

# ANSI/AMCA Standard 320-08 (R2013)

## Laboratory Methods of Sound Testing of Fans Using Sound Intensity

An American National Standard Approved  
by ANSI on September 17, 2013



**AIR MOVEMENT AND CONTROL  
ASSOCIATION INTERNATIONAL, INC.**

The International Authority on Air System Components

**ANSI/AMCA STANDARD 320-08  
(R2013)**

**Laboratory Method of Sound Testing  
of Fans Using Sound Intensity**



**Air Movement and Control Association International, Inc.  
30 West University Drive  
Arlington Heights, IL 60004-1893**

© 2013 by Air Movement and Control Association International, Inc.

All rights reserved. Reproduction or translation of any part of this work beyond that permitted by Sections 107 and 108 of the United States Copyright Act without the permission of the copyright owner is unlawful. Requests for permission or further information should be addressed to the Executive Director, Air Movement and Control Association International, Inc. at 30 West University Drive, Arlington Heights, IL 60004-1893 U.S.A.

### **Authority**

ANSI/AMCA Standard 320 was adopted by the membership of the Air Movement and Control Association International, Inc. on May 6, 2007. It was approved as an American National Standard on April 18, 2008. It was reaffirmed on September 17, 2013.

### **AMCA 320 Review Committee**

|                    |  |
|--------------------|--|
| Tim Mathson, Chair | Greenheck Fan Corporation                    |
| Dr. John Cermak    | Acme Engineering & Manufacturing Corporation |
| Joseph Langford    | American Coolair Corp.                       |
| David Ortiz        | Soler & Palau, S.A. de C.V.                  |
| Jeff Hill          | Cleanpak International                       |
| Thomas Gustafson   | Hartzell Fan, Inc.                           |
| Dr. John Murphy    | JOGRAM, Inc.                                 |
| Tan Tin Tin        | Kruger Ventilation Industries Pte. Ltd.      |
| Iain Kinghorn      | Flaktwoods                                   |
| Ray Sexton         | Matthews & Yates                             |
| Joe Pope           | Pope Engineering Company                     |
| Boyd Kunze         | The New York Blower Company                  |
| Scott Hausmann     | The Trane Co.                                |
| Rad Ganesh         | Twin City Fan Companies, Ltd.                |
| Kim Osborn         | Governair Corporation                        |
| Kurt Eichelberger  | York, a Johnson Controls Company             |
| Tom Paige          | Kinetics Noise Control, Inc.                 |
| Bob Valbracht      | Loren Cook Company                           |
| Ralph Susey        | Howden Buffalo, Inc.                         |
| Mark Stevens       | AMCA International, Inc.                     |
| Joseph Brooks      | AMCA International, Inc.                     |

## **Disclaimer**

AMCA uses its best efforts to produce standards for the benefit of the industry and the public in light of available information and accepted industry practices. However, AMCA does not guarantee, certify or assure the safety or performance of any products, components or systems tested, designed, installed or operated in accordance with AMCA standards or that any tests conducted under its standards will be non-hazardous or free from risk.

## **Objections to AMCA Standards and Certifications Programs**

Air Movement and Control Association International, Inc. will consider and decide all written complaints regarding its standards, certification programs, or interpretations thereof. For information on procedures for submitting and handling complaints, write to:

Air Movement and Control Association International  
30 West University Drive  
Arlington Heights, IL 60004-1893 U.S.A.

## **Foreword**

This standard was developed in response to the need for an accurate and reliable method of determining the sound power level of fan equipment without special acoustical facilities such as anechoic, hemi-anechoic, or reverberant rooms. It allows for smaller and larger fans to be tested than was possible previously in the AMCA laboratory using ANSI/AMCA 300 Reverberant Room Method for Sound Testing of Fans. This standard combines the established fan installation and operation procedures of ANSI/AMCA 300 with the method of sound power determination using sound intensity measurements in ANSI S12.12 American National Standard Engineering Method for the Determination of Sound Power Levels of Noise Sources Using Sound Intensity.

Since sound power levels are considered to be independent of the acoustical environment around the fan, a good comparison may be made between two or more fans proposed for any specific air performance condition. Moreover, these values establish an accurate base for estimating the acoustical outcome of the fan installation in terms of sound pressure levels. A successful estimate of sound pressure levels requires extensive information on the fan and the environment in which it is to be located.

It is often advantageous for the equipment user to employ acoustical consultation to ensure that all factors which affect the final sound pressure levels are considered. More detailed information on the complexity of this situation may be found in other documents available elsewhere.

## TABLE OF CONTENTS

|  |    |
|--|----|
| <b>1. Scope</b>  | 1  |
| <b>2. Normative References</b>   | 1  |
| <b>3. Definitions / Units of Measure / Symbols</b>   | 2  |
| 3.1 Definitions  | 2  |
| 3.2 Symbols (Table 2)  | 3  |
| <b>4. Instruments and Methods of Test</b>  | 4  |
| 4.1 Sound pressure microphones   | 4  |
| 4.2 Sound intensity probes   | 4  |
| 4.3 Frequency analyzer   | 4  |
| 4.4 Reference sound source (RSS)   | 4  |
| 4.5 Frequency response of instrumentation system   | 5  |
| 4.6 Transducer and instrumentation system calibration checks                                   | 5  |
| 4.7 Performance verification   | 5  |
| 4.8 Test method  | 6  |
| <b>5. Equipment and Test Setups</b>  | 6  |
| 5.1 Test environment   | 6  |
| 5.2 Fan installation   | 7  |
| 5.3 Measurement surface  | 7  |
| 5.4 Reference sound source (RSS)   | 7  |
| <b>6. Observations and Conduct of Test</b>   | 8  |
| 6.1 Information to be recorded   | 8  |
| 6.2 Measurement techniques and requirements  | 9  |
| 6.3 Measurements   | 9  |
| <b>7. Calculations</b>   | 10 |
| 7.1 Surface average levels $\overline{L}_{pb}$ , $\overline{L}_{lf}$ , and $\overline{L}_{lq}$ | 10 |
| 7.2 Background noise criterion   | 11 |

|                 |  |           |
|-----------------|--|-----------|
| 7.3             | Convergence index $\delta_{WN}$ .....  | 11        |
| 7.4             | Reference sound source adjustment $R_w$ .....  | 11        |
| 7.5             | Sound power level $L_w$ .....  | 11        |
| <b>8.</b>       | <b>Results and Report</b> .....  | <b>12</b> |
| 8.1             | Accuracy of results .....  | 12        |
| 8.2             | Presentation of results .....  | 12        |
| 8.3             | Results .....  | 12        |
| 8.4             | Minimum information to be reported .....   | 12        |
| <b>Annex A.</b> | <b>Indicators for Use in Case of Difficulty (Informative)</b> .....                    | <b>18</b> |
| <b>Annex B.</b> | <b>Duct End Reflection Correction (Normative)</b> .....                                | <b>19</b> |
| B.1             | General .....  | 19        |
| B.2             | End reflection curves .....  | 19        |
| <b>Annex C.</b> | <b>Testing of Large Fan Equipment (Informative)</b> .....                              | <b>23</b> |
| C.1             | General .....  | 23        |
| C.2             | Procedure .....  | 23        |
| C.3             | Results .....  | 23        |
| <b>Annex D.</b> | <b>Radiation of Sound by Fan Casing (Informative)</b> .....                            | <b>24</b> |
| D.1             | General .....  | 24        |
| D.2             | Setup .....  | 24        |
| D.3             | Measurements .....   | 24        |
| <b>Annex E.</b> | <b>Uncertainties (Informative)</b> .....   | <b>26</b> |
| <b>Annex F.</b> | <b>Alternative Procedures for RSS Calibration (Normative)</b> .....                    | <b>27</b> |
| F.1             | General .....  | 27        |
| F.2             | Normative references for this annex .....  | 27        |
| F.3             | Sound intensity measurements alternative procedure .....                               | 27        |
| F.4             | Transfer calibration alternative procedure .....                                       | 27        |
| <b>Annex G.</b> | <b>Filter Weighted Measurements (Informative)</b> .....                                | <b>29</b> |
| <b>Annex H.</b> | <b>Efficient Demonstration of a Satisfactory Convergence Index (Informative)</b> ..... | <b>30</b> |
| H.1             | Measurements at discrete points .....  | 30        |
| H.2             | Measurements by scanning .....   | 30        |

# Laboratory Method of Sound Testing of Fans Using Sound Intensity

## 1. Scope

This standard is intended to apply to fans of all types and sizes. This standard is limited to the determination of airborne sound emission for the specified setups. Vibration is not measured, and the sensitivity of airborne sound emission to vibration effects is not determined.

The size of a fan which can be tested in accordance with this standard is limited only by the practical aspects of the test setup.

This standard establishes a method of determining the octave band sound power levels of a fan. The method is reproducible when all requirements of the method are met.

In this standard, sound power levels are determined using sound intensity measurements on a measurement surface that encloses the sound source. Guidelines are provided on suitable test environment acoustical characteristics, the measurement surface, and the number of intensity measurements. Test setups are designated generally to represent the physical orientation of fans as installed following ANSI/AMCA 210, and used also in ANSI/AMCA 300.

## 2. Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI/AMCA 210-99/ ANSI/ASHRAE 51-99 *American National Standard Laboratory Method of Testing Fans for Aerodynamic Performance Rating*, Air Movement and Control Association International, Inc., 30 W. University Drive, Arlington Heights, IL, 60004-1893 U.S.A.

ANSI/AMCA 300-05 *American National Standard Reverberant Room Method for Sound Testing of Fans*, Air Movement and Control Association International, Inc., 30 W. University Drive, Arlington Heights, IL 60004-1893 U.S.A.

ANSI S1.6-1984 (R1990) *American National Standard Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements*, Acoustical Society of America, 120 Wall Street, 32nd Floor, New York, 10005-3993 U.S.A.  
(AMCA 1108-84-A0)

ANSI S1.11-1986, *American National Standard Specification for Octave-Band and Fractional-Octave Band Analog and Digital Filters*, Acoustical Society of America, 120 Wall Street, 32nd Floor, New York, 10005-3993 U.S.A. (AMCA 1727-86-A0)

ANSI S1.13-1995, *Measurement of Sound Pressure Levels in Air*, Acoustical Society of America, 120 Wall Street, 32nd Floor, New York, 10005-3993 U.S.A.

ANSI S12.5-1990 *American National Standard Requirements for the Performance and Calibration of Reference Sound Sources*, Acoustical Society of America, 120 Wall Street, 32nd Floor, New York, 10005-3993 U.S.A. (AMCA 1863-90-A0)

ANSI S12.12-1992 *American National Standard Engineering Method for the Determination of Sound Power Levels of Noise Sources Using Sound Intensity*, Acoustical Society of America, 120 Wall Street, 32nd Floor, New York, 10005-3993 U.S.A. (AMCA 1850-92-A0)

ANSI S1.40-1984 (R1990), *American National Standard Specification for Acoustical Calibrators*, Acoustical Society of America, 120 Wall Street, 32nd Floor, New York, 10005-3993 U.S.A. (AMCA 1895-84-A0)

ANSI/IEEE SI 10-1997 *Standard for Use of the International System of Units (SI): The Modern Metric System*, Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, N.J., 08854-4141 USA