of the U.S. The requirements vary by locality so **the designer is cautioned to always check the criteria and local requirements before selecting equipment locations**

A. Ground Level Equipment

1. If the equipment must be located in close proximity to a building, it should be placed next to an unoccupied space such as a storage room, mechanical room, switch gear/electrical room or other typically unoccupied space. It is not recommended to locate the equipment near occupied, sound sensitive areas of the building or near windows. Also, do not locate the equipment adjacent to other building walls or large objects which may reflect the sound back to the sound sensitive receiver.
2. Seal all piping and electrical conduit penetrations in the building envelope with an approved fire safe sealant. Utilize insulated, dielectrically compatible sleeves at wall penetrations to properly support the piping and provide vibration damping. Provide flexible couplings and vibration isolators for the water circulating pump and connections to prevent the transmission of sound throughout the building.
3. Install the unit on a pad isolated from the building or install the unit with proper vibration isolation underneath the unit to prevent machine vibrations from being transmitted to the structure of the building.

B. Roof Mounted Equipment

1. Roof Location

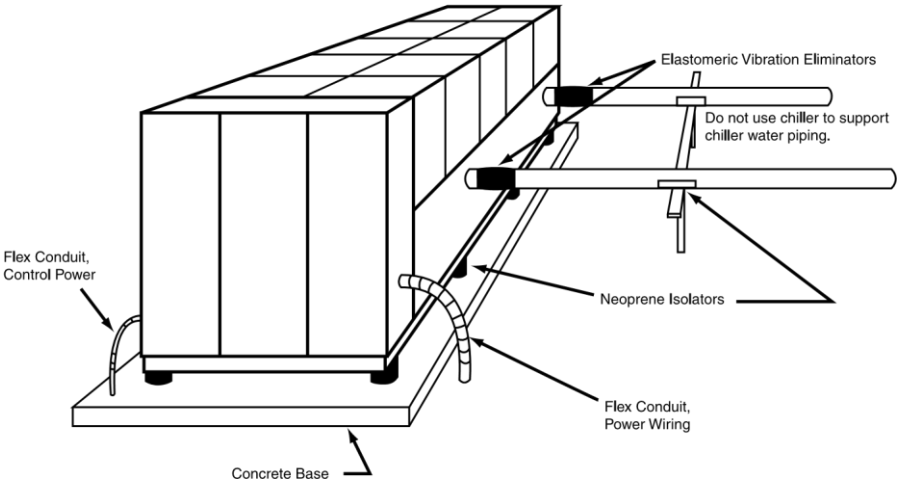
- The single most effective recommendation to prevent sound problems within a building is to locate the unit over non-critical areas such as copy rooms, restrooms, storage rooms, and other similar non-occupied areas of the building. It is not recommended to locate a unit directly over or in close proximity to sound sensitive areas such as conference rooms, executive office spaces, libraries, etc.
- It is not recommended to locate the equipment near occupied, sound sensitive areas of the building or near window glass. Also, do not locate the equipment adjacent to other building walls or large objects which may reflect the sound back to the sound sensitive receiver.

2. Building Structure

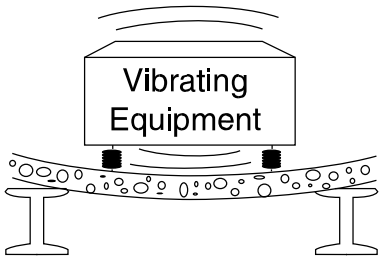
- When mounting the chiller on the roofline, it is not recommended to locate the unit on a beam or structure at mid-span of the column grid. Rather, directly support the unit over columns. Nor is it recommended to locate the unit in the middle of a horizontal beam. Try to avoid large column spans. This will minimize the roof deflection vibration transmission.
- When directly mounting chillers on I-beams that are above the roofline and mounted to the building support columns, there exists the potential for a resonant frequency at which higher than normal vibration may be transmitted to the rest of the building. Be cognizant of this application. A consultant may be required for evaluation.

Unit Location

When directly mounting chillers on I-beams (at the roofline) that are mounted to the building, support columns potentially can transmit higher than normal vibration at a resonant frequency to the rest of the building. The following drawing depicts what type of prevention methods can be taken.

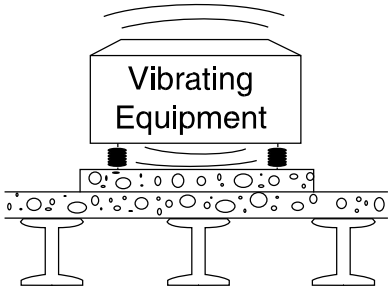


Building Support



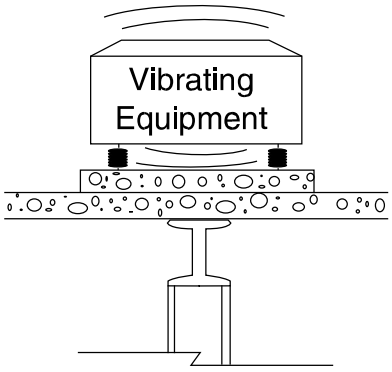
Poor

Concentration of equipment weight between beams causes excessive roof deflection and vibration transmission, even for isolated equipment.



Good

Further addition of housekeeping pad and additional beams add mass and stiffness to roof.



Very Good

A column directly under the equipment gives the roof a very high local stiffness, but some equipment vibration still enters the roof slab.

3. Base

- It is not recommended to bolt down vibrating equipment directly to foundation without using isolators.
- Install the unit upon an inertia base or concrete pad structure with vibration isolation to match the characteristics of the roof structure. Beware of lightweight roof structures which are difficult to isolate from vibration.
- Use an inertia base or solid concrete pad as a base for the chiller. This mass, properly supported, will maximize vibration dampening and help prevent noise from penetrating through the roof directly below the unit. Floors and ceiling should be concrete slabs.

4. Isolators

- Isolate chiller on ELASTOMERIC isolators. Originally intended for reciprocating compressors, spring isolators are not as effective at absorbing movement and vibration on air-cooled Series R chiller installations. This is because air-cooled Series R chillers have higher frequency vibration (900 Hz) than reciprocating chillers (less than 125 Hz).
- Isolate the unit on elastomeric isolators selected to match the characteristics of the roof structure. It is not recommended that equipment be applied to buildings with a lightweight roof structure unless column supports are provided which are independent of the roof structure.

5. Chilled Water Piping

- Provide flexible couplings and vibration isolators for the water circulating pump connections to prevent the transmission of sound throughout the building.
- Isolate chilled water piping from the chiller with ELASTOMERIC vibration eliminators. Metal braided eliminators have proven to be much less effective than elastomeric isolators in reducing vibration transmission to the building through the piping.
- Isolate pipe hangers with ELASTOMERIC isolators. This reduces vibration transmission to the building. Do not let the chiller support the weight of the chilled water piping. Isolating pipe hangers this way reduces vibration transmission to the building.

6. Electrical

- Electrical connections to the chiller should be in flex conduit. Hard electrical conduit is another vibration path that should be eliminated in chiller installations.

Unit Location

Table 1 — Sound Pressure Levels Series R™ Air-Cooled Chiller

Unit Size RTAG	A-Weighted Sound Pressure Level, dBA, ref 20 micro Pa, Standard Noise Option					
	High Efficiency Unit		Extra High Efficiency Unit		Premium Seasonal Efficiency Unit	
	AC fan @ 10m	EC fan @ 10m	AC fan @ 10m	EC fan @ 10m	AC fan @ 10m	EC fan @ 10m
85	NA	NA	66.5	66.0	NA	66.0
100	66.5	66.0	66.5	66.0	NA	66.0
125	68.0	67.5	68.5	68.0	NA	68.0
145	68.0	67.5	68.5	68.0	NA	68.0
155	68.5	68.5	69.0	68.5	NA	68.5
170	69.0	69.0	69.5	69.0	NA	69.0
190	69.5	69.0	69.5	69.0	NA	69.0
205	69.5	69.0	69.5	69.0	NA	69.0
250	71.0	70.5	71.5	71.0	NA	71.0
280	71.0	70.5	71.5	71.0	NA	71.0
310	71.5	71.5	72.0	71.5	NA	71.5
350	72.0	72.0	72.5	72.0	NA	72.0
380	72.5	72.0	72.5	72.0	NA	72.0
410	72.5	72.0	72.5	72.0	NA	72.0

Note: 10 m is measured from the side of the chiller. Sound radiation at this distance will approximate a line noise source.

Unit Size RTAG	A-Weight Sound Pressure Level, dBA, ref 20 micro Pa, Low Noise Option					
	High Efficiency Unit		Extra High Efficiency Unit		Premium Seasonal Efficiency Unit	
	AC fan @ 10m	EC fan @ 10m	AC fan @ 10m	EC fan @ 10m	AC fan @ 10m	EC fan @ 10m
85	NA	NA	63.0	62.5	NA	62.5
100	63.0	62.5	63.0	62.5	NA	62.5
125	64.5	63.5	65.0	64.5	NA	64.5
145	64.5	63.5	65.0	64.5	NA	64.5
155	65.0	64.0	65.5	64.5	NA	64.5
170	65.0	64.5	65.5	65.0	NA	65.0
190	65.5	65.0	66.0	65.5	NA	65.5
205	65.5	65.0	66.0	65.5	NA	65.5
250	67.5	66.5	68.0	67.5	NA	67.5
280	67.5	66.5	68.0	67.5	NA	67.5
310	68.0	67.0	68.5	67.5	NA	67.5
350	68.0	67.5	68.5	68.0	NA	68.0
380	68.5	68.0	69.0	68.5	NA	68.5
410	68.5	68.0	69.0	68.5	NA	68.5

Note: 10 m is measured from the side of the chiller. Sound radiation at this distance will approximate a line noise source.

Unit Size RTAG	A-Weighted Sound Pressure Level, dBA, ref 20 micro Pa, Low Noise With Night Noise Set Back Option					
	High Efficiency Unit		Extra High Efficiency Unit		Premium Seasonal Efficiency Unit	
	AC fan @ 10m	EC fan @ 10m	AC fan @ 10m	EC fan @ 10m	AC fan @ 10m	EC fan @ 10m
85	NA	NA	NA	59.5	NA	59.5
100	NA	59.5	NA	59.5	NA	59.5
125	NA	61.0	NA	61.5	NA	61.5
145	NA	61.0	NA	61.5	NA	61.5
155	NA	61.5	NA	62.0	NA	62.0
170	NA	62.0	NA	62.5	NA	62.5
190	NA	62.5	NA	62.5	NA	62.5
205	NA	62.5	NA	62.5	NA	62.5
250	NA	64.0	NA	64.5	NA	64.5
280	NA	64.0	NA	64.5	NA	64.5
310	NA	64.5	NA	65.0	NA	65.0
350	NA	65.0	NA	65.5	NA	65.5
380	NA	65.5	NA	65.5	NA	65.5
410	NA	65.5	NA	65.5	NA	65.5

Note: 10 m is measured from the side of the chiller. Sound radiation at this distance will approximate a line noise source.

7. Sealing Penetrations

- Seal all piping and electrical conduit penetrations in the building envelope with an approved fire safe sealant. Utilize insulated, dielectrically compatible sleeves at wall penetrations to properly support the piping and provide vibration damping.
- Acoustically treat all wall penetrations (piping, conduit, duct, outdoor vents, etc.)

Sound Pressure

Table 1 gives the overall A-weighted sound pressure levels for the air-cooled Series R™ chiller. Information given in this bulletin along with the data in Table 1 may be used to estimate the sound pressure levels of common installations. Estimations made using this bulletin are considered typical of what may be measured in a free field with a hand-held sound meter, in the absence of a nearby reflective surface.

Sound power octave band data are given in Appendix A. Acoustical consultants may require the data in Appendix A to perform a detailed acoustical analysis. Acoustical analysis may also be done using the Trane Acoustics Program (C.D.S.).

Note: The sound power data in Appendix 1 cannot be compared directly to SOUND PRESSURE data given in Table 1 above.

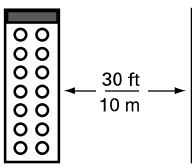


Figure 1

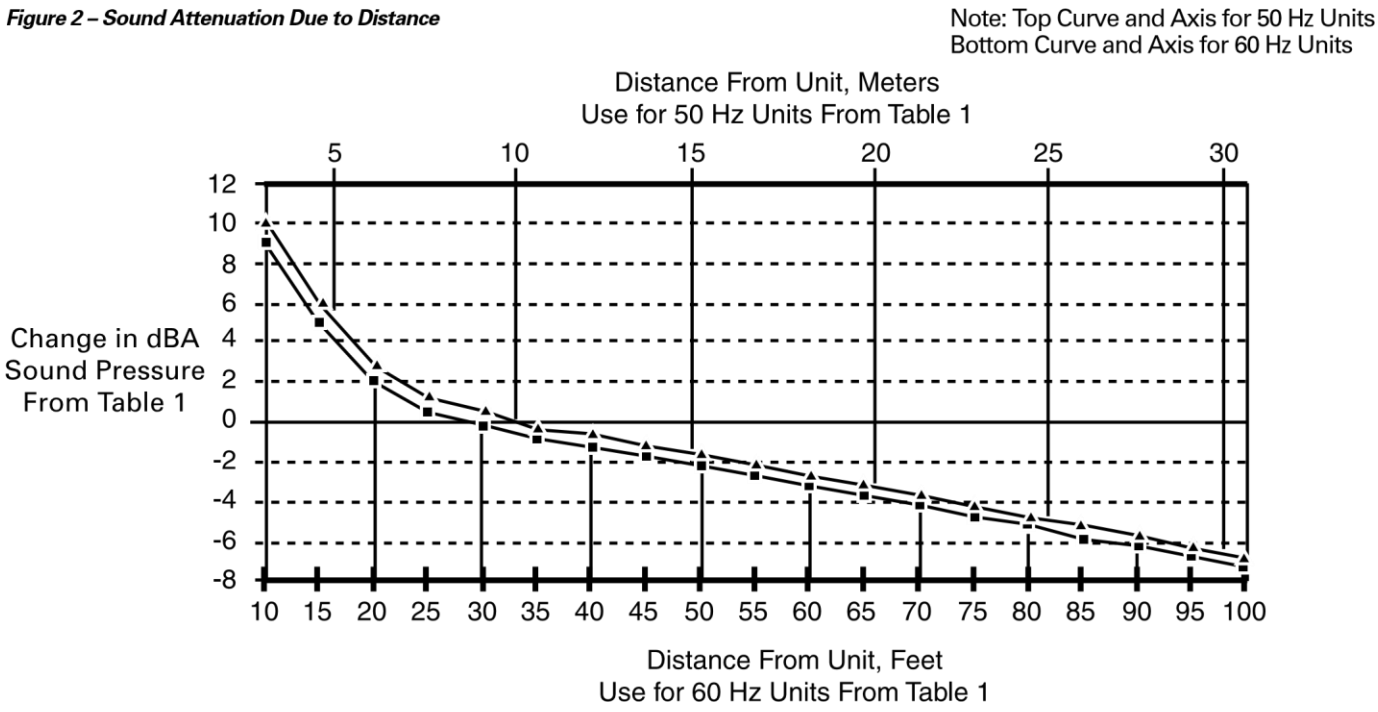
Sound measurements taken closer than 30 ft/10 m may be greatly distorted due to the large chiller lengths and multiple noise sources within the chiller.

Unit Location

Distance Factor

The distance between a source of sound and the receiver or place of sound measurement plays an important part in minimizing potential noise problems. Figure 2 gives the reductions in sound pressure level, dBA based on increasing distance from the chiller. Sound levels at a specific location can be minimized by correctly orienting the chiller (see Figure 1) and placing the chiller as far away from the location as possible (see Figure 2).

Figure 2 – Sound Attenuation Due to Distance



Note: Sound measurements taken closer than 30 ft/10 m may be greatly distorted when compared to an estimation made using Table 1 and Figure 2 due to large chiller lengths and multiple noise sources within the chiller.

Note: Beyond 100 ft or 30 meters, the sound pressure will continue to decrease 5 dBA for each doubling of the distance from the unit to the place of measurement. For example, the sound pressure at 200 ft will be 5 dBA lower than the sound pressure at 100 ft.

Unit Location

Sound Attenuation Using Barrier Walls Reciprocating chillers are characterized by a low frequency pounding sound that is typically difficult to attenuate. The direct drive Series R™ compressor and condenser fans have a medium and high frequency characteristic that may be attenuated with simple, inexpensive barrier walls.

A barrier wall constructed to only ½ inch exterior grade plywood gives a dramatic 10 dBA reduction in sound. Refer to Figure 3 for minimum wall requirements. Solid walls of brick or other more robust outdoor materials are equally acceptable and can be expected to give better attenuation. Masonry block walls with special sound absorbing cavities should be considered for critical applications.

A minimum distance of 4 ft is recommended, but the chiller may be placed closer than 4 ft to a barrier wall. Some loss of performance will occur.
Refer to Trane engineering bulletin RLC-PRB004-EN.

Louvered panels or decorative walls with any amount of open area should not be used to attenuate sound. They have little or no sound reflecting or attenuating benefit. Also, an insulated sheet metal box covering the compressors alone will provide minimal sound attenuation and is not recommended.

Figure 3 – Suggested Barrier Wall for Sound Attenuation

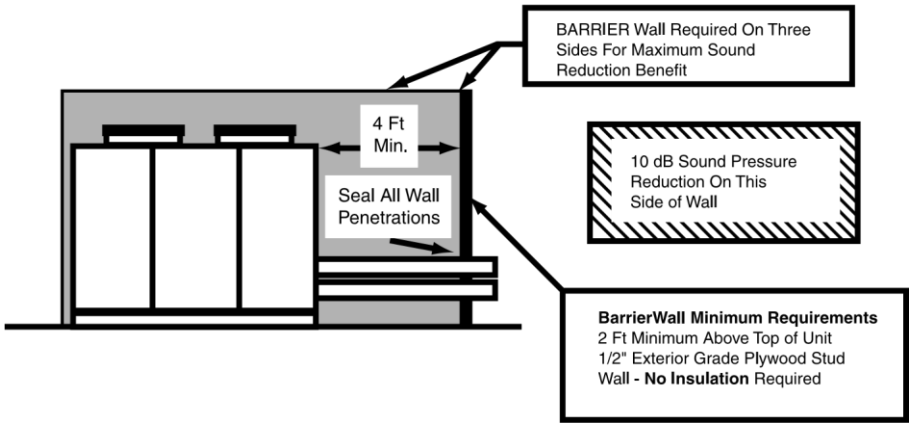
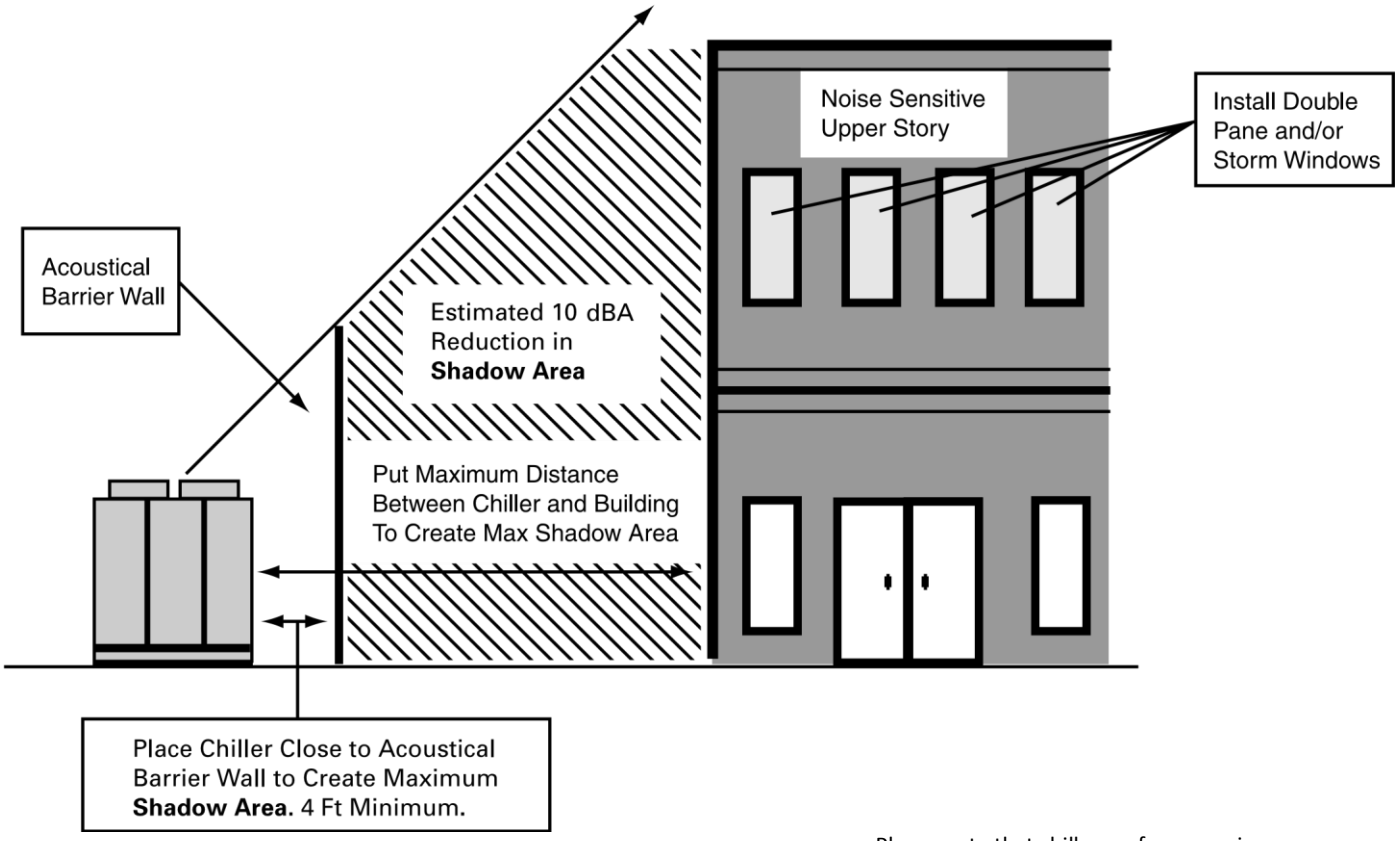


Figure 4 – Use of Attenuation for Upper Story Building Sound Problems



Acoustical Fan Discharge Stacks Use of acoustical fan discharge stacks by themselves will produce only marginal sound attenuating benefits. It is important to remember that both the compressors and the fans contribute to the sound of the air-cooled Series R™ chiller. Compressor noise is not attenuated by a fan discharge stack and a locally built and installed acoustical "box" around the compressors is not an effective means of compressor sound attenuation.

However, acoustical fan discharge stacks can be used with an acoustical barrier wall. Selection and installation of acoustical fan discharge stacks must be done by a competent acoustical engineer in order to be effective.

Please note that chiller performance is adversely affected by the use of acoustical fan discharge stacks. Refer to Figures 6 through 8. The length and open area of acoustical fan discharge stacks must be designed to produce no more than 0.5 inch of additional static pressure on the condenser fans. Also note that care must be taken to properly support discharge fan stacks against severe cross winds.

Appendix A

Appendix A

Sound Power Octave Band Data

Sound power octave band data can be used for purposes of describing the basic acoustical properties of the air-cooled Series R™ chiller. However, there are two cautionary notes. First, if the engineer is using the data as a criteria in a bid evaluation, make sure that the data from all competitors is on an equal basis. Insist that all competitors present data terms of **SOUND POWER (not sound pressure),** in a consistent format, according to **ARI Standard 370**.

>>>Sound **power** data CANNOT be compared directly to sound **pressure** data. <<<

Second, the sound power data does not provide sufficient information to correctly position the chiller or attenuate its sound to take full advantage of the characteristics of the air-cooled Series R chiller. Unlike most reciprocating chillers that exhibit a low frequency, pounding sound, the air-cooled Series R chiller sound is directional in nature and has a higher frequency characteristic that is more easily attenuated. The specific application information given in the preceding parts of this bulletin can be used to create a significant competitive advantage over competitive air-cooled reciprocating chillers.

NOTE: Sound Power Rating data given in Tables A-1 through A-2 and Tables B-7 through B-10 may vary ± 2 dB in any specific octave band due to normal variations in chiller construction.

Table A-1 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, High Efficiency Unit with AC Fan, Standard Noise Option

Unit Size RTAG	Standard Noise Option, High Efficiency Unit with AC Fan								
	Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	96.0	89.0	91.5	97.0	94.0	89.0	80.5	74.0	98.0
125	97.0	90.5	92.5	98.5	95.5	90.5	82.0	75.5	99.5
145	97.0	90.5	92.5	98.5	95.5	90.5	82.0	75.5	99.5
155	97.0	90.5	93.0	98.5	96.5	91.0	82.5	76.0	100.0
170	97.5	90.5	93.5	99.0	97.0	91.5	83.0	76.5	100.5
190	98.5	91.5	94.0	99.5	97.0	92.0	83.5	77.0	101.0
205	98.5	91.5	94.0	99.5	97.0	92.0	83.5	77.0	101.0
250	100.0	93.5	95.5	101.5	98.5	93.5	85.0	78.5	102.5
280	100.0	93.5	95.5	101.5	98.5	93.5	85.0	78.5	102.5
310	100.5	93.5	96.0	101.5	99.5	94.0	85.5	79.0	103.0
350	100.5	93.5	96.5	102.0	100.0	94.5	86.0	79.5	103.5
380	101.0	94.5	97.0	102.5	100.0	95.0	86.0	79.5	104.0
410	101.0	94.5	97.0	102.5	100.0	95.0	86.0	79.5	104.0

Sound Power is a calculated quantity and cannot be measured directly like SOUND PRESSURE. Sound power is the amount of acoustical power produced at the source, and thus is an absolute quantity and not dependent on the surrounding environment or distance, as is sound pressure. 32 measurements are taken over a prescribed area around the unit. Data is then mathematically reduced to give the sound power level, dB.

Appendix A

Table A-2 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, High Efficiency Unit with EC Fan, Standard Noise Option

Unit Size RTAG	Standard Noise Option, High Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	99.0	90.5	92.5	95.0	94.5	89.0	81.5	74.5	97.5
125	100.5	91.5	94.0	96.5	96.0	90.5	83.0	76.0	99.0
145	100.5	91.5	94.0	96.5	96.0	90.5	83.0	76.0	99.0
155	100.5	91.5	94.5	97.0	96.5	91.5	83.5	76.5	100.0
170	100.5	91.5	94.5	97.5	97.0	92.0	83.5	77.0	100.5
190	101.5	92.5	95.5	97.5	97.5	92.0	84.0	77.0	100.5
205	101.5	92.5	95.5	97.5	97.5	92.0	84.0	77.0	100.5
250	103.5	94.5	97.0	99.5	99.0	93.5	86.0	79.0	102.0
280	103.5	94.5	97.0	99.5	99.0	93.5	86.0	79.0	102.0
310	103.5	94.5	97.5	100.0	99.5	94.5	86.5	79.5	103.0
350	103.5	94.5	98.0	100.5	100.0	95.0	86.5	80.0	103.5
380	104.5	95.5	98.5	100.5	100.5	95.0	87.0	80.0	103.5
410	104.5	95.5	98.5	100.5	100.5	95.0	87.0	80.0	103.5

Table A-3 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, Extra High Efficiency Unit with AC Fan, Standard Noise Option

Unit Size RTAG	Standard Noise Option, Extra High Efficiency Unit with AC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	96.0	89.0	91.5	97.0	94.0	89.0	80.5	74.0	98.0
100	96.0	89.0	91.5	97.0	94.0	89.0	80.5	74.0	98.0
125	98.0	91.0	93.0	99.0	95.5	90.5	82.5	75.5	100.0
145	98.0	91.0	93.0	99.0	95.5	90.5	82.5	75.5	100.0
155	98.0	91.0	93.5	99.0	96.5	91.0	83.0	76.0	100.5
170	98.5	91.5	94.0	99.5	97.0	92.0	83.5	77.0	101.0
190	99.0	92.0	94.5	100.0	97.0	92.0	83.5	77.0	101.0
205	99.0	92.0	94.5	100.0	97.0	92.0	83.5	77.0	101.0
250	101.0	94.0	96.0	102.0	98.5	93.5	85.5	78.5	103.0
280	101.0	94.0	96.0	102.0	98.5	93.5	85.5	78.5	103.0
310	101.0	94.5	96.5	102.0	99.5	94.0	86.0	79.0	103.5
350	101.0	94.5	97.0	102.5	100.0	95.0	86.0	79.5	104.0
380	102.0	95.0	97.5	103.0	100.0	95.0	86.5	80.0	104.0
410	102.0	95.0	97.5	103.0	100.0	95.0	86.5	80.0	104.0

Appendix A

Table A-4 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, Extra High Efficiency Unit with EC Fan, Standard Noise Option

Unit Size RTAG	Standard Noise Option, Extra High Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	99.0	90.5	92.5	95.0	94.5	89.0	81.5	74.5	97.5
100	99.0	90.5	92.5	95.0	94.5	89.0	81.5	74.5	97.5
125	101.5	92.5	94.5	96.5	96.0	90.5	83.5	76.0	99.5
145	101.5	92.5	94.5	96.5	96.0	90.5	83.5	76.0	99.5
155	101.5	92.5	95.0	97.0	97.0	91.5	84.0	76.5	100.0
170	101.5	92.5	95.5	97.5	97.5	92.0	84.0	77.0	100.5
190	102.0	93.5	95.5	98.0	97.5	92.0	84.5	77.5	100.5
205	102.0	93.5	95.5	98.0	97.5	92.0	84.5	77.5	100.5
250	104.5	95.5	97.5	99.5	99.0	93.5	86.5	79.0	102.5
280	104.5	95.5	97.5	99.5	99.0	93.5	86.5	79.0	102.5
310	104.5	95.5	98.0	100.0	100.0	94.5	87.0	79.5	103.0
350	104.5	95.5	98.5	100.5	100.5	95.0	87.0	80.0	103.5
380	105.0	96.5	98.5	101.0	100.5	95.0	87.5	80.5	103.5
410	105.0	96.5	98.5	101.0	100.5	95.0	87.5	80.5	103.5

Table A-5 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, Premium Seasonal Efficiency Unit with EC Fan, Standard Noise Option

Unit Size RTAG	Standard Noise Option, Premium Seasonal Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	99.0	90.5	92.5	95.0	94.5	89.0	81.5	74.5	97.5
100	99.0	90.5	92.5	95.0	94.5	89.0	81.5	74.5	97.5
125	101.5	92.5	94.5	96.5	96.0	90.5	83.5	76.0	99.5
145	101.5	92.5	94.5	96.5	96.0	90.5	83.5	76.0	99.5
155	101.5	92.5	95.0	97.0	97.0	91.5	84.0	76.5	100.0
170	101.5	92.5	95.5	97.5	97.5	92.0	84.0	77.0	100.5
190	102.0	93.5	95.5	98.0	97.5	92.0	84.5	77.5	100.5
205	102.0	93.5	95.5	98.0	97.5	92.0	84.5	77.5	100.5
250	104.5	95.5	97.5	99.5	99.0	93.5	86.5	79.0	102.5
280	104.5	95.5	97.5	99.5	99.0	93.5	86.5	79.0	102.5
310	104.5	95.5	98.0	100.0	100.0	94.5	87.0	79.5	103.0
350	104.5	95.5	98.5	100.5	100.5	95.0	87.0	80.0	103.5
380	105.0	96.5	98.5	101.0	100.5	95.0	87.5	80.5	103.5
410	105.0	96.5	98.5	101.0	100.5	95.0	87.5	80.5	103.5

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Table A-6 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, High Efficiency Unit with AC Fan, Low Noise Option

Unit Size RTAG	Low Noise Option, High Efficiency Unit with AC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	96.0	89.0	88.5	95.0	89.0	83.5	78.0	69.0	94.5
125	97.0	90.0	89.5	96.5	90.5	84.5	79.5	70.5	96.0
145	97.0	90.0	89.5	96.5	90.5	84.5	79.5	70.5	96.0
155	97.0	90.0	90.0	96.5	91.0	85.5	79.5	71.0	96.5
170	97.0	90.0	90.0	96.5	91.5	86.0	80.0	71.5	96.5
190	98.0	91.0	91.0	97.5	92.0	86.0	80.5	72.0	97.0
205	98.0	91.0	91.0	97.5	92.0	86.0	80.5	72.0	97.0
250	100.0	93.0	92.5	99.5	93.5	87.5	82.5	73.5	99.0
280	100.0	93.0	92.5	99.5	93.5	87.5	82.5	73.5	99.0
310	100.0	93.0	93.0	99.5	94.0	88.5	82.5	74.0	99.5
350	100.0	93.0	93.0	99.5	94.5	88.5	82.5	74.0	99.5
380	101.0	94.0	94.0	100.5	95.0	89.0	83.5	75.0	100.0
410	101.0	94.0	94.0	100.5	95.0	89.0	83.5	75.0	100.0

Table A-7 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, High Efficiency Unit with EC Fan, Low Noise Option

Unit Size RTAG	Low Noise (Compressor+Tube Sound Wrap) Option, High Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	99.0	90.0	91.0	91.0	90.5	84.0	80.0	70.5	94.0
125	100.0	91.0	92.0	92.5	91.5	85.5	81.0	72.0	95.0
145	100.0	91.0	92.0	92.5	91.5	85.5	81.0	72.0	95.0
155	100.0	91.0	92.0	93.0	92.0	86.0	81.0	72.0	95.5
170	100.5	91.5	92.5	93.0	92.5	86.5	81.5	72.5	96.0
190	101.0	92.0	93.0	93.5	93.0	86.5	82.0	73.0	96.5
205	101.0	92.0	93.0	93.5	93.0	86.5	82.0	73.0	96.5
250	103.5	94.0	95.0	95.5	94.5	88.5	84.0	75.0	98.0
280	103.5	94.0	95.0	95.5	94.5	88.5	84.0	75.0	98.0
310	103.5	94.0	95.0	96.0	95.0	89.0	84.0	75.0	98.5
350	103.5	94.5	95.0	96.0	95.5	89.5	84.5	75.5	99.0
380	104.0	95.0	96.0	96.5	96.0	89.5	85.0	76.0	99.5
410	104.0	95.0	96.0	96.5	96.0	89.5	85.0	76.0	99.5

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Table A-8 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, Extra High Efficiency Unit with AC Fan, Low Noise Option

Unit Size RTAG	Low Noise (Compressor+Tube Sound Wrap) Option, Extra High Efficiency Unit with AC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	96.0	89.0	88.5	95.0	89.0	83.5	78.0	69.0	94.5
100	96.0	89.0	88.5	95.0	89.0	83.5	78.0	69.0	94.5
125	98.0	91.0	90.5	97.5	91.0	85.0	80.5	71.0	96.5
145	98.0	91.0	90.5	97.5	91.0	85.0	80.5	71.0	96.5
155	98.0	91.0	90.5	97.5	91.5	85.5	80.5	71.5	97.0
170	98.0	91.0	91.0	97.5	92.0	86.0	80.5	72.0	97.0
190	99.0	92.0	91.5	98.0	92.0	86.5	81.0	72.0	97.5
205	99.0	92.0	91.5	98.0	92.0	86.5	81.0	72.0	97.5
250	101.0	94.0	93.5	100.5	94.0	88.0	83.5	74.0	99.5
280	101.0	94.0	93.5	100.5	94.0	88.0	83.5	74.0	99.5
310	101.0	94.0	93.5	100.5	94.5	88.5	83.5	74.5	100.0
350	101.0	94.0	94.0	100.5	95.0	89.0	83.5	75.0	100.0
380	102.0	95.0	94.5	101.0	95.0	89.5	84.0	75.0	100.5
410	102.0	95.0	94.5	101.0	95.0	89.5	84.0	75.0	100.5

Table A-9 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, Extra High Efficiency Unit with EC Fan, Low Noise Option

Unit Size RTAG	Low Noise (Compressor+Tube Sound Wrap) Option, Extra High Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	99.0	90.0	91.0	91.0	90.5	84.0	80.0	70.5	94.0
100	99.0	90.0	91.0	91.0	90.5	84.0	80.0	70.5	94.0
125	101.5	92.5	93.0	93.0	92.5	86.0	82.0	72.5	96.0
145	101.5	92.5	93.0	93.0	92.5	86.0	82.0	72.5	96.0
155	101.5	92.5	93.0	93.5	92.5	86.5	82.0	73.0	96.0
170	101.0	92.0	93.0	93.5	93.0	86.5	82.0	73.0	96.5
190	102.0	93.0	94.0	94.0	93.5	87.0	83.0	73.5	97.0
205	102.0	93.0	94.0	94.0	93.5	87.0	83.0	73.5	97.0
250	104.5	95.5	96.0	96.0	95.5	89.0	85.0	75.5	99.0
280	104.5	95.5	96.0	96.0	95.5	89.0	85.0	75.5	99.0
310	104.5	95.5	96.0	96.5	95.5	89.5	85.0	76.0	99.0
350	104.0	95.0	96.0	96.5	96.0	89.5	85.0	76.0	99.5
380	105.0	96.0	96.5	97.0	96.5	90.0	86.0	76.5	100.0
410	105.0	96.0	96.5	97.0	96.5	90.0	86.0	76.5	100.0

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Table A-10 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, Premium Seasonal Efficiency Unit with EC Fan, Low Noise Option

Unit Size RTAG	Low Noise (Compressor+Tube Sound Wrap) Option, Premium Seasonal Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	99.0	90.0	91.0	91.0	90.5	84.0	80.0	70.5	94.0
100	99.0	90.0	91.0	91.0	90.5	84.0	80.0	70.5	94.0
125	101.5	92.5	93.0	93.0	92.5	86.0	82.0	72.5	96.0
145	101.5	92.5	93.0	93.0	92.5	86.0	82.0	72.5	96.0
155	101.5	92.5	93.0	93.5	92.5	86.5	82.0	73.0	96.0
170	101.0	92.0	93.0	93.5	93.0	86.5	82.0	73.0	96.5
190	102.0	93.0	94.0	94.0	93.5	87.0	83.0	73.5	97.0
205	102.0	93.0	94.0	94.0	93.5	87.0	83.0	73.5	97.0
250	104.5	95.5	96.0	96.0	95.5	89.0	85.0	75.5	99.0
280	104.5	95.5	96.0	96.0	95.5	89.0	85.0	75.5	99.0
310	104.5	95.5	96.0	96.5	95.5	89.5	85.0	76.0	99.0
350	104.0	95.0	96.0	96.5	96.0	89.5	85.0	76.0	99.5
380	105.0	96.0	96.5	97.0	96.5	90.0	86.0	76.5	100.0
410	105.0	96.0	96.5	97.0	96.5	90.0	86.0	76.5	100.0

Table A-11 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, High Efficiency Unit with EC Fan, Low Noise with Night Setback Option

Unit Size RTAG	Low Noise + Night Noise Set Back Option, High Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	90.0	84.5	91.5	87.5	87.5	82.0	75.5	67.0	91.0
125	91.0	85.5	93.0	89.0	89.0	83.5	76.5	68.5	92.5
145	91.0	85.5	93.0	89.0	89.0	83.5	76.5	68.5	92.5
155	91.0	85.5	93.0	89.5	89.5	84.0	77.0	69.0	93.0
170	91.0	85.5	93.0	90.0	90.0	85.0	77.0	69.5	93.5
190	92.5	87.0	94.0	90.5	90.5	85.0	78.0	70.0	94.0
205	92.5	87.0	94.0	90.5	90.5	85.0	78.0	70.0	94.0
250	94.0	88.5	96.0	92.0	92.0	86.5	79.5	71.5	95.5
280	94.0	88.5	96.0	92.0	92.0	86.5	79.5	71.5	95.5
310	94.0	88.5	96.0	92.5	92.5	87.0	80.0	72.0	96.0
350	94.5	89.0	96.0	93.0	93.0	88.0	80.0	72.5	96.5
380	95.5	90.0	97.0	93.5	93.5	88.0	81.0	73.0	97.0
410	95.5	90.0	97.0	93.5	93.5	88.0	81.0	73.0	97.0

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Table A-12 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, Extra High Efficiency Unit with EC Fan, Low Noise with Night Setback Option

Unit Size RTAG	Low Noise + Night Noise Set Back Option, Extra High Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	90.0	84.5	91.5	87.5	87.5	82.0	75.5	67.0	91.0
100	90.0	84.5	91.5	87.5	87.5	82.0	75.5	67.0	91.0
125	92.0	86.5	94.0	89.0	89.0	83.5	77.0	68.5	93.0
145	92.0	86.5	94.0	89.0	89.0	83.5	77.0	68.5	93.0
155	92.5	86.5	94.0	90.0	89.5	84.5	77.5	69.5	93.5
170	92.5	87.0	94.0	90.5	90.5	85.0	78.0	70.0	94.0
190	93.0	87.5	94.5	90.5	90.5	85.0	78.5	70.0	94.0
205	93.0	87.5	94.5	90.5	90.5	85.0	78.5	70.0	94.0
250	95.5	89.5	97.0	92.0	92.0	86.5	80.0	71.5	96.0
280	95.5	89.5	97.0	92.0	92.0	86.5	80.0	71.5	96.0
310	95.5	89.5	97.0	93.0	92.5	87.5	80.5	72.5	96.5
350	95.5	90.0	97.0	93.5	93.5	88.0	81.0	73.0	97.0
380	96.0	90.5	97.5	93.5	93.5	88.0	81.5	73.0	97.0
410	96.0	90.5	97.5	93.5	93.5	88.0	81.5	73.0	97.0

Table A-13 (50 Hz) – Octave Band Sound Power Levels, dB ref, 1 pw, Premium Seasonal Efficiency Unit with EC Fan, Low Noise with Night Setback Option

Unit Size RTAG	Low Noise + Night Noise Set Back Option, Premium Seasonal Efficiency Unit with EC Fan								
	Octave Band Sound Power Levels, dB ref, 1 pw								Overall A'Wtd
	Octave Band Center Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	
85	90.0	84.5	91.5	87.5	87.5	82.0	75.5	67.0	91.0
100	90.0	84.5	91.5	87.5	87.5	82.0	75.5	67.0	91.0
125	92.0	86.5	94.0	89.0	89.0	83.5	77.0	68.5	93.0
145	92.0	86.5	94.0	89.0	89.0	83.5	77.0	68.5	93.0
155	92.5	86.5	94.0	90.0	89.5	84.5	77.5	69.5	93.5
170	92.5	87.0	94.0	90.5	90.5	85.0	78.0	70.0	94.0
190	93.0	87.5	94.5	90.5	90.5	85.0	78.5	70.0	94.0
205	93.0	87.5	94.5	90.5	90.5	85.0	78.5	70.0	94.0
250	95.5	89.5	97.0	92.0	92.0	86.5	80.0	71.5	96.0
280	95.5	89.5	97.0	92.0	92.0	86.5	80.0	71.5	96.0
310	95.5	89.5	97.0	93.0	92.5	87.5	80.5	72.5	96.5
350	95.5	90.0	97.0	93.5	93.5	88.0	81.0	73.0	97.0
380	96.0	90.5	97.5	93.5	93.5	88.0	81.5	73.0	97.0
410	96.0	90.5	97.5	93.5	93.5	88.0	81.5	73.0	97.0

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