Designation: D4650 – 14

Standard Specification for Normal Butane Thermophysical Property Tables[1]

This standard is issued under the fixed designation D4650; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 The thermophysical property tables for normal butane are for use in the calculation of the pressure-volume-temperature (PVT), thermodynamic, and transport properties of normal butane for process design and operations. Two tables provide properties at the conditions of liquid-vapor equilibrium (saturation properties), one for liquid and one for vapor, at temperatures between 135 K and the critical point, 425.13 K. A third table provides properties at selected *T*, *p* points for the equilibrium phase at temperatures between 140 K and 560 K at pressures to 20 MPa. The tables were developed using the National Institute of Standards and Technology Standard Reference Database product REFPROP, version 9.1.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Applicability

2.1 These tables apply directly only to pure normal butane. They may also be used in mathematical models and tables for the thermophysical properties of mixtures containing normal butane.

3. Tables

3.1 These tables were produced by equations from a computer package, "NIST Standard Reference Database 23; Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1."[2] A wide selection of units (SI units, engineering units, chemical units) and additional properties are available with this program.

3.2 These thermophysical property tables are:

3.2.1 *Thermophysical Properties of Normal Butane Liquid at Vapor-Liquid Equilibrium, in SI units*. See Table 1.

3.2.2 *Thermophysical Properties of Normal Butane Vapor at Vapor-Liquid Equilibrium, in SI units*. See Table 2.

3.2.3 *Thermophysical Properties of Normal Butane Along Isobars, in SI units*. See Table 3.

3.3 The symbols are:

T, temperature (K)
ρ, molar density ($mol \cdot L_{-1}$)
H, molar enthalpy ($J \cdot mol_{-1}$)
S, molar entropy ($J \cdot K_{-1} \cdot mol_{-1}$)
Cv, constant volume molar heat capacity ($J \cdot K_{-1} \cdot mol_{-1}$)
Cp, constant pressure molar heat capacity ($J \cdot K_{-1} \cdot mol_{-1}$)
c, speed of sound ($m \cdot s_{-1}$)
η, viscosity (μPa·s)
λ, thermal conductivity ($mW \cdot m_{-1} \cdot K_{-1}$)

3.4 The tabulated thermophysical properties are:

ρ, molar density ($mol \cdot L_{-1}$)
H, molar enthalpy ($J \cdot mol_{-1}$)
S, molar entropy ($J \cdot K_{-1} \cdot mol_{-1}$)
Cv, constant volume molar heat capacity ($J \cdot K_{-1} \cdot mol_{-1}$)
Cp, constant pressure molar heat capacity ($J \cdot K_{-1} \cdot mol_{-1}$)
c, speed of sound ($m \cdot s_{-1}$)
η, viscosity (μPa·s)
λ, thermal conductivity ($mW \cdot m_{-1} \cdot K_{-1}$)

4. Additional Information

4.1 Reference state properties are required to calculate the thermodynamic properties enthalpy and entropy from an equation of state formulation. The reference state properties used are those specified by the International Institute of Refrigeration (IIR): enthalpy, *H*= 200 J/g, and entropy, *S*= 1 J/(g·K), for the saturated liquid at 273.15K (0°C).

4.2 The molar mass of normal butane is 58.122 g/mol.

5. Keywords

5.1 butane; N-butane; natural gas; normal butane gas tables; thermodynamic properties of normal butane; transport properties of normal butane

[1] This specification is under the jurisdiction of ASTM Committee D03 on Gaseous Fuels and is the direct responsibility of Subcommittee D03.08 on Thermophysical Properties.

Current edition approved June 1, 2014. Published July 2014. Originally approved in 1987. Last previous edition approved in 2008 as D4650 – 08. DOI: 10.1520/D4650-14.

[2] Available from Standard Reference Data, National Institute of Standards and Technology (NIST), 100 Bureau Drive, Stop 3460, Gaithersburg, MD 20899.

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