2018 (Reaffirmed 2023) Standard for

Application of Outdoor Unitary Equipment A-weighted Sound Power Ratings

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ICS Code: 17.140.1

Note:

This standard supersedes ANSI/AHRI Standard 275-2010.
This standard was reaffirmed September 2023.

This version of the standard differs from that of 2010 in the following ways:

- The 2015 Edition of AHRI Standard 270 is now used for the rating.
- Expanded the scope to include the list of the products covered by AHRI Standard 270: Air-source Unitary Heat Pumps, Heat Pump Pool Heaters, Unitary Air-conditioners and Variable Refrigerant Flow (VRF) System.

Note: Although this standard is meant as an application for equipment rated per AHRI Standard 270, other standards that provide rating(s) similar to AHRI Standard 270 may be able to use the methodology, techniques and procedures described within this standard.

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APPENDICES

APPLICATION OF OUTDOOR UNITARY EQUIPMENT A-WEIGHTED SOUND POWER RATINGS

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish for outdoor unitary equipment: definitions, procedures for estimating A-weighted Sound Pressure Levels from the A-weighted Sound Power Ratings, and recommended application practices.

1.1.1 *Intent*. This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 *Review and Amendment*. This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope*. This standard applies to the outdoor sections of factory-made air-conditioning and heat pump equipment as defined in the following AHRI standards, when rated in accordance with AHRI Standard 270.

2.1.1 AHRI Standard 210/240, *Unitary Air-conditioning and Air-source Heat Pump Equipment;*

2.1.2 AHRI Standard 340/360, *Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment* (cooling capacity ratings of equal to or less than 40.0 kW);

2.1.3 AHRI Standard 1230, *Variable Refrigerant Flow (VRF) Multi-split Air-conditioning and Heat Pump Equipment* (cooling capacity ratings of equal to or less than 40.0 kW)*;*

2.1.4 ANSI/AHRI Standards 1160 (I-P) and 1161 (SI), *Heat Pump Pool Heaters.*

Section 3. Definitions

All terms in this document will follow the standard industry definitions in the *ASHRAE Terminology* website (https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology) unless otherwise defined in this section.

3.1 *Published Rating.* A statement of the assigned values of those performance characteristics, under stated rating conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the same manufacturer. As used herein, the term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated rating conditions.

3.1.1 *Application Rating.* A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).

3.1.2 *Standard Rating.* A rating based on tests performed at Standard Rating Conditions.

3.2 *Rating Conditions*. Any set of operating conditions under which a single level of performance results, and which cause only that level of performance to occur.

3.2.1 *Standard Rating Conditions*. Rating Conditions used as the basis of comparison for performance characteristics.

3.3 "Shall," "Should," "Recommended," or "It Is Recommended." "Shall," "should," "recommended," or "it is recommended" shall be interpreted as follows:

3.3.1 *Shall*. Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.3.2 *Should, Recommended, or It Is Recommended*. "Should," "recommended," or "it is recommended" is used to indicate provisions which are not mandatory, but which are desirable as good practice.

3.4 *Sound Power.* The rate at which acoustic energy is emitted from a source, expressed in Watts. This quantity is a function of the source only and independent of its surroundings.

3.5 *Sound Power Level, L_w.* Ratio of the Sound Power to a reference of 1 picowatt, expressed in decibels.

3.5.1 *A-weighted Sound Power Level, L_{wA}.* The logarithmic summation of A-weighted, one-third octave band Sound Power Levels. It is used for sound level rating in AHRI Standard 270 (Calculation can refer to AHRI Standard 270 Appendix D).

3.6 *Sound Pressure.* The difference between the pressure produced by an acoustic wave and the ambient air pressure. This quantity is a function of the source, its surroundings and distance to the receiver. It is measured by a microphone and perceived by the human ear.

3.7 *Sound Pressure Level, L_p.* Ratio of the Sound Pressure to a reference of 20 micro pascals, expressed in decibels. The reference of 20 micro pascals is the threshold of human hearing.

3.7.1 *A-weighted Sound Pressure Level L_{pA}* . The measured level obtained with a sound level meter using its A-weighting network or the level as calculated per this standard. The meter shall meet the requirements of ANSI/ASA Standard S1.4 Part 3.

3.8 *Sound Level Rating(s).* The Sound Power Level(s) of the equipment when rated in accordance with AHRI Standard 270.

3.8.1 *Standard Sound Rating*. The Sound Power Level(s) of the equipment when rated at Standard Rating Conditions in accordance with AHRI Standard 270.

3.8.2 *Application Sound Rating*. The Sound Power Level(s) of the equipment when rated in accordance with AHRI Standard 270 at conditions other than Standard Rating Conditions.

Section 4. Procedure for Estimating A-weighted Sound Pressure Level(s)

4.1 *Introduction*. AHRI Standard 270 establishes a method of rating outdoor equipment in terms of Sound Power Level(s). AHRI Standard 275 provides the methodology for estimating the A-weighted Sound Pressure Level at a given location resulting from outdoor equipment based on A-weighted sound power level obtained via AHRI Standard 270. The application is dependent not only upon the equipment's A-weighted Sound Power Level rating but also upon several significant factors related to the application of the equipment. These factors include equipment location, barrier shielding, sound path, and distance as described in Sections 4.1.1 through 4.1.4 and Tables 1-4. Quantitative values for each of these factors and the equipment's A-weighted Sound Power Level rating are then used to estimate the A-weighted Sound Pressure Level at a given location.

4.1.1 *Equipment Location Factor*. This factor takes into consideration the effect of walls and other reflective surfaces adjacent to the equipment. Factors for typical equipment locations are given in Table 1 and described with Figures 1 through 5.

Table 1. Application Factors for Estimating A-weighted Sound Pressure Level(s) (Equipment Location Factor)	
Equipment Location Factor	Factor Value
a. Equipment on ground, roof, or on side of building wall with no adjacent reflective surface within 3 m (d greater than 3 m)	0 dB
b. Equipment on ground, roof, or on side of building wall with a single adjacent reflective surface within 3 m (d less than 3 m) – (See Figures 1 and 2)	3 dB
c. Equipment on ground, roof, or on side of building wall within 3m of two adjacent walls forming an inside corner (d less than 3 m to both surfaces) – (See Figures 3 and 4)	6 dB
d. Equipment on ground, roof, or on side of building wall and between two opposite reflecting surfaces less than 5 m apart – (See Figure 5)	6 dB

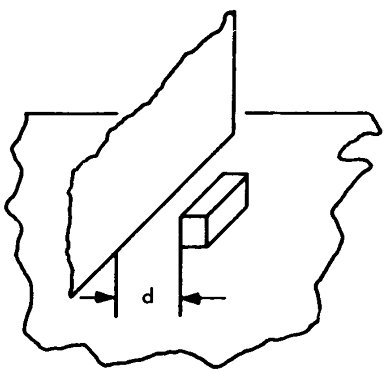

Figure 1. On Ground or Roof – Single Reflective Surface

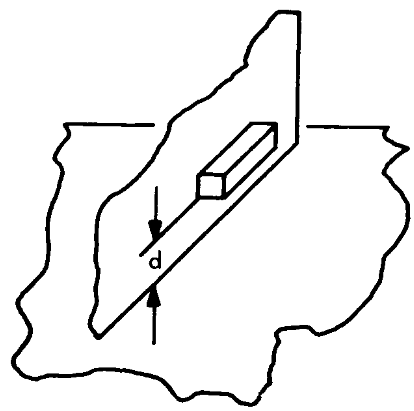

Figure 2. On Side of Building – Single Reflective Surface

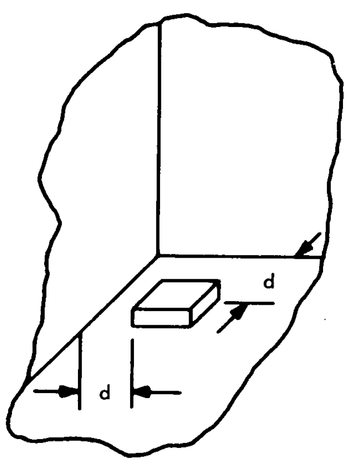

Figure 3. On Ground or Roof – Two Adjacent Reflecting Surfaces

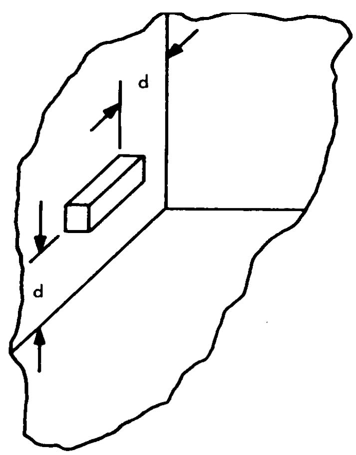

Figure 4. On Side of Building – Two Adjacent Reflecting Surfaces

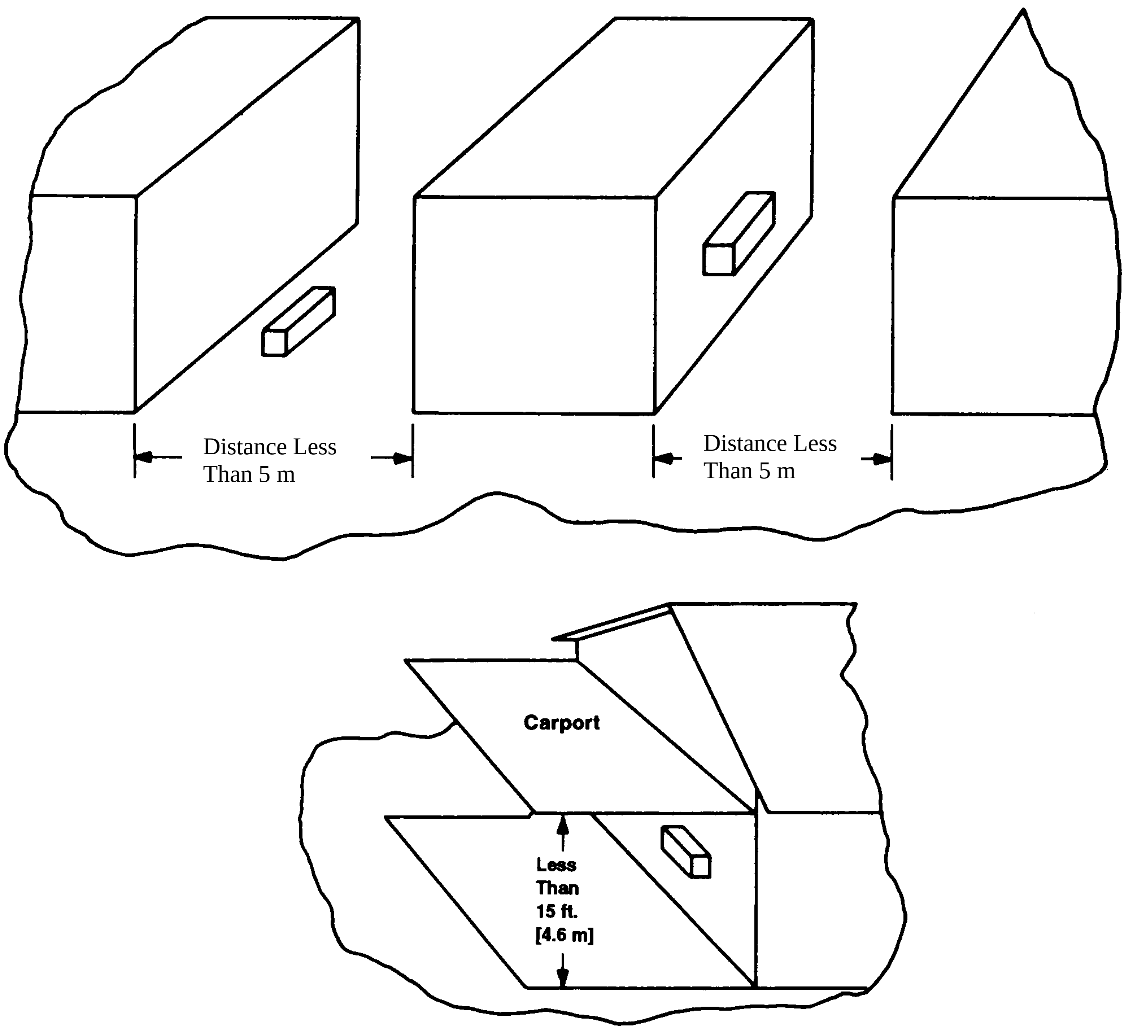

Figure 5. On Ground, Roof, or on Side of Building Wall – Between Two Opposite Reflecting Surfaces

4.1.2 *Barrier Shielding Factor*. This factor accounts for the sound reduction benefit of any solid structure that obstructs the line of sight (or sound) from the equipment location to the point of evaluation. Such a barrier may be the corner of a building, the edge of a roof, or a heavy wall of masonry, etc., built for the specific purpose of shielding noise from a unit to an area of concern. See Table 2 for the normal Barrier Shielding Factors and Figures 6 through 9 for illustrative examples.

Table 2. Application Factors for Estimating A-weighted Sound Pressure Level(s) (Barrier Shielding Factor)

L^1, m	0.15	0.3	0.6	0.9	1.8	3.7
Factor Value, dB	4	7	10	12	15	17

Note:
1. The value for L is calculated using Equation 1.

$$L = L_1 + L_2 - D \qquad (1)$$

Where:

$L_1 + L_2$ = Distance from equipment to point of evaluation around barrier, m (Use minimum $L_1 + L_2$ value)
D = Direct distance from source to point of evaluation with no barrier, m (Determine D by layout sketch)

Sound reduction benefits can be gained when a solid structure obstructs the sound path. Examples of these structures are illustrated in Figures 6 through 9.

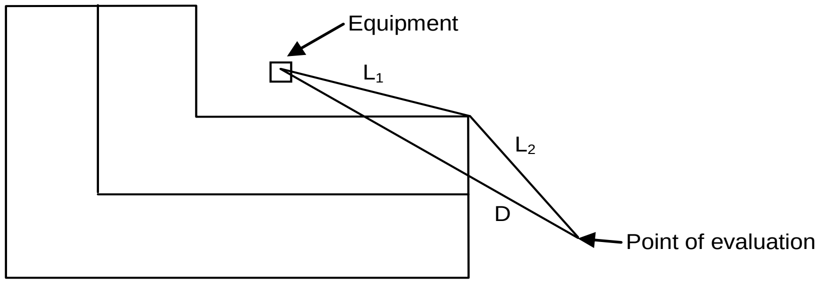

Figure 6. Corner of Building (Top View)

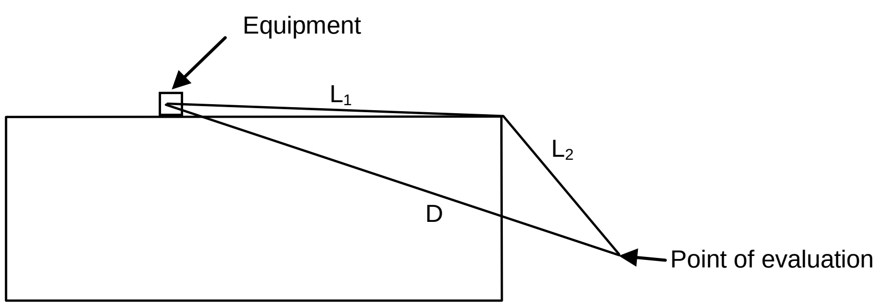

Figure 7. Corner of Flat Roof and Wall (Plan View)

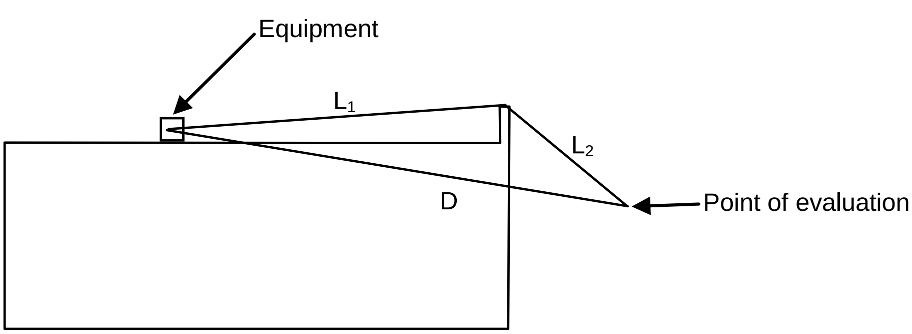

Figure 8. Parapet Around Flat Roof (Plan View)

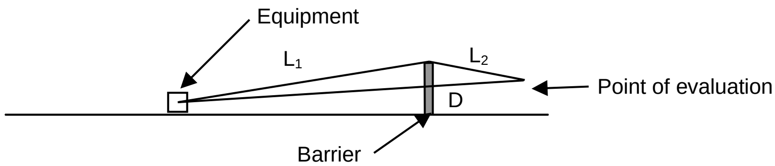

Figure 9. Heavy Continuous Wall (Plan View)

4.1.3 *Sound Path Factor*. This factor adjusts for the path of sound from the unit to the point of evaluation, which may be to the outdoors only, to a room through open windows, to a room through closed windows, or through a wall. See Table 3.

Table 3. Application Factors for Estimating A-weighted Sound Pressure Level(s) (Sound Path Factor)

Sound Path (see Figure 10)	Sound Path Factor, dB
a. To a point of evaluation outdoors	0
b. To room through open window(s) or open door(s)	10
c. To room through closed single glass window(s) or door	17
d. To room through closed double glass window(s) or solid wall (not illustrated)	23

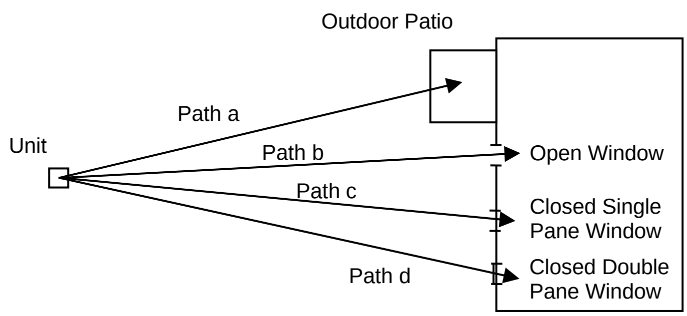

Figure 10. Sound Paths According to Table 3

4.1.4 *Distance Factor*. The distance factor (DF) is a decrease in sound level based on the distance from the source to the point of evaluation that is obtained from Equation 2 and shown as an example in Table 4. The direct distance, D, from the equipment location to the point of evaluation is a very significant application factor in determining the estimated A-weighted Sound Pressure Level(s) resulting from the operation of outdoor equipment in any installation.

$$DF = |-20 \cdot \text{Log}(D) - 8| \qquad (2)$$

Where:

D = Direct distance from source to point of evaluation, m

Table 4. Distance Factor[1]

D, m	1	1.5	2	3	4	6	8	12	16	24	32	48
DF Value, dB	8	12	14	18	20	24	26	30	32	36	38	42

Note:
1. The values in Table 4 are rounded to the nearest whole decibel.

4.2 *Procedure for Estimating the A-weighted Sound Pressure Level(s) - Single Unit Installation*. The basic procedure for estimating A-weighted Sound Pressure Level(s) at a given point of interest consists of summing the A-weighted Sound Power Level Rating of the equipment with the Equipment Location Factor and then subtracting the Barrier Shielding Factor and the Sound Path Factor and the Distance Factor. The resultant will be the estimated A-weighted Sound Pressure Level rounded to the nearest whole decibel as shown in Table 5 (see examples in Sections 4.5.1, 4.5.2 and 4.5.3).

Table 5. Calculation Procedures for Estimating A-weighted Sound Pressure Level

Line	Step
1	Unit A-weighted Sound Level Rating (AHRI Standard 270)
2	Equipment Location Factor (Table 1)
3	Add Lines 1 and 2
4	Barrier Shielding Factor (Table 2)
5	Sound Path Factor (Table 3)
6	Distance Factor (from Equation 2 or Table 4)
7	Add Lines 4, 5 and 6
8	Estimated A-weighted Sound Pressure Level (Subtract Line 7 from Line 3), dBA

4.3 *Procedure for Estimating the A-weighted Sound Pressure Level-multiple Unit Installation*. Estimating the A-weighted Sound Pressure Level for multiple unit installations at any point of interest can be determined by combining the effects of each unit at the point of interest. The procedure for multi-unit installations follows that used for single units except for the additional procedure used to combine levels. The combined A-weighted Sound Pressure Level for multiple units can be calculated following the equation in Section 4.3.1 or approximated following the tabular approach in Section 4.3.2. For an example of a multi-unit installation see example in Section 4.5.4.

4.3.1 The combined A-weighted Sound Pressure Level for multiple units can be found by logarithmically adding the A-weighted Sound Pressure Level of the individual units per Equation 3.

$$L_{pcA} = 10 \cdot \mathrm{Log}\left(\sum_{i=1}^{t} 10^{\frac{L_{piA}}{10}}\right) \qquad 3$$

Where:

L_{pcA} = Combined A-weighted Sound Pressure Level from all units (Rounded to the nearest whole decibel), dBA
L_{piA} = Individual A-weighted Sound Pressure Level from each unit, dBA
t = Number of units

4.3.2 The combined A-weighted Sound Pressure Level for all units can alternatively be approximated as follows:

4.3.2.1 Determine the numerical difference between the largest and second largest A-weighted Sound Pressure Levels.

4.3.2.2 Using Table 6, find the indicated value and add it to the larger A-weighted Sound Pressure Level from Section 4.3.2.1. This combines the two largest A-weighted Sound Pressure Levels.

4.3.2.3 Determine the numerical difference between this combined A-weighted Sound Pressure Level and the third largest A-weighted Sound Pressure Level. Again, using Table 6, find the indicated value and add it to the combined A-weighted Sound Pressure Level.

4.3.2.4 Continue this combining procedure until the value to be added from Table 6 becomes 0 or until all A-weighted Sound Pressure Levels have been combined.

4.3.2.5 The resulting single A-weighted Sound Pressure Level represents the effect of all units at the point of evaluation.

Table 6. Values Used to Combine Sound Levels for Multi-unit Installations	
Difference Between Levels, dBA	Value to be Added, dBA
0 or 1	3
2, 3, 4, or 5	2
6 or 7	1
greater than 7	0

4.4 *Points of Evaluation*. The calculation procedures described in Sections 4.2 and 4.3 should be made for each area of concern to evaluate the installation from an acoustic standpoint (see Section 4.5). The effects of environmental conditions, such as wind speed and direction, local temperature inversions, and variations in air absorption on estimated sound levels are not included in this procedure. However, at distances less than 50 m, these effects can usually be ignored. The method described above is only applicable if the background level is at least 5 dBA below the calculated level. The background level is the level without the unit(s) operating.

4.5 *Examples*. Calculated values in the following examples are obtained using the equations and rounded to the nearest whole decibel.

4.5.1 *Example 1: Installation with No Barriers and One Reflective Surface*. See Table 7 and Figure 11.

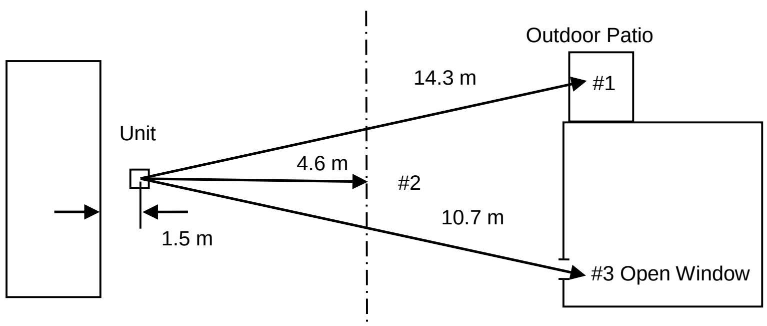

Figure 11. Example 1: Installation with No Barriers and One Reflective Surface (Top View)

Table 7. Estimated A-weighted Sound Pressure Level for Figure 11 Installation Example				
Calculation Steps for Estimating A-weighted Sound Pressure Level		Evaluation Points According to Figure 11		
		#1	#2	#3
1	Unit A-weighted Sound Level Rating (AHRI Standard 270)	68	68	68
2	Equipment Location Factor (Table 1)	3	3	3
3	Add Lines 1 and 2	71	71	71
4	Barrier Shielding Factor (Table 2)	0	0	0
5	Sound Path Factor (Table 3)	0	0	10
6	Distance Factor (from Equation 2 or Table 4)	31	21	29
7	Add Lines 4, 5 and 6	31	21	39
8	Estimated A-weighted Sound Pressure Level, dBA (Subtract Line 7 from Line 3)	40	50	32

4.5.2 *Example 2: Installation with Barriers*. See Table 8 and Figure 12.

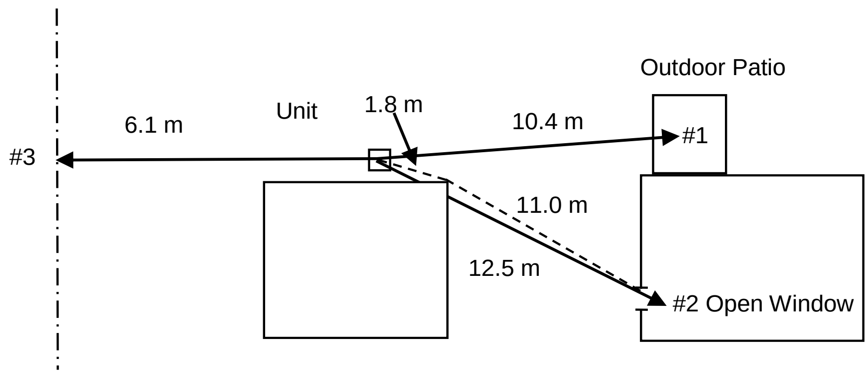

Figure 12. Example 2: Installation with Barriers (Top View)

Table 8. Estimated A-weighted Sound Pressure Level for Figure 12 Installation Example				
Calculation Steps for Estimating A-weighted Sound Pressure Level		Evaluation Points According to Figure 12		
		#1	#2	#3
1	Unit A-weighted Sound Level Rating (AHRI Standard 270)	70	70	70
2	Equipment Location Factor (Table 1)	3	3	3
3	Add Lines 1 and 2	73	73	73
4	Barrier Shielding Factor (Table 2)	0	7	0
5	Sound Path Factor (Table 3)	0	10	0
6	Distance Factor (from Equation 2 or Table 4)	28	30	24
7	Add Lines 4, 5 and 6	28	47	24
8	Estimated A-weighted Sound Pressure Level, dBA (Subtract Line 7 from Line 3)	45	26	49

4.5.3 *Example 3: Installation with Two Reflective Surfaces.* See Table 9 and Figure 13.

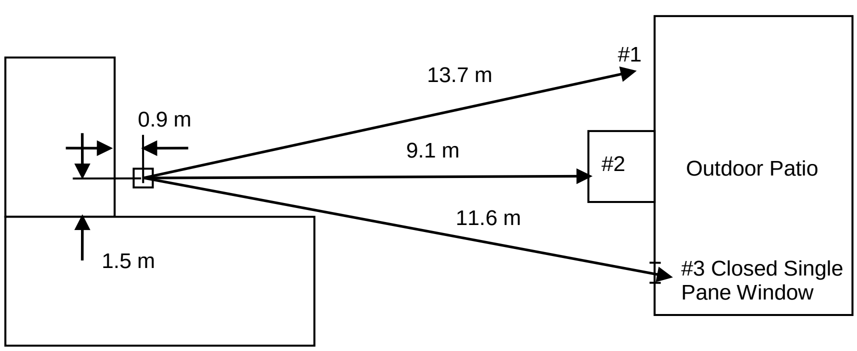

Figure 13. Example 3: Installation with Two Reflective Surfaces (Top View)

Table 9. Estimated A-weighted Sound Pressure Level for Figure 13 Installation Example				
Calculation Steps for Estimating A-weighted Sound Pressure Level		Evaluation Points According to Figure 13		
		#1	#2	#3
1	Unit A-weighted Sound Level Rating (AHRI Standard 270)	71	71	71
2	Equipment Location Factor (Table 1)	6	6	6
3	Add Lines 1 and 2	77	77	77
4	Barrier Shielding Factor (Table 2)	0	0	0
5	Sound Path Factor (Table 3)	0	0	17
6	Distance Factor (from Equation 2 or Table 4)	31	27	29
7	Add Lines 4, 5 and 6	31	27	46
8	Estimated A-weighted Sound Pressure Level, dBA (Subtract Line 7 from Line 3)	46	50	31

4.5.4 *Example 4: Multiple Units.* See Table 10 and Figure 14. For Figure 14, the A-weighted Sound Power Level rating of unit 1 is 68 dBA, the A-weighted Sound Power Level rating of unit 2 is 68 dBA, and the A-weighted Sound Power Level rating of unit 3 is 72 dBA.

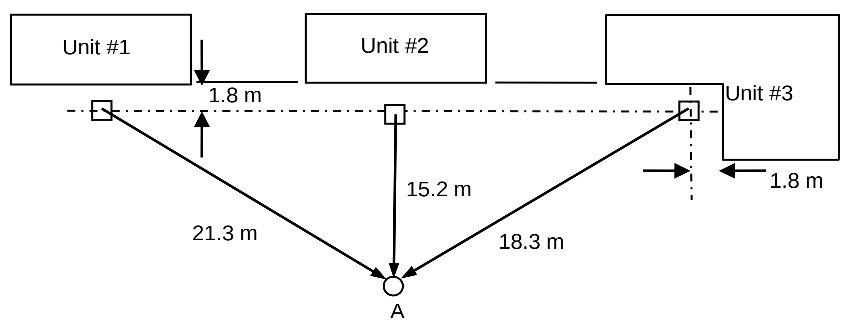

Figure 14. Example 4: Installation with Multiple Units (Top View)

Table 10. Estimated A-weighted Sound Pressure Level for Figure 14 Installation Example				
Calculation Steps for Estimating A-weighted Sound Pressure Level at Evaluation Point A		Units According to Figure 14		
		#1	#2	#3
1	Unit A-weighted Sound Level Rating (AHRI Standard 270)	68	68	72
2	Equipment Location Factor (Table 1)	3	3	6
3	Add Lines 1 and 2	71	71	78
4	Barrier Shielding Factor (Table 2)	0	0	0
5	Sound Path Factor (Table 3)	0	0	0
6	Distance Factor (from Equation 2 or Table 4)	35	32	33
7	Add Lines 4, 5 and 6	35	32	33
8	Estimated A-weighted Sound Pressure Level (Subtract Line 7 from Line 3)	36	39	45
9	Estimated Combined A-Weighted Sound Pressure Level at Point A (sum line 8 levels using Equation 3 or Table 6), dBA	46		

Section 5. Voluntary Conformance

5.1 *Conformance*. While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within the standard's *Purpose* (Section 1) and *Scope* (Section 2) unless such product claims meet all of the requirements of the standard and all of the testing and rating requirements are measured and reported in complete compliance with the standard. Any product that has not met all the requirements of the standard shall not reference, state, or acknowledge the standard in any written, oral, or electronic communication.

APPENDIX A. REFERENCES - NORMATIVE

A1 Listed here are all standards, handbooks, and other publications essential to the formation and implementation of the standard. All references in this appendix are considered part of the standard.

A1.1 AHRI Standard 1230-2014 with Addendum 1, *Performance Rating of Variable Refrigerant Flow (VRF) Multi-split Air-conditioning and Heat Pump Equipment*, 2014, Air-conditioning, Heating, & and Refrigeration Institute, 2311 Wilson Blvd., Suite 400, Arlington, VA 22201, U.S.A.

A1.2 AHRI Standard 210/240-2017, *Unitary Air Conditioning and Air-Source source Heat Pump Equipment*, 2017, Air-conditioning, Heating, & and Refrigeration Institute, 2311 Wilson Blvd., Suite 400, Arlington, VA 22201, U.S.A.

A1.3 AHRI Standard 270-2015 with Addendum 1, *Sound Performance Rating of Outdoor Unitary Equipment*, 2015, Air-conditioning, Heating, and Refrigeration Institute, 2311 Wilson Blvd., Suite 400, Arlington, VA 22201, U.S.A.

A1.4 AHRI Standard 340/360-2015, *Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment*, 2015, Air-conditioning, Heating, and Refrigeration Institute, 2311 Wilson Blvd., Suite 400, Arlington, VA 22201, U.S.A.

A1.5 ANSI/AHRI Standards 1160 (I-P) and 1161 (SI)-2014, *Performance Rating of Heat Pump Pool Heaters*, 2014, Air-conditioning, Heating, & and Refrigeration Institute, 2311 Wilson Blvd., Suite 400, Arlington, VA 22201, U.S.A.

A1.6 ANSI/ASA Standard S1.4 Part 1-2014, *American National Standard Electroacoustics- Sound Level Meters-Part 3: Periodic Tests*, 2014, Acoustical Society of America, 1305 Walt Whitman Road, Suite 300, Melville, NY 11747, U.S.A.

A1.7 *ASHRAE Terminology*, https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology, 2018, ASHRAE, 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A.

APPENDIX B. REFERENCES - INFORMATIVE

B1 Listed here are standards, handbooks and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the standard.

B1.1 ASHRAE Handbook 2015, *HVAC Applications Volume*, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

B1.2 ASHRAE Handbook 2017, *Fundamentals Volume*, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

B1.3 *ASHRAE Load Calculation Applications Manual 2014*, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

APPENDIX C. RECOMMENDED PRACTICES - INFORMATIVE

C1 *Unit Selection*. Sizing should be adequate to handle the heat gains established by use of the ASHRAE Load Calculation Applications Manual or equivalent. More than slight over sizing should be avoided, as this will result in excessive cycling (the end results being both poor thermal control and objectionable acoustical behavior).

C2 *Location*. Outdoor units should be placed on sites chosen to minimize sound heard by building occupants and/or neighbors. This is accomplished by choosing a location that results in the lowest equipment location factor, the highest barrier shielding factor, and/or the greatest distance to sound sensitive areas. (See Section 4 and Tables 1-4).

C.2.1 *Barrier Shielding*. Section 4.1.2 and Table 2 address the sound reduction which would be estimated when barriers exist between a sound source and a point of observation. Using these data, advantage should be taken of any possible barriers offered by existing structures. If a barrier is to be constructed specifically for this purpose, more accurate results can be obtained if the noise emanating from the installed equipment is measured before the barrier design is finalized.

C2.2 *Orientation*. Many items of equipment have a directional pattern of sound radiation. In the absence of such data, it can be assumed that sound will be radiated most strongly in directions normal to the surfaces through which air enters and leaves the equipment. Where permitted by the manufacturer's installation recommendation, the directions of maximum sound radiation from the equipment should be oriented towards the least sensitive locations on the site.

C2.3 *Multiple Unit Locations*. When the Sound Pressure Level for a combination of units exceeds the desired value at the point of evaluation, changes in unit location or sound path should be made to the individual unit that produced the highest single contribution to the Sound Pressure Level. This may not be the unit with the highest Sound Level Rating. When reduction in the combined Sound Pressure Level is required in cases where several units produce equal individual Sound Pressure Levels (they differ by less than 2 dB), changes must be considered for each of these in order to make an overall improvement. Recalculating the combined Sound Pressure Level assuming several possible changes will quickly indicate the most desirable modifications.

C3 *Installation*.

C3.1 *Mounting*. Equipment should be mounted on a substantial foundation. Precast concrete slabs may be used for smaller units, in which case, care should be taken to assure a firm, distributed support for the slab. Equipment intended for mounting in a wall or on a roof should be installed in accordance with the manufacturer's recommendations. It should be ascertained that the building structure at the point of attachment is sufficiently strong and rigid to accept the added load. Equipment which is not intended for mounting to the building structure should not be rigidly attached to a wall or other structure of substantial size which may radiate sound.

C3.2 *Isolation*. Equipment mounted to the building structure should employ a system to isolate vibrations from that structure. An isolation system is desirable in all other cases except possibly the unit mounted to a small foundation slab provided solely for this purpose. (In this case, the manufacturer's recommendations regarding attachment should be followed.) In many cases the manufacturer may have designed isolation into the equipment, or may provide such isolation as an available accessory, or may provide specific recommendations for achieving such isolation. In the absence of such direction, isolators should be chosen in accordance with good practice. (The ASHRAE Handbook, HVAC Applications and Fundamentals Volumes' Chapters on sound and vibration control are references for further discussion of isolation).

C3.3 *Connections*. Ductwork, piping, and electrical conduit all provide potential short circuits to an isolation mount by making rigid connections between the equipment and the building structure. Providing flexible connections in each of these will prove effective in reducing sound transmission. Where flexible connections are not provided, it is desirable to resiliently support electrical service lines and refrigerant piping from the building structure. As a minimum requirement, direct firm contact between such components and the basic building structure should be avoided. Sealing of space between refrigerant lines and the holes provided through walls or roofs should be done with resilient material.

C3.4 *Start-up*. When placed in operation, the equipment should:

C3.4.1 Be adjusted to operate on a recommended cycle for expected conditions (i.e., not cycling excessively).
C3.4.2 Be properly charged, for efficient operation and cycling.
C3.4.3 Have all shipping retainers or tie-downs removed, as specified in installation instructions.
C3.4.4 Have all cabinet elements, access panels, etc., properly and securely fastened in place.
C3.4.5 Be provided with electrical power within the nameplate specifications and tolerances.

Many of these conditions are necessary for proper thermal performance, but all can also affect sound generated by equipment.