**ANSI/ASHRAE Standard 87.3-2001 (RA 2006)**
**Reaffirmation of ANSI/ASHRAE Standard 87.3-2001**

# ASHRAE STANDARD

# Method of Testing Propeller Fan Vibration— Diagnostic Test Methods

Approved by the ASHRAE Standards Committee June 23, 2001, and reaffirmed October 2, 2005. Approved by the ASHRAE Board of Directors June 28, 2001, and reaffirmed January 22, 2006. Approved by the American National Standards Institute December 17, 2001, and reaffirmed January 23, 2006.

ASHRAE Standards are scheduled to be updated on a five-year cycle; the date following the standard number is the year of ASHRAE Board of Directors approval. The latest copies may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide) or toll free 1-800-527-4723 (for orders in US and Canada).



ISSN 1041-2336

When addenda, interpretations, or errata to this standard have been approved, they can be downloaded free of charge from the ASHRAE Web site at http://www.ashrae.org.

Approved American National Standard
ANSI

**American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.**
**1791 Tullie Circle NE, Atlanta, GA 30329**
**www.ashrae.org**

## SPECIAL NOTE

This American National Standard (ANS) is a national voluntary consensus standard developed under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Consensus is defined by the American National Standards Institute (ANSI), of which ASHRAE is a member and which has approved this standard as an ANS, as “substantial agreement reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made toward their resolution.” Compliance with this standard is voluntary until and unless a legal jurisdiction makes compliance mandatory through legislation.

ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

The Manager of Standards of ASHRAE should be contacted for:

a. interpretation of the contents of this Standard,
b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard,
d. permission to reprint portions of the Standard.

## DISCLAIMER

ASHRAE uses its best efforts to promulgate Standards and Guidelines for the benefit of the public in light of available information and accepted industry practices. However, ASHRAE does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with ASHRAE’s Standards or Guidelines or that any tests conducted under its Standards or Guidelines will be nonhazardous or free from risk.

## ASHRAE INDUSTRIAL ADVERTISING POLICY ON STANDARDS

ASHRAE Standards and Guidelines are established to assist industry and the public by offering a uniform method of testing for rating purposes, by suggesting safe practices in designing and installing equipment, by providing proper definitions of this equipment, and by providing other information that may serve to guide the industry. The creation of ASHRAE Standards and Guidelines is determined by the need for them, and conformance to them is completely voluntary.

In referring to this Standard or Guideline and in marking of equipment and in advertising, no claim shall be made, either stated or implied, that the product has been approved by ASHRAE.

# CONTENTS

## ANSI/ASHRAE Standard 87.3-2001 (RA 2006)
## Method of Testing Propeller Fan Vibration—Diagnostic Test Methods



**NOTE**

**When addenda, interpretations, or errata to this standard have been approved, they can be downloaded free of charge from the ASHRAE Web site at http://www.ashrae.org.**




1791 Tullie Circle NE
Atlanta, GA 30329
www.ashrae.org

**(This foreword is not a part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process.)**

## FOREWORD

*This is a reaffirmation of ASHRAE Standard 87.3-2001. This standard falls under the Standards Committee classification of Standard Method of Measurement. This standard was prepared under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). It may be used, in whole or in part, by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interests of obtaining uniform standards throughout the industry.*

*The changes made for the 2006 reaffirmation were:*

- *Certain key words throughout the document were italicized (e.g., unit, pp. 2)*
- *References were updated*

## 1. PURPOSE

This standard establishes laboratory and on-site diagnostic test methods for identifying causes of vibration problems involving direct-driven propeller fans for condenser cooling in air-conditioning units, heat pumps, and chillers.

## 2. SCOPE

This standard applies to all types and sizes of air-conditioning units, heat pumps, and chillers using direct-driven 250 mm to 750 mm (10 in. to 30 in.) diameter propeller fans, which, for the purposes of this standard, are called a "system."

This standard covers system vibration problems excited by unbalance of the rotating parts, aerodynamic forces acting on the fan blades, and electromagnetic forces in the motor.

This standard does not cover system vibration problems excited by the compressor in the unit or by external sources such as the structure supporting the system.

## 3. DEFINITIONS

***dominant peak***: the point in the response spectrum (normally plotted as velocity vs. frequency) that has the highest value.

***mode shape:*** the shape of the structure when vibrating at a natural frequency. **Note:** mode shapes should be normalized (usually by referring all values to a fraction of the motion at some reference point).

***natural frequency:*** a frequency at which a structure will vibrate when excited. **Note:** all practical structures possess many natural frequencies.

***near-resonance***: operation at a frequency near, but not exactly equal to, the resonance frequency.

***normal operating conditions***: a point of operation representing normal usage of the equipment**. Note:** there may be a multiplicity of normal operating conditions.

***operating deflection shape:*** the shape of the structure at the maximum point in the cycle during operation of the equipment. **Note:** normally this shape is determined only when the equipment is being operated at a frequency corresponding to a dominant peak; also, unlike the mode shape, operating deflection shape should be reported in absolute terms (deflection, velocity, or acceleration).

***resonance frequency:*** the frequency at which operation of the equipment leads to a peak in the response spectrum. **Note:** for lightly damped structures, the resonance frequency can be taken to be the natural frequency.

***vibration severity:*** the magnitude of the vibration expressed in engineering units (usually velocity [mm/s]). **Note:** vibration severity values may represent either the overall value or a value obtained from a frequency analysis. It is extremely important to denote which choice was made. It is also necessary to denote whether the value is zero-to-peak, peak-to-peak, or rms.

***PSC motor*****:** a permanent split capacitor motor.

***unit, system, test unit:*** wherever these words appear they mean the "system" under test as defined in Section 2.

## 4. INTRODUCTION

Fan system vibration problems are caused by a combination of factors related to the design of the fan, the *unit*, and the motor as well as to the electric power supply. The test methods of this standard are separated into the following categories:

a. Those for dealing with the driving forces that excite the *system* vibrations
b. Those for dealing with the response of the relevant parts of the *system* to a given excitation

A certain amount of vibration is inherent and normal in the operation of all fans. For the purposes of this standard, fan *system* vibration shall be considered a problem only if it causes any of the following:

a. Mechanical failure of any part of the fan/motor/support assembly. Typical failures include cracks of the fan impeller, loosening or fretting of the attachment of the impeller to the motor shaft, and cracks in the motor support structure.
b. Excessive noise related to the electromagnetic forces in the fan motor. Typical frequencies of excessive motor-related noise are the torque pulsation frequency of two times the electric power frequency and the second, third, and fourth harmonics of that frequency. The torque pulsations of the drive motor will excite natural modes in the rotating assembly as well as the motor stator and its support structure. Stator vibrations transmitted to the *unit* structure and rotor vibrations transmitted to the fan impeller both may contribute significantly to the noise.

**Note:** For the purposes of this standard, this noise can be considered excessive if, in the frequency range of 100 to 500 Hz, any given third-octave band level exceeds the average of the adjacent band levels by more than 4 dB measured in accordance with ANSI Standard S12.32 or