GUIDELINE

ASHRAE Guideline 6-2015
(Supersedes ASHRAE Guideline 6-2008)

Refrigerant Information Recommended for Product Development and Standards

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NOTE

Approved addenda, errata, or interpretations for this guideline can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.

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(This foreword is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

FOREWORD

Guideline 6 was first published in 1996 for the purpose of informing refrigerant suppliers of the type and format of refrigerant information that the industry would be looking for in order to evaluate new refrigerants and blends intended to replace ozone-depleting chlorinated fluorocarbon refrigerants that were being regulated starting in 1996.

Guideline 6 was revised in 2008 to reflect a change of focus away from commercialization of new refrigerants and toward the application of refrigerants, whether new or old. The revised purpose and scope further deemphasized newly commercialized refrigerants in favor of all refrigerant data that may be needed for the design of HVAC&R equipment, ASHRAE standards, or other codes.

The 2015 edition of Guideline 6 is a revision of Guideline 6-2008. Due to market and regulatory forces driving new interest in increased energy efficiency to reduce carbon emissions, public interest in "green" refrigerant alternatives, and the introduction of proposed restrictions on the future use of high-global-warming-potential refrigerants, this guideline presents additional information needed for product development and standards to respond to these new changes in the refrigeration industry. Specifically, this edition broadens the scope of the guideline to include new refrigerant product families that were not commercially used in the United States in 2008: hydrocarbons, hydrofluoro-olefins, and ethers. The commercial development of a new lower flammability Class 2L of refrigerants and blends introduces additional (optional) property information needed in ASHRAE Standards 34 and 15 and in risk assessments for various applications, such as burning velocity, autoignition temperature, minimum ignition energy, hot surface ignition temperature, and more stringent thermal and hydrolytic stability properties. System chemistry, refrigerant reactivity, and blend fractionation testing are covered in greater detail to reflect recent technology developments. CO_2 subcritical and transcritical cycle applications were not covered in Guideline 6-2008, but they are covered in this edition due to renewed interest in "natural refrigerants" and concerns for global warming.

The references have also been brought up to date to reflect the latest editions of the referenced standards. Please note that as these references continue to change, they may no longer be consistent with the information presented in this edition of Guideline 6. In most cases, however, the most current information is desirable.

1. PURPOSE

a. This guideline identifies the types of refrigerant data that may be required by product development and system design engineers, ASHRAE standards, and appropriate codes to successfully apply a refrigerant in refrigeration or air-conditioning equipment.
b. This guideline also provides refrigerant suppliers and researchers with examples of measurement methods, previous research, and desired accuracy levels for various refrigerant properties.

2. SCOPE

2.1 This guideline lists the types of refrigerant information recommended as the minimum necessary for refrigerant research and development and commercial application or for use in ASHRAE standards.

2.2 This guideline covers property data for fluids used as refrigerants in HVAC&R applications. These include saturated and unsaturated halocarbons, saturated and unsaturated hydrocarbons, ethers, and inorganic compounds (such as ammonia and carbon dioxide).

2.3 The guideline also addresses

a. basic chemical data,
b. thermophysical property data,
c. materials compatibility data, and
d. safety, health, and environmental information.

2.4 Suggested accuracies and methods that may be used in obtaining the data either are given or have references to applicable standards or other sources.

3. DEFINITIONS

autoignition temperature: the minimum temperature to which any part of a vapor-air mixture must be raised by application of heat to produce self-sustained (autogenous) combustion, as indicated by the appearance of flame or glow. The autoignition temperature of a liquid or gas is not a physical constant and is affected by variables such as the size, shape, and degree of confinement of the space in which the ignition occurs; catalytic and other actions of the heated surface; surface combustion; initial pressure; and the concentration of the vapor-air mixture [1].

azeotropic refrigerant: a blend of two or more refrigerants whose equilibrium vapor and liquid phase compositions are the same at a given pressure. At this pressure, the slope of the temperature versus composition curve equals zero, which is expressed mathematically as $(dT/dx)_p = 0$, which in turn implies the occurrence of a maximum, minimum, or saddle-point temperature. Azeotropic blends exhibit some segregation of components at other conditions. The extent of segregation depends on the particular azeotrope and the application [2].

blend: a refrigerant consisting of a mixture of two or more different chemical compounds. Often the compounds are used individually as refrigerants for other applications [2].

bubble-point temperature: the liquid saturation temperature of a refrigerant at the specified pressure; the temperature at which a liquid refrigerant first begins to boil. The bubble point of a zeotropic refrigerant blend, at constant pressure, is lower than the dew point.

burning velocity (S_u): the maximum velocity in centimetres per second (inches per second) at which a laminar flame propagates in a normal direction relative to the unburned gas ahead of it [2].