HVAC SYSTEMS APPLICATIONS

SHEET METAL AND AIR CONDITIONING CONTRACTORS'
NATIONAL ASSOCIATION, INC.
www.smacna.org

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SECOND EDITION – MARCH, 2010

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FOREWORD

It is the policy of the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) to continually re-visit and update the technical manuals that have become the backbone of the industry.

With this policy in mind, a Task Force was organized and tasked with the purpose of reviewing and bringing up to date the HVAC Systems Applications. This manual is often referred to as one-of-three manuals that constitute SMACNA's approach to HVAC systems. The other two manuals making up this group are the "*HVAC Systems – Duct Design*" manual and the "*HVAC Systems – Testing, Adjusting and Balancing*" manual. It is recommended that this manual be used in conjunction with the latest ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) "*HVAC Applications*" handbook.

Accordingly, the Task Force found areas that were in need of updating, primarily due to the advancement of technology, since the manual was last revised. This included hardware as well as software improvements. In addition, the science and methodology of Heating, Ventilating and Air Conditioning has changed, with an increased emphasis on energy efficiency and sustainability.

As you review this 2nd edition, you will notice that some chapters have been re-named, others have been deleted, and the order of the remaining chapters presented has been adjusted. However the emphasis is still on Air and Hydronic systems. You will also notice new topics of discussion, *i.e.*:

- Displacement Ventilation
- Variable Flow Refrigerant systems
- Fan Wall Systems
- HVAC Systems as they pertain to Sustainable Buildings
- Updated review of modern Variable Frequency Drives
- Revised/Updated Figures
- Expanded chapters for Smoke Control, Cleanrooms and Laboratory HVAC systems

It is the hope of the Task Force that this revised manual will be of value to those contractors who participate in the Design Build arena, as well as those that are involved with retro-fitting existing building systems. For those working in the retro-fit market, references to systems that may be obsolete by today's standards have been retained to offer an insight into these systems.

Finally, the Glossary has also been updated to reflect these changes.

SHEET METAL AND AIR CONDITIONING CONTRACTORS'
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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter provides an introduction to heating, ventilating, and air conditioning (HVAC) applications. This chapter starts with stating the purpose of HVAC systems followed by a discussion of human thermal comfort and the industry standards that are used to establish the operating parameters for HVAC systems. Basic HVAC system components are then identified and discussed and a typical central HVAC system is presented. The importance of HVAC operating efficiency is addressed along with discussion of energy codes and standards. Energy codes and standards, green building rating systems and their relationship to HVAC system applications are also covered. This chapter closes by addressing various issues that should be considered when selecting, designing, and installing HVAC systems.

1.2 HVAC SYSTEM PURPOSE

The purpose of an HVAC system is to provide a suitable thermal environment in a defined space that meets the needs of the occupants and the activity that takes place in the space. Most HVAC systems are installed to establish an indoor environment within which building occupants can live, work, and play. The indoor environment impacts the quality of life, productivity, and well being of building occupants. As people spend an increasing amount of time inside buildings HVAC systems and their associated control systems are becoming more important. To address this growing need this manual focuses on HVAC equipment that creates human comfort indoors. Energy use in buildings is becoming increasingly important and impacting the type of the HVAC distribution system design, the HVAC equipment specified, and how the HVAC operates. HVAC systems are also required to provide suitable environmental conditions in addition to providing human comfort. In addition, energy use in buildings is becoming increasingly important and impacting the type of the HVAC distribution system design, the HVAC equipment specified, and how the HVAC operates. HVAC systems are also required to provide suitable environmental conditions for purposes other than human comfort.

1.3 HUMAN THERMAL COMFORT

1.3.1 Variables That Determine Human Thermal Comfort

Human thermal comfort is determined by the following four variables:

- Temperature
- Humidity
- Air Movement
- Air Quality

The objective of an HVAC system installed for human comfort is to control these four variables within an acceptable range for the occupants in the zone served by the HVAC system. The zone can be an entire building, an enclosed space within a building such as a room, or an area within a building. The HVAC system must be capable of controlling these four variables considering the activity taking place in the zone as well as changes in the outside environment, changes in the occupancy of the zone, and changes in the activity taking place in the zone. All of these changes take place continuously throughout the day and the HVAC system must be able to adjust and adapt to the dynamic nature of building thermal loads.

1.3.2 Establishing Parameters For Human Thermal Comfort

There are a number of industry standards and recommended practices that provide recommendations and guidance in establishing the parameters for achieving human thermal comfort for a given occupancy that take into account the activity being performed in the zone served by the HVAC system. Two important industry standards that establish the general parameters for human thermal comfort are published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE) and are as follows:

- ASHRAE Standard 55-2004: *Thermal Environmental Conditions for Human Occupancy*
- ASHRAE Standard 62.1-2004: *Ventilation for Acceptable Indoor Air Quality*

Both of these standards are referenced in building codes, project technical specifications, and green building rating systems and their requirements may be mandatory on a building project. The following sections will discuss each of these industry standards.

1.3.2.1 ASHRAE Standard 55

ASHRAE Standard 55 specifies the combinations of indoor space environment and personal factors that will produce thermal environmental conditions acceptable to 80 percent of the occupants in a space. The environmental factors addressed are temperature,