

ASTM-D1218

ADOPTION NOTICE

ASTM-D1218, "LIQUIDS, HYDROCARBON, REFRACTIVE INDEX AND REFRACTIVE DISPERSION OF", was adopted on 03-OCT-94 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Commander, Naval Sea Systems Command, SEA 03R42, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160. Copies of this document may be purchased from the American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, Pennsylvania, United States, 19428-2959. <http://www.astm.org/>

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Standard Test Method for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids¹

This standard is issued under the fixed designation D 1218; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers the measurement of refractive indexes, accurate to six units in the fifth decimal place, and refractive dispersions, accurate to twelve units in the fifth decimal place, of transparent and light-colored hydrocarbon liquids that have refractive indexes in the range from 1.33 to 1.50, and at temperatures from 20 to 30°C. The test method is not applicable within the accuracy stated to liquids having colors darker than No. 4 ASTM Color as determined by Test Method D 1500, to liquids having bubble points so near the test temperature that a reading cannot be obtained before substantial weathering takes place, to liquids having a refractive index above 1.50, or to measurements made at temperatures above 30°C.

NOTE 1—The instrument can be successfully used for refractive indexes above 1.50 and at temperatures both below 20°C and above 30°C. As yet, certified liquid standards for the ranges above a refractive index of 1.50 are not available, so the precision and accuracy of the instrument under these conditions have not been evaluated. Similarly, certified refractive indexes of liquids at temperatures other than the 20 to 30°C range are not available, although the instrument can be used up to 50°C.

1.2 *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.*

2. Referenced Documents

2.1 ASTM Standards:

- D 841 Specification for Nitration Grade Toluene²
- D 1500 Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)³
- E 1 Specification for ASTM Thermometers⁴

¹ This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.04 on Hydrocarbon Analysis.

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² *Annual Book of ASTM Standards*, Vol 06.04.

³ *Annual Book of ASTM Standards*, Vol 05.01.

⁴ *Annual Book of ASTM Standards*, Vol 14.03.

3. Terminology

3.1 Definitions:

3.1.1 *refractive index*—the ratio of the velocity of light (of specified wavelength) in air, to its velocity in the substance under examination. It may also be defined as the sine of the angle of incidence divided by the sine of the angle of refraction, as light passes from air into the substance. This is the relative index of refraction. If absolute refractive index (that is, referred to vacuum) is desired, this value should be multiplied by the factor 1.000 27, the absolute refractive index of air. The numerical value of refractive index of liquids varies inversely with both wavelength and temperature.

3.1.2 *refractive dispersion*—the difference between the refractive indexes of a substance for light of two different wavelengths, both indexes being measured at the same temperature. For convenience in calculations, the value of the difference thus obtained is usually multiplied by 10 000.

4. Summary of Test Method

4.1 The refractive index is measured by the critical angle method with a Bausch & Lomb Precision Refractometer (or other instruments of equivalent or superior performance), using monochromatic light. The instrument is previously adjusted by means of a solid reference standard and the observed values are corrected, when necessary, by a calibration obtained with certified liquid standards.

5. Significance and Use

5.1 Refractive index and refractive dispersion are fundamental physical properties that can be used in conjunction with other properties to characterize pure hydrocarbons and their mixtures.

6. Apparatus

6.1 *Refractometer*, Bausch & Lomb, “Precision” type,⁵ range 1.33 to 1.64 for the sodium *D* line. Other instruments of

⁵ Manufactured by Bausch & Lomb Optical Co., Rochester, NY, Catalog No. 33-45-03. All instrument terminology used in this method corresponds with that used in the “Reference Manual” supplied with the instrument. Production of this refractometer was discontinued in 1976. However it may be obtainable from instrument exchanges or used equipment suppliers. If other available instrumentation is used, the precision statements of Section 13 will not apply.

equivalent or superior performance, such as automatic refractometers, shall meet the precision section requirements as minimum criteria.

NOTE 2—When other instruments are used, follow the manufacturer’s instruction for operation and maintenance. Section 12 shall strictly be adhered to on any instrument used, except that Sections 11 and 13 may be substituted with the appropriate manufacturer’s instructions.

6.2 *Thermostat and Circulating Pump*, capable of maintaining the indicated prism temperature constant within 0.02°C of the desired test temperature. The thermostating liquid should pass the thermometer on leaving, not on entering, the prism assembly.

NOTE 3—In the Bausch & Lomb refractometer, the thermostating liquid shall pass the thermometer on leaving, not on entering the prism assembly.

6.3 *Thermometer*—ASTM Saybolt Viscosity Thermometer 17C having a range from 19 to 27°C, and conforming to the requirements of Specification E 1. The thermometer shall be used in an approved holder, as shown in Fig. 1, such that almost total immersion (not more than emergent stem) is obtained, and reading to 0.01°C is possible.

NOTE 4—Other temperature sensing devices, such as thermocouples, that can provide equivalent or better temperature control may be used in place of the thermometer specified in 6.3.

6.4 *Light Sources*—The following light sources have been found satisfactory:

6.4.1 *Sodium Arc Lamp*—The Unitized “Sodium Lab Arc” is furnished with the instrument.

6.4.2 *Mercury Arc Lamp*—The H-4 type capillary mercury arc is furnished as an accessory to the refractometer.

6.4.3 *Hydrogen Discharge Lamp*—Any type of lamp capable of producing light having an intensity of at least 32 lx (3

footcandles) on an area of 1 cm² on the entrance face of the illuminating prism. The luminous intensity may be conveniently measured by means of a photographic light meter held 254 mm (10 in.) from the lamp and perpendicular to the light beam. For convenience, the lamp should be mounted on an extension of the sodium lamp support.

6.4.4 *Other Sources*—Helium may be used in place of hydrogen in the lamp discussed in 6.4.3.

6.4.5 *Light Filters*—For isolating the various spectral lines from the above sources, special light filters are required. The following are tentatively recommended:

Wave-length, Å	Spectral Line	Filter
6678	Helium	Corning No. 2404
6563	H _c	None required. May use Corning No. 2404.
5893	Na _D	None required
5461	Hg _c	Wratten No. 62, or No. 77A, Corning Nos. 3486 + 4303 + 5120
5016	Helium	Wratten No. 45
4861	H _F	Corning Nos. 5030 + 3387, 4303, or Wratten No. 45
4358	Hg _g	Corning Nos. 5113, 3389 + 5850.

NOTE 5—In determinations of refractive indexes above approximately 1.53 (wherever the short wavelengths show a higher scale reading than the long), this system of filters is rendered worthless, and filters must be chosen that remove all spectral lines of shorter wavelength than the one being read. Below this refractive index, the specific filters listed above, which remove spectral lines of longer wavelengths than the one being read, should be used.

7. Solvents

7.1 *n-Pentane*, 95 mol % minimum purity. (**Warning**—Extremely flammable. Harmful if inhaled. Vapors may cause flash fire.)

7.2 *Toluene*, conforming to Specification D 841. (**Warning**—Flammable. Vapor harmful.)

8. Reference Standards

8.1 *Solid Reference Standard*, accurate to ±0.000 02 with the value of the refractive index engraved upon its upper face.

8.2 *Primary Liquid Standards*—The organic liquids listed below, with the values of their refractive indexes for the *D*, *F*, and *C* lines certified at 20, 25, and 30°C, obtained from the API Standard Reference Office:⁶ (**Warning**—Flammable.)

2,2,4-Trimethylpentane	<i>n_D</i> = 1.39
Methylcyclohexane	<i>n_D</i> = 1.42
Toluene	<i>n_D</i> = 1.49

9. Sample

9.1 A sample of at least 0.5 mL is required. The sample shall be free of suspended solids, water, or other materials that tend to scatter light. Water can be removed from hydrocarbons by treatment with calcium chloride, followed by filtering or centrifuging to remove the desiccant. The possibility of changing the composition of a sample by action of the drying agent, by selective adsorption on the filter, or by fractional evaporation shall be considered. (**Warning**—Volatile hydrocarbon samples are flammable.)

10. Preparation of Apparatus

10.1 The refractometer shall be kept scrupulously clean at

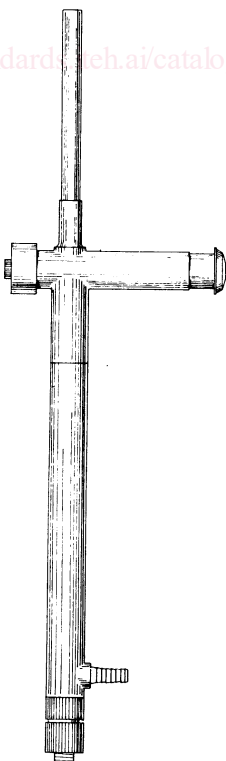


FIG. 1 Thermometer Holder

⁶ Available from ASTM Test Monitoring Ctr., 6555 Penn Ave., Pittsburgh, PA 15206.