



Standard Test Method for Purity of Hydrocarbons from Freezing Points¹

This standard is issued under the fixed designation D 1016; 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 (€) indicates an editorial change since the last revision or reapproval.

€¹ NOTE—Warning notes were editorially moved into the standard text in May 2004.

1. Scope

1.1 This test method covers the sampling and determination of purity of essentially pure compounds for which the freezing points for zero impurity and cryoscopic constants are given.² The compounds to which the test method is applicable are: (**Warning**—Extremely flammable liquids and liquefied gases.)

<i>n</i> -butane	1,3-butadiene
isobutane	isoprene(2-methyl-1,3-butadiene)
<i>n</i> -pentane	benzene
isopentane	toluene (methylbenzene)
<i>n</i> -hexane	ethylbenzene
<i>n</i> -heptane	<i>o</i> -xylene (1,2-dimethylbenzene)
<i>n</i> -octane	<i>m</i> -xylene (1,3-dimethylbenzene)
2,2,4-trimethylpentane	<i>p</i> -xylene (1,4-dimethylbenzene)
methylcyclohexane	styrene (ethenylbenzene)
isobutene	

1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements, see Sections 1, 6, 8, and 10-26.

NOTE 1—This test method covers systems in which the impurities form with the major component a substantially ideal or sufficiently dilute solution, and also systems which deviate from the ideal laws, provided that, in the latter case, the lowering of the freezing point as a function of the concentration is known for each most probable impurity in the given substance.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.04 on Hydrocarbon Analysis.

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² Numerical constants in this test method were taken from the most recently published data appearing in “Tables of Physical and Thermodynamic Properties of Hydrocarbons and Related Compounds,” or *ASTM DS 4A, Physical Constants of Hydrocarbons* *C*₁ to *C*₁₀, or both, prepared by the American Petroleum Institute, Research Project 44.

2. Referenced Documents

2.1 *ASTM Standards*:³

D 1015 Test Method for Freezing Points of High-Purity Hydrocarbons

3. Summary of Test Method

3.1 After measurement of the freezing point of the actual sample, purity can be calculated from the value of the determined freezing point and the values given for the freezing point for zero impurity and for the applicable cryoscopic constant or constants.⁴

3.2 For the equilibrium between an infinitesimal amount of the crystalline phase of the major component and a liquid phase of the major component and one or more other components, the thermodynamic relation between the temperature of equilibrium and the composition of the liquid phase is expressed by the equation:⁵

$$-1 \ln N_1 = -1 \ln (1 - N_2) = A(t_{f0} - t_f)[1 + B(t_{f0} - t_f) + \dots] \quad (1)$$

where:

N_1 = mole fraction of the major component,

N_2 = $(1 - N_1)$ = sum of the mole fractions of all the other components,

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ For a more complete discussion of this test method, see Glasgow, A. R., Jr., Streiff, A. J., and Rossini, F. D., “Determination of the Purity of Hydrocarbons by Measurement of Freezing Points,” *Journal of Research*, JRNBA, National Institute of Standards and Technology, Vol 35, No. 6, 1945, p. 355.

⁵ For details, see Taylor, W. J., and Rossini, F. D., “Theoretical Analysis of Time-Temperature Freezing and Melting Curves as Applied to Hydrocarbons,” *Journal of Research*, JRNBA, Nat. Bureau Standards, Vol 32, No. 5, 1944, p. 197; also Lewis, G. N., and Randall, M., “Thermodynamics and the Free Energy of Chemical Substances,” 1923, 238, McGraw-Hill Book Co., New York, NY.