2017 Standard for
Method of Measuring
Machinery Sound
Within an Equipment Space
IMPORTANT

SAFETY DISCLAIMER

AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with this standard/guideline. It is strongly recommended that products be designed, constructed, assembled, installed and operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk.

Note:
This standard supersedes ANSI/AHRI Standard 575-2008.

Foreword

This document establishes a uniform method of measuring and recording the sound levels produced by air-conditioning and refrigerating machinery installed in mechanical equipment spaces. However, it should be emphasized that this standard was developed for use where the test conditions usually cannot be controlled, e.g., ambient temperature; equipment loading; physical attributes of the space; background sound sources, etc. Since the results obtained may vary substantially, a tolerance on these results cannot be specified.

Uniform practices in making sound level measurements are necessary for effective communication between the owner, the architect, the acoustician, the consulting engineer, the contractor and the equipment manufacturer.

If ratings or specifications for sound power levels of water-cooled chillers are needed, AHRI Standard 1280 defines the proper procedure to obtain this information.

Specifications for sound levels produced by machinery may be written, both for the purpose of supplying information in order to evaluate compliance with noise exposure limits and for the purpose of providing information for adequate building design to meet the acoustical design goals of adjacent occupied spaces. In view of the geometrical and acoustical properties of large equipment, both purposes can be served by sound data expressed in terms of Sound Pressure Level measured close to the equipment.

This standard is based upon the procedures established in ANSI Standard S1.13.
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1</td>
<td>Purpose</td>
<td>1</td>
</tr>
<tr>
<td>Section 2</td>
<td>Scope</td>
<td>1</td>
</tr>
<tr>
<td>Section 3</td>
<td>Definitions</td>
<td>1</td>
</tr>
<tr>
<td>Section 4</td>
<td>Instruments</td>
<td>2</td>
</tr>
<tr>
<td>Section 5</td>
<td>Sound Measurements and Calculation Procedures</td>
<td>2</td>
</tr>
<tr>
<td>Section 6</td>
<td>Machinery Sound Specifications and Data Presentation</td>
<td>4</td>
</tr>
<tr>
<td>Section 7</td>
<td>System Operating Conditions</td>
<td>5</td>
</tr>
<tr>
<td>Section 8</td>
<td>Conformance Conditions</td>
<td>5</td>
</tr>
</tbody>
</table>

### TABLES

| Table 1     | Octave Band Center Frequencies                                       | 3    |

### FIGURES

| Figure 1    | Test Unit Measurement Points                                         | 3    |

### APPENDICES

| Appendix A  | Reference – Normative                                               | 6    |
| Appendix B  | Reference – Informative                                              | 6    |
| Appendix C  | Operating Conditions – Informative                                   | 7    |
| Appendix D  | Example of Sound Level Recording Format Per AHRI Standard 575–Informative | 11   |

### FIGURES FOR APPENDICES

| Figure D1   | Example Sketch Showing Microphone Locations, Orientation of Test Unit, Key Measurement Points and Surroundings | 12   |
TABLE OF CONTENTS (CONTINUED)

FORMS

<table>
<thead>
<tr>
<th>Form C1.</th>
<th>Centrifugal Chiller Operational Data Recording Form Per AHRI Standard 575</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form C2.</td>
<td>Reciprocating, Screw or Scroll Chiller Operational Data Recording Form Per AHRI Standard 575</td>
<td>8</td>
</tr>
<tr>
<td>Form C3.</td>
<td>Absorption Chiller Operational Data Recording Form Per AHRI Standard 575</td>
<td>9</td>
</tr>
<tr>
<td>Form C4.</td>
<td>Pump Operational Data Recording Form Per AHRI Standard 575</td>
<td>10</td>
</tr>
</tbody>
</table>
METHOD OF MEASURING MACHINERY SOUND WITHIN AN EQUIPMENT SPACE

Section 1. Purpose

1.1 Purpose. The purpose of this standard is to establish for machinery installed in a mechanical equipment space: definitions; instruments; sound measurement and calculation procedures; machinery sound specifications and data presentation; system operating conditions; and conformance conditions. It is not the intent of this standard to be used for the sound rating of equipment.

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 water chilling systems, pumps and similar operating machines and parts thereof, which for reasons of size or operating characteristics are more practically evaluated in situ. Furthermore, this standard provides an indication of occupational exposure.

2.2 Exclusions. Measurements for sound power ratings for water-cooled chillers shall be conducted according to AHRI Standard 1280.

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 A-weighted Sound Pressure Level. The measured value obtained with a sound level meter using its A-weighting network.

3.2 Key Measurement Points. Locations on the measurement parallelepiped at the center of each vertical plane.

3.3 Octave Band. A band of sound covering a range of frequencies such that the highest is twice the lowest.

3.4 Operating Conditions. Those conditions specified for a particular installation. In general, they are those parameters listed in the job specification sheets for the particular equipment. Examples of parameters to be recorded are found on data forms in Appendix C.

3.5 Representative A-weighted Sound Pressure Level (A_h). An average A-weighted Sound Pressure Level from a measurement made with a majority of measurement points not affected by nearby reflective surfaces.

3.6 Representative High Limit A-weighted Sound Pressure Levels (A_h). An average A-weighted Sound Pressure Level from a measurement made with a majority of measurement points affected by reflections from nearby surfaces. The value represents an upper bound to the representative A-weighted value.

3.7 Representative High Limit Octave Band Sound Pressure Level (OB_h). An average Octave Band Sound Pressure Level calculated from a measurement made with more than two Key Measurement Points affected by reflections from nearby surfaces.
3.8 **Representative Octave Band Sound Pressure Levels (OB<sub>R</sub>).** An average Octave Band Sound Pressure Level calculated from a measurement made with two or less Key Measurement Points affected by reflections from nearby surfaces.

3.9 "**Shall**" or "**Should.**" "Shall" or "Should," shall be interpreted as follows:

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

- **3.9.2 Should.** "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.10 **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.

3.11 **Sound Pressure Level.** Ratio of the Sound Pressure to a reference of 20 micropascals, expressed in decibels. The reference of 20 micropascals is the threshold of human hearing.

- **3.11.1 Octave Band Sound Pressure Level.** A Sound Pressure Level measured when using an octave band filter as defined in ANSI/ASA Standard S1.11 Part 1.

3.12 **Uncertain Measurement Point.** A location where sound energy of other sources causes the observed value to be above its true value.

3.13 **Valid Measurement Point.** A location where other equipment or adjacent surfaces do not significantly affect the value observed.

### Section 4. Instruments

4.1 **Sound Pressure Measurement Hardware.** A meter meeting the requirements of the Type 1 meter described in ANSI Standard S1.4 or an equivalent spectrum analyzer, data acquisition system and microphone(s) combination shall be used.

4.2 **Calibration.** During each series of measurements, an acoustical calibrator with an accuracy of ±0.5 dB shall be applied to the microphone for checking the calibration of the entire measuring system at one or more frequencies over the frequency range of interest. The calibrator shall be checked at the manufacturer's recommended intervals or at least once every year to verify that its output has not changed. In addition, an electrical calibration of the instrumentation system over the entire frequency range of interest shall be performed periodically as recommended by the manufacturer, but at intervals of not more than two years.

### Section 5. Sound Measurements and Calculation Procedures

5.1 **Measurements.**

- **5.1.1 Measurement Points.** The measurement points shall be determined relative to a reference parallelepiped, which is the smallest imaginary rectangular parallelepiped that will enclose the machine, shown in Figure 1. Minor projections from the machine are disregarded in determining the size of the reference parallelepiped.

The measurement points shall be positioned on the surface of a measurement parallelepiped whose planes are one meter out from the vertical sides of the reference parallelepiped. Key Measurement Points are located at the center of each vertical plane of the measurement parallelepiped. The remaining measurement points are at one meter intervals on the measurement planes starting from the Key Measurement Points. All measurement points are at a height of 1.5 m from the floor. If the shortest distance between two measurement
points at a corner of the measurement parallelepiped is less than one meter, the point nearest to the corner shall be eliminated. The total number of points on the measurement parallelepiped is \( N \).

Figure 1. Test Unit Measurement Points

5.1.2 Measurement Time Interval. An integrating, averaging device is preferred and the signal shall be averaged for a minimum of 8 seconds. If a sound level meter is used it shall be set in the slow response position. The instrument manufacturer’s recommendations shall be followed in using the sound level meter and in determining the correct microphone orientation for the flattest frequency response.

5.1.3 Data to be Taken. At a minimum, A-weighted sound pressure level measurements shall be taken at all measurement points. Octave band measurements (63 through 8,000 Hz octave band center frequencies) shall be made at the four Key Measurement Points. The octave band center frequencies are listed in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Octave Band Center Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Octave Band</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
</tbody>
</table>

A full set of measurements shall be taken with the test unit operating. A second full set of data shall be obtained with the test unit off and all other equipment in the area operating as before to establish the background sound levels.
5.1.4 Valid Measurement Points. A Valid Measurement Point cannot be closer than one meter to a wall or other plane surface larger than 1 square meter. A measurement shall not be recorded at any measurement point that does not meet this criterion. The number of invalid measurement points is \( N_1 \).

5.2 Calculation Procedures.

5.2.1 Uncertain Measurements Due to Background Noise. Any A-weighted or Octave Band Sound Pressure Level taken with the test unit operating must be at least 6 dB above the corresponding level with the test unit off and other equipment operating. Any level which does not meet this criterion shall be marked uncertain by the use of an asterisk (*). The number of Uncertain Measurement Points is \( N_U \).

5.2.2 Representative A-weighted Sound Pressure Level (\( A_R \)). If half or more of the measurement points remain (that is, if \( N - N_U - N_I \geq N/2 \)) after applying the limitations of Sections 5.1.4 and 5.2.1, \( A_R \) shall be calculated using Equation 1. However, if less than half remain, \( A_H \) shall be calculated per Section 5.2.4.

5.2.3 Representative Octave Band Sound Pressure Levels (\( OB_R \)). If two or more Key Measurement Points remain after applying the limitations of Sections 5.1.4 and 5.2.1, \( OB_R \), shall be calculated using Equation 1. However, if less than two remain \( OB_H \) shall be calculated per Section 5.2.5.

5.2.4 Representative High Limit A-weighted Sound Pressure Levels (\( A_H \)). If half or more of the measurement points can be obtained by adding the uncertain to the Valid Measurement Points (that is, if \( N - N_I \geq N/2 \)), \( A_H \) can be calculated using Equation 1 below with \( N_U = 0 \). If this criteria cannot be met, neither \( A_R \) nor \( A_H \) can be obtained.

5.2.5 Representative High Limit Octave Band Sound Pressure Level (\( OB_H \)). If two or more Key Measurement Points can be obtained by adding the uncertain points to the Valid Measurement Points \( OB_H \) can be calculated using Equation 1. If this criteria cannot be met, neither \( OB_R \) nor \( OB_H \) can be obtained.

5.2.6 Sound Pressure Level Averaging Equation.

\[
L = 10 \cdot \log_{10} \left[ \sum_{i=1}^{n} 10^{L_i/10} \right] - 10 \cdot \log_{10} n
\]  

Where:

\( L \) = Representative or high limit sound pressure level logarithmic average rounded to the nearest 0.5 dB
\( L_i \) = Sound Pressure Level at the measured points, dB
\( n \) = Number of points to be averaged = \((N - N_U - N_I)\)

Section 6. Machinery Sound Specifications and Data Presentation

6.1 Sound Level Specifications. Information required for specifying machinery sound levels should include the following:

6.1.1 Machine description.
6.1.2 \( A_R \).
6.1.3 If desired, optional \( OB_R \).
6.1.4 Operating Conditions at which, \( A_R \), and \( OB_R \), are specified within Section 6.

6.2 Data Presentation. When a sound test is conducted in accordance with this standard, a report shall be supplied and it shall include the information in Sections 6.2.1, 6.2.2 and 6.2.3. In addition, if specified by the user, the data defined in Section 6.2.4 shall be provided.

6.2.1 Statement that the test was conducted in accordance with AHRI Standard 575.
6.2.2 Description of the machine, the Operating Conditions and a sketch or an image showing the test layout and microphone locations, orientation of test unit, key measurement points, and surroundings. The valid and invalid measurement points shall be included in the description. (see Appendix D for sample calculation).

6.2.3 $A_R$ or $A_H$ as calculated per Section 5.2. $A_H$ will be reported only if the data for computing $A_R$ cannot be obtained. If the latter course is followed, the reasons the $A_R$ cannot be obtained shall be submitted to the user.

6.2.4 $OB_R$, or $OB_H$, in the 63 Hz through 8,000 Hz bands, inclusive, as the calculated high limit. $OB_H$ levels, calculated per Section 5.2, shall only be reported in the case that $OB_R$ levels cannot be obtained. If the latter course is followed, the reasons the lower value $OB_R$ cannot be obtained shall be submitted to the user.

Section 7. System Operating Conditions

7.1 *Operating Conditions for Test.* Sound tests shall be made with the machine operating at design Operating Conditions. If this operating point cannot be obtained, the sound test may be made at some other steady state condition mutually agreed upon by the parties concerned. This condition shall clearly be described in the test report. See Appendix C for examples of typical recording forms.

Section 8. Conformance Conditions

8.1 *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 cannot 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 as part of the standard.


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.

None.
APPENDIX C. OPERATING CONDITIONS – INFORMATIVE

The following data forms shown in this appendix are intended as a guide to ensure that adequate data are recorded. Because of the wide range of machinery which can be expected to be installed in building machinery spaces, a universal data form is not practical. If the attached forms are not adequate, one should be tailored to meet individual requirements.

FORM C1. CENTRIFUGAL CHILLER OPERATIONAL DATA RECORDING FORM
PER AHRI STANDARD 575

**MACHINE SPECIFICATIONS:**

<table>
<thead>
<tr>
<th>Model:</th>
<th>Manufacturer:</th>
<th>Serial Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Compressor Speed:</td>
<td>rpm</td>
<td>Capacity: ton [kW]</td>
</tr>
<tr>
<td>Rated Load Current:</td>
<td>A</td>
<td>Voltage: V</td>
</tr>
<tr>
<td>Type of Driver:</td>
<td></td>
<td>Refrigerant:</td>
</tr>
<tr>
<td>Auxiliaries, such as Gears:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TEST CONDITIONS:**

<table>
<thead>
<tr>
<th>Suction Temperature/Pressure</th>
<th>°F [°C]/ psig [kPag]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water Temperature In/Out</td>
<td>°F [°C]/ psig [kPag]</td>
</tr>
<tr>
<td>Chilled Water Pressure In/Out</td>
<td>psig [kPag]/ psig [kPag]</td>
</tr>
<tr>
<td>Discharge Temperature/Pressure</td>
<td>°F [°C]/ psig [kPag]</td>
</tr>
<tr>
<td>Condenser Water Temperature In/Out</td>
<td>°F [°C]/ psig [kPag]</td>
</tr>
<tr>
<td>Condenser Water Pressure In/Out</td>
<td>psig [kPag]/ psig [kPag]</td>
</tr>
<tr>
<td>Interstage(s) Temperature/Pressure</td>
<td>°F [°C]/ psig [kPag]</td>
</tr>
<tr>
<td>Compressor Speed</td>
<td>rpm</td>
</tr>
<tr>
<td>Compressor Capacity Control Position</td>
<td>%</td>
</tr>
<tr>
<td>Driver Speed</td>
<td>rpm</td>
</tr>
<tr>
<td>Electric Motor Current and Voltage</td>
<td>A</td>
</tr>
<tr>
<td>Steam Turbine Pressures:</td>
<td></td>
</tr>
<tr>
<td>Before Control Valve</td>
<td>psig [kPag]</td>
</tr>
<tr>
<td>Steam Chest</td>
<td>psig [kPag]</td>
</tr>
<tr>
<td>Condenser</td>
<td>psig [kPag]</td>
</tr>
<tr>
<td>Atmospheric Pressure</td>
<td>in Hg [kPa]</td>
</tr>
</tbody>
</table>
FORM C2. RECIPROCATING, SCREW OR SCROLL CHILLER OPERATIONAL DATA RECORDING FORM PER AHRI STANDARD 575

MACHINE SPECIFICATIONS:

Model: ____________________ Manufacturer: ____________________ Serial Number: ____________________

Rated Compressor Speed: ______________ rpm Capacity: ______________ tonR [kW]

Rated Load Current: ______________ A Voltage: ______________ V

Type of Driver: ____________________ Refrigerant: ____________________

Auxiliaries, such as Gears: ____________________

Comments: ____________________

TEST CONDITIONS:

Suction Temperature/Pressure ______________ °F [°C]/ ______________ psig [kPag]

Chilled Water Temperature In/Out ______________ °F [°C]/ ______________ °F [°C]

Chilled Water Pressure In/Out ______________ psig [kPag]/ ______________ psig [kPag]

Discharge Temperature/Pressure ______________ °F [°C]/ ______________ kPag

Condenser Water Temperature In/Out ______________ °F [°C]/ ______________ °F [°C]

Condenser Water Pressure In/Out ______________ psig [kPag]/ ______________ psig [kPag]

Number of Compressors ____________________

Number and Location of Compressors Running ____________________

_______________________

Compressor Speed or Unloading Stage ______________ rpm

Electric Motor Current and Voltage – Compressor 1 ______________ A ______________ V

2 ______________ A ______________ V

3 ______________ A ______________ V

4 ______________ A ______________ V
FORM C3. ABSORPTION CHILLER OPERATIONAL DATA RECORDING FORM
PER AHRI STANDARD 575

MACHINE SPECIFICATIONS:

Model: ____________________ Manufacturer: ____________________ Serial Number: ____________________
Pump speed: ________________ rpm  Capacity: ________________ ton/hr [Kw]
Heat Source:  Steam: ☐  Hot Water: ☐  Direct Fired ☐
Rated Steam Pressure: ________________ psig [kPag]  Rated Hot Water Temperature: ________________ °F [°C]
Type and Location of Control Valve: ________________  Valve Position ______% open
Comments: ____________________

TEST CONDITIONS:

Chilled Water Temperature In/Out  ________________ °F [°C]/  ________________ °F [°C]
Chilled Water Pressure In/Out  ________________ psig [kPag]/  ________________ psig [kPag]
Condenser Water Temperature—Absorber In/Out  ________________ °F [°C]/  ________________ °F [°C]
Condenser Water Pressure—Absorber In/Out  ________________ psig [kPag]/  ________________ psig [kPag]
Condenser Water Temperature—Condenser In/Out  ________________ °F [°C]/  ________________ °F [°C]
Condenser Water Pressure—Condenser In/Out  ________________ psig [kPag]/  ________________ psig [kPag]
Capacity Control Valve  ____________________
Steam (Hot Water) Pressure at Control Valve
Upstream/Downstream  ________________ psig [kPag]/  ________________ psig [kPag]
Atmospheric Pressure  ________________ in Hg [KPa]
Steam (Hot Water) Temperature at Control Valve
Upstream/Downstream  ________________ °F [°C]/  ________________ °F [°C]
FORM C4. PUMP OPERATIONAL DATA RECORDING FORM
PER AHRI STANDARD 575

MACHINE SPECIFICATIONS:

Model: ____________________  Manufacturer: ____________________  Serial Number: ____________________

Rated Pump Speed: ______________ rpm  Capacity: ______________ GPM [L/s]

Rated Load Current: ______________ A  Voltage: ______________ V

Type of Driver: ____________________  Type of Pump: ____________________

Auxiliaries, such as Gears: ____________________

Comments: ____________________

TEST CONDITIONS:

Fluid Being Pumped: ____________________

Suction Temperature/Pressure: ______________ °F [°C]/ ______________ psig [kPag]

Discharge Temperature/Pressure: ______________ °F [°C]/ ______________ psig [kPag]

Pump Speed: ______________ rpm

Driver Speed: ______________ rpm

Electric Motor Current and Voltage: ______________ A  ______________ V

Note: If there are more than one pump please use multiple forms.
APPENDIX D. EXAMPLE OF SOUND LEVEL RECORDING FORMAT PER AHRI STANDARD 575 – INFORMATIVE

Unit Type _______________________
Model Number ____________________
Serial Number ____________________

<table>
<thead>
<tr>
<th>Measurement Points</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Unit On</td>
<td>89</td>
<td>88</td>
<td>87</td>
<td>89</td>
<td>91</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>88</td>
<td>87</td>
<td>87</td>
<td>87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Unit OFF</td>
<td>80</td>
<td>81</td>
<td>82</td>
<td>81</td>
<td>80</td>
<td>81</td>
<td>80</td>
<td>78</td>
<td>79</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A-weighted Sound Pressure Level ($A_R$ or $A_H$), dBA

<table>
<thead>
<tr>
<th>Hz</th>
<th>Octave Band Sound Pressure Levels at Key Measurements Points</th>
<th>Average Octave Band Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>77* (Note B) 75</td>
<td>81* (Note B) 76</td>
</tr>
<tr>
<td>125</td>
<td>83 70</td>
<td>84 70</td>
</tr>
<tr>
<td>250</td>
<td>85 72</td>
<td>87 71</td>
</tr>
<tr>
<td>500</td>
<td>86 74</td>
<td>88 71</td>
</tr>
<tr>
<td>1,000</td>
<td>85 73</td>
<td>86 74</td>
</tr>
<tr>
<td>2,000</td>
<td>80 72</td>
<td>77* 72</td>
</tr>
<tr>
<td>4,000</td>
<td>84* (Note B) 82</td>
<td>82* (Note B) 81</td>
</tr>
<tr>
<td>8,000</td>
<td>73 55</td>
<td>73 56</td>
</tr>
</tbody>
</table>

*Indicates Uncertain Measurements Points (see Section 5.2.1 of standard)
Note A: No measurements can be taken at these points because they are less than 1 meter from large surfaces (see Section 5.1.4).

Note B: A Valid Measurement must be 6 dB above the ambient (see Section 5.2.1). Final results using these values less than 6 dB above background result in representative high limit values.

Note C: Thirteen Valid Measurements exist out of a possible 24 measurements. This is greater than half, and a value of $A_R$ can be obtained. See Section 5.2.2.

Figure D1. Example Sketch Showing Microphone Locations, Orientation of Test Unit, Key Measurement Points and Surroundings
SAMPLE CALCULATIONS

Sample calculation for a water chiller where the measurement procedure is complicated by:

1) The close proximity of a wall,
2) The close proximity of a water tank,
3) High background level in the 63 Hz band.

To obtain the Representative A-weighted Sound Pressure Level ($A_R$):

$$A_R = 10 \cdot \log \left[ \frac{1}{10} \left( \frac{10^{89/10} + 10^{88/10} + 10^{87/10}}{10^{87/10} + 10^{86/10} + 10^{85/10} + 10^{84/10} + 10^{83/10} + 10^{82/10} + 10^{81/10} + 10^{80/10} + 10^{79/10} + 10^{78/10}} \right) \right] - 10 \cdot \log(13)$$

$$A_R = 100.1 - 11.1$$

$$= 89.0 \text{ dB (Note C)}$$

To obtain the Representative Octave Band Sound Pressure Level ($OBR$) or Representative High Limit Octave Band Sound Pressure Level ($OBH$) at 1 Meter:

For the 63 Hz Band:

$$(\text{Note B})$$

$$OBR = 10 \cdot \log \left( \frac{10^{77/10} + 10^{81/10}}{2} \right) - 10 \cdot \log (2)$$

$$OBR = 79.4 \text{ dB; use 79.5* dB}$$

For the 125 Hz Band:

$$OBR = 10 \cdot \log \left( \frac{10^{83/10} + 10^{84/10}}{2} \right) - 10 \cdot \log (2)$$

$$OBR = 83.4 \text{ dB; use 83.5 dB}$$

For the 2,000 Hz Band:

$$OBR = 10 \cdot \log \left( \frac{10^{80/10} + 10^{77/10}}{2} \right) - 10 \cdot \log (2)$$

$$OBR = 78.8 \text{ dB; use 79.0* dB}$$

For the 4,000 Hz Band:

$$OBR = 10 \cdot \log \left( \frac{10^{84/10} + 10^{82/10}}{2} \right) - 10 \cdot \log (2)$$

$$OBR = 83.1 \text{ dB; use 83.0* dB}$$