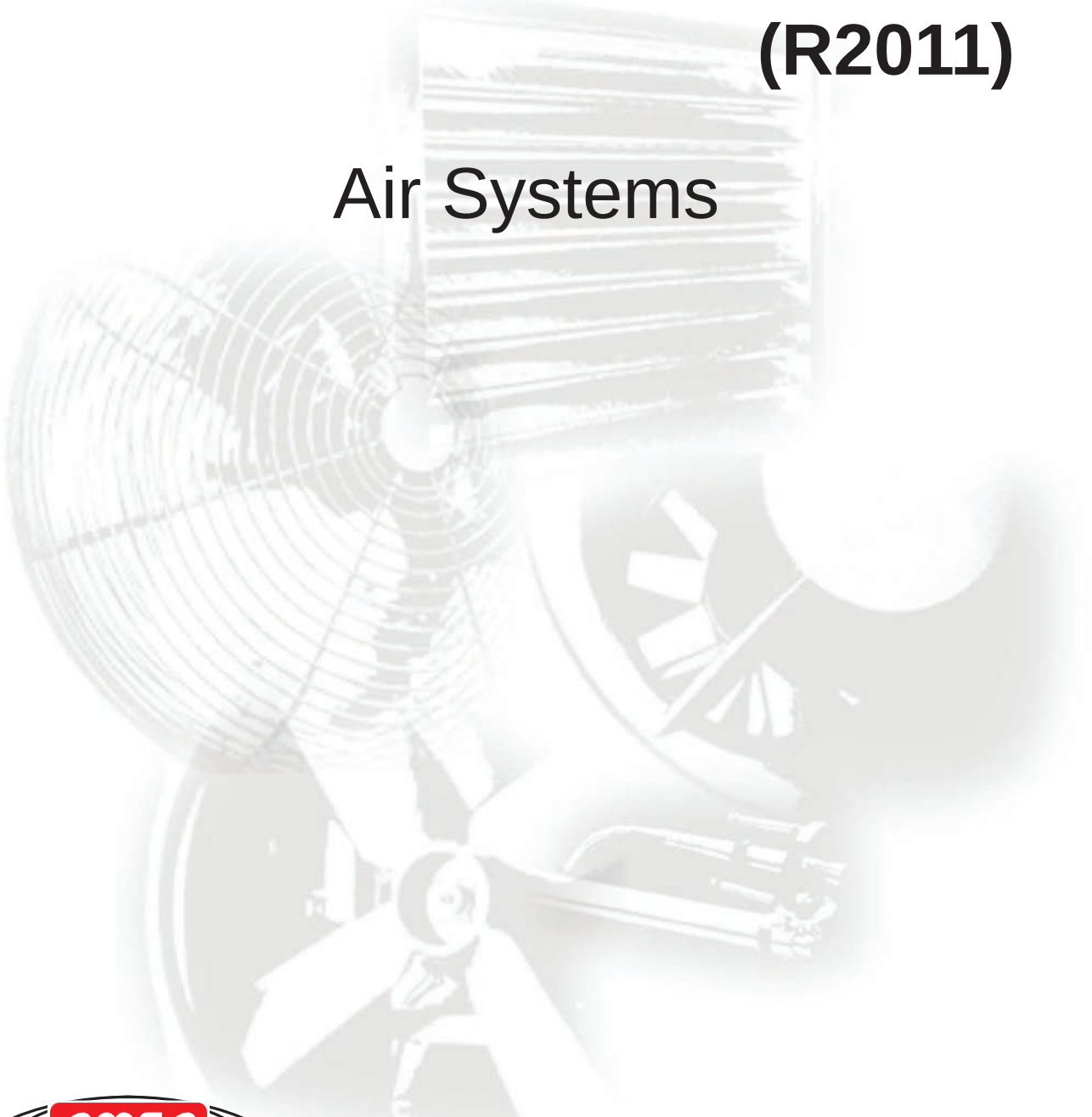
AMCA Publication 200-95 (R2011)

Air Systems



AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

The International Authority on Air System Components

AMCA PUBLICATION 200-95 (R2011)

Air Systems

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

Authority

AMCA Publication 200-95 was adopted by the membership of the Air Movement and Control Association International, Inc. in 1995, and it was reaffirmed in 2000, 2007, and 2011.

Foreword

This publication is intended to provide basic information needed to design effective and energy efficient air systems. in those cases where the system handles a gas other than air, the design data must be modified to allow for the different physical properties of the gas being used.

Discussion is limited to systems where there is a clear separation of the fan inlet and outlet and does not cover applications in which fans are used only to circulate air in an open space.

The design of most air sytems is based on airflow velocities which result in turbulent airflow. Some applications require very low velocities, resulting in laminar flow conditions; others may require very high velocities, approaching the speed of sound (Mach 1). The information given in this publication applies only to turbulent flow conditions and not to these special systems using very low or very high flow velocities.

The flow through an air system will stabilize when the total pressure provided by the fan is exactly equal to the total pressure losses in the system.

To achieve the desired airflow in the system the diesgner must have complete information on:

a) System Pressure Losses: The total pressure loss due to friction losses, shock losses, dissipation of velocity pressure at the system discharge, and static pressure differences between the entry and discharge openings. System pressure losses are discussed in detail in Section 4.

b) Fan Performance Characteristics: The relationship of the total pressure rise and the volume flow generated by the fan. Fan performance characteristics are reviewd in Section 5. More complete information is contained in AMCA Publication 201, *Fans and Systems*.

c) System Effect: The effect on the performance of the fan resulting from the difference between the fan inlet and outlet connections to the installed system and the standardized connections used in laboratory tests to obtain fan performance ratings. A practical approach to estimating System Effects is explained in AMCA Publication 201, *Fans and Systems*.

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This manual has been prepared by the Air Movement and Control Association, Inc. The information contained in this manual has been derived from many sources and is believed to e accurate. Please note that the recommendations contained herein do not necessarily represent the only methods or procedures appropriate for the situation discussed, but rather are inteded to present consensus opinions and practices of the air movement and control industry which may be helpful, or of interest to those who design, test, install, operate or maintain fan-duct systems. Thus, AMCA disclaimes any and all warranties, expressed or implied, regarding the accuracy of the information contained in this maual and further disclaims any liability for the use or misuse of this information. AMCA does not guarantee, certify or assure the performance of any fan-duct system designed, tested, installed, operated or maintained on the basis of the information provided in this manual.

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

or

AMCA International, Incorporated
c/o Federation of Environmental Trade Associations
2 Waltham Court, Milley Lane, Hare Hatch
Reading, Berkshire
RG10 9TH United Kingdom

Related AMCA Standards and Publications

Publication 200 ***AIR SYSTEMS***

System Pressure Losses
Fan Performance Characteristics
System Effect
System Design Tolerances

Air Systems is intended to provide basic information needed to design effective and energy efficient air systems. Discussion is limited to systems where there is a clear separation of the fan inlet and outlet and does not cover applications in which fans are used only to circulate air in an open space.

Publication 201 ***FANS AND SYSTEMS***

Fan Testing and Rating
The Fan "Laws"
Air Systems
Fan and System Interaction
System Effect Factors

Fans and Systems is aimed primarily at the designer of the air moving system and discusses the effect on inlet and outlet connections of the fan's performance. System Effect Factors, which must be included in the basic design calculations, are listed for various configurations. AMCA 202 and AMCA 203 are companion documents.

Publication 202 ***TROUBLESHOOTING***

System Checklist
Fan Manufacturer's Analysis
Master Troubleshooting Appendices

Troubleshooting is intended to help identify and correct problems with the performance and operation of the air moving system after installation. AMCA 201 and AMCA 203 are companion documents.

Publication 203 ***FIELD PERFORMANCE MEASUREMENTS OF FAN SYSTEMS***

Acceptance Tests
Test Methods and Instruments
Precautions
Limitations and Expected Accuracies
Calculations

Field Performance Measurements of Fan Systems reviews the various problems of making field measurements and calculating the actual performance of the fan and system. AMCA 201 and AMCA 202 are companion documents.

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Air Systems 200

1. Introduction

An air system is any assembly of ducts, filters, conditioning devices, dampers, louvers, fans, etc., the main purpose of which is to move air from one place to another in a controlled fashion. Most air systems draw air from one space and discharge it into another.

Air systems are often required to operate satisfactorily in a wide range of environmental conditions. The conditions which will be encountered must be considered in the design of the ducts, pipes, etc., which will contain the airflow and constitute the boundary of the system.

1.1 Air system components

A typical air system may contain one or more of the following (see Figure 1):

a) System inlet
b) Distribution system
c) Fan
d) Control device
e) Conditioning device
f) System outlet

1.1.1 System inlet. An air system usually includes devices such as louvers, filters, screens, guards, grilles, etc., where the air enters the system. These are used for safety reasons as well as to inhibit the entry of rain, dust, and other unwanted matter. Their appearance may be important as they are usually visible on the exterior of a structure.

1.1.2 Distribution system. Most air systems are made up of ducts specially designed and constructed to convey air from the system inlet(s) to the system outlet(s). In some cases, enclosed spaces in the structure such as plenums above ceilings or holes in walls may be used to confine and direct the flow.

1.1.3 Fan. Understanding the design and opera-tion of air systems begins with an understanding of the various types of fans, their performance characteristics, and their applications.

A fan is required in order to produce the pressure differential which results in the flow of air through a system. The fan must be carefully selected to meet the specified airflow and pressure for proper system operation. Different fan designs produce different pressure-volume and fan power relationships, which are critical to air system operation. Refer to Figure 4.2, AMCA Publication 201-90.

1.1.4 Control devices. In many air systems it is necessary to regulate and control the flow through the system in response to some monitoring signal, usually temperature or pressure. It may be also necessary to regulate the flow in the individual branches of the system. Control devices such as dampers function by controlling the amount of airflow. In some cases, the output of the fan can be varied by other methods (variable speed motor, variable inlet vanes, variable pitch impeller, etc.)

1.1.5 Conditioning device. Most air systems are designed to take air from the inlet and change its condition before discharging it at the outlet. Changes may include the temperature, humidity, pressure, contaminant level and cleanliness, etc., of the air. Many conditioning devices require outside energy sources, for example, heating and cooling coils; other components such as filters are passive devices and have no external energy connection. All conditioning devices increase the pressure drop across the system and this effect must be considered in the selection of the fan.

1.1.6 System outlet. An air system usually includes a special component at the termination of the system or at the end of each of the system's branches, such as a simple screen or louver. In many cases the distribution of the air at the outlet to the receiving space is very important, e.g., in an occupied air conditioned room. These systems require carefully selected outlets and diffusing devices to achieve desirable air motion and temperature conditions in the conditioned space. Typical devices are ceiling diffusers and grilles. In some cases these may incorporate control devices such as dampers and mixing boxes.