

2016 ASHRAE HANDBOOK

HVAC Systems and Equipment

I-P Edition

Supported by ASHRAE Research

2016 ASHRAE® HANDBOOK

Heating, Ventilating, and Air-Conditioning SYSTEMS AND EQUIPMENT

Inch-Pound Edition

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- MTG.LowGWP Lower Global Warming Potential Alternative Refrigerants
- MTG.O&MEE Operations and Maintenance Activities That Impact Energy Efficiency
- MTG.OBB Occupant Behavior in Buildings

ASHRAE Research: Improving the Quality of Life

ASHRAE is the world's foremost technical society in the fields of heating, ventilation, air conditioning, and refrigeration. Its members worldwide are individuals who share ideas, identify needs, support research, and write the industry's standards for testing and practice. The result is that engineers are better able to keep indoor environments safe and productive while protecting and preserving the outdoors for generations to come.

One of the ways that ASHRAE supports its members' and industry's need for information is through ASHRAE Research. Thousands of individuals and companies support ASHRAE Research annually, enabling ASHRAE to report new data about material

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Chapters in the ASHRAE Handbook are updated through the experience of members of ASHRAE Technical Committees and through results of ASHRAE Research reported at ASHRAE conferences and published in ASHRAE special publications, *ASHRAE Transactions*, and ASHRAE's journal of archival research, *Science and Technology for the Built Environment*.

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Preface

The 2016 *ASHRAE Handbook—HVAC Systems and Equipment* discusses various systems and the equipment (components or assemblies) they comprise, and describes features and differences. This information helps system designers and operators in selecting and using equipment. ASHRAE Technical Committees in each subject area have reviewed all chapters and revised them as needed for current technology and practice. An accompanying CD-ROM contains all the volume's chapters in both I-P and SI units.

Some of the volume's revisions and additions are as follows:

- Chapter 7, Combined Heat and Power Systems, has a new section on economic evaluation and includes an update on EU Directive 2004/8/EC.
- Chapter 9, Applied Heat Pump and Heat Recovery Systems, has new content on waste heat recovery, district applications, and industrial process heat pumps.
- Chapter 12, District Heating and Cooling, has new content from ASHRAE research project RP-1267 (the new *District Heating Guide* and *District Cooling Guide*).
- Chapter 18, Variable Refrigerant Flow, has new sections on modeling and system commissioning, and an updated system design example.
- Chapter 19, Duct Construction, has extensive revisions on system leakage and air dispersion systems.
- Chapter 20, Room Air Distribution Equipment, has updates for current technology, with new information on specialized components and air curtains.
- Chapter 21, Fans, has new sections on series fan operation and field performance testing plus added content on fan and motor efficiency grades and parallel multiple-fan operation.
- Chapter 24, Desiccant Dehumidification and Pressure-Drying Equipment, has expanded content on applications, air filters, and liquid strainers, plus recommendations from ASHRAE research project RP-1339 on rating equipment at altitude.
- Chapter 25, Mechanical Dehumidifiers and Related Components, has new content on psychrometrics, outdoor air, controls, and industrial dehumidifiers.
- Chapter 26, Air-to-Air Energy Recovery Equipment, has new information on heat pipes and desiccant and heat wheel systems.
- Chapter 28, Unit Ventilators, Unit Heaters, and Makeup Air Units, has revisions on standards, controls, and fan selection for makeup air units.
- Chapter 29, Air Cleaners for Particulate Contaminants, has updates on standards and performance testing.
- Chapter 31, Automatic Fuel-Burning Systems, has added content on pneumatically and electronically linked gas/air ratio burner systems.

- Chapter 33, Furnaces, has updates for current technology and efficiency requirements.
- Chapter 37, Solar Energy Equipment, has new data on worldwide solar technology use, plus an expanded section on photovoltaic equipment.
- Chapter 38, Compressors, has revisions on general theory; screw and scroll compressors; and bearings, including oil-free technologies.
- Chapter 44, Centrifugal Pumps, has new content on vertical, inline, split-coupled pumps; hydronic system pump selection; and differential pressure control.
- Chapter 45, Motors, Motor Controls, and Variable-Frequency Drives, has new content on standards, bearing currents, and permanent-magnet motors.
- Chapter 47, Valves, has new content on control valve sizing; electronic actuators; and ball, butterfly, flow-limiting, and pressure-independent control valves.
- Chapter 49, Unitary Air Conditioners and Heat Pumps, has a new map of U.S. regional appliance efficiency standards.
- Chapter 50, Room Air Conditioners and Packaged Terminal Air Conditioners, has updates for efficiency standards.
- Chapter 51, Thermal Storage, has new content on grid reliability, renewable power integration, heat storage, emergency cooling, water treatment, and commissioning.

This volume is published, as a bound print volume and in electronic format on CD-ROM and online, in two editions: one using inch-pound (I-P) units of measurement, the other using the International System of Units (SI).

Corrections to the 2013, 2014, and 2015 Handbook volumes can be found on the ASHRAE website at www.ashrae.org and in the Additions and Corrections section of this volume. Corrections for this volume will be listed in subsequent volumes and on the ASHRAE website.

Reader comments are enthusiastically invited. To suggest improvements for a chapter, **please comment using the form on the ASHRAE website** or, using the cutout page(s) at the end of this volume's index, write to Handbook Editor, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, or fax 678-539-2187, or e-mail mowen@ashrae.org.

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