Designation: D4790 – 14

Standard Terminology of Aromatic Hydrocarbons and Related Chemicals[1]

This standard is issued under the fixed designation D4790; 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. Referenced Documents

1.1 *ASTM Standards:*[2]

D835 Specification for Refined Benzene-485 (Withdrawn 1997)[3]
D841 Specification for Nitration Grade Toluene
D843 Specification for Nitration Grade Xylene
D846 Specification for Ten-Degree Xylene (Withdrawn 1989)[3]
D847 Test Method for Acidity of Benzene, Toluene, Xylenes, Solvent Naphthas, and Similar Industrial Aromatic Hydrocarbons
D848 Test Method for Acid Wash Color of Industrial Aromatic Hydrocarbons
D1015 Test Method for Freezing Points of High-Purity Hydrocarbons
D1016 Test Method for Purity of Hydrocarbons from Freezing Points
D1129 Terminology Relating to Water
D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
D1492 Test Method for Bromine Index of Aromatic Hydrocarbons by Coulometric Titration
D1840 Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry
D2031 Test Method for Reducing Substances in Refined Pyridine (Withdrawn 2003)[3]
D2121 Test Methods for Polymer Content of Styrene Monomer and AMS (α–Methylstyrene)
D2147 Method of Test for Detection and Estimation of Water-Insoluble Impurities in Refined Phenol by Cloud Point Depression (Withdrawn 1979)[3]
D2269 Test Method for Evaluation of White Mineral Oils by Ultraviolet Absorption
D2279 Method of Test for Acid Wash Color of Refined Naphthalene (Withdrawn 1982)[3]
D2323 Specification for Refined Pyridine (1 Degree) (Withdrawn 2003)[3]
D2359 Specification for Refined Benzene-535
D2403 Specification for Refined Phthalic Anhydride-1308 (Withdrawn 2008)[3]
D2777 Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water
D2827 Specification for Styrene Monomer
D2935 Test Method for Apparent Density of Industrial Aromatic Hydrocarbons (Withdrawn 2005)[3]
D3980 Practice for Interlaboratory Testing of Paint and Related Materials (Withdrawn 1998)[3]
D4053 Test Method for Benzene in Motor and Aviation Gasoline by Infrared Spectroscopy (Withdrawn 2013)[3]
D4734 Specification for Refined Benzene-545
E12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases (Withdrawn 1996)[3]

2. Terminology

absorbance, *n*—the logarithm to the base 10 of the reciprocal of the relative transmittance, *T*, expressed as:

$$A = \log_{10}(1/T) = -\log_{10} T \quad (1)$$

D1840, D2269, D4053; D02

accuracy, *n*—the agreement between the mean of a series of repeated measurements of a property and the accepted reference value of the property. **D3980; D01**

acidity, *n*—the number of milligrams of sodium hydroxide consumed when 100 mL of the sample are titrated under the conditions prescribed in this method. **D847; D16**

acid reaction, *n*—a characteristic of materials producing the acid-color of the indicator used under the conditions prescribed in this method. **D847; D16**

acid wash color, *n*—the color developed in the separated acid when a sample is agitated with sulfuric acid under the condition prescribed in this method. **D848; D2279; D16**

[1] This terminology is under the jurisdiction of ASTM Committee D16 on Aromatic Hydrocarbons and Related Chemicals and is the direct responsibility of Subcommittee D16.05 on Editorial and Nomenclature.

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The boldface designations refer to the original source of the definition and the ASTM Technical Committee having jurisdiction.

[2] 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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

aldehydes, *n*—a broad class of organic compounds having a generic formula RCHO, and characterized by a carbonyl group.

alkaline or basic reaction, *n*—a characteristic of the materials producing the alkalicolor of the indicator used under the conditions prescribed in this method. **D847; D16**

alpha-methylstyrene, *n*—2-phenylpropene (C_9H_{10}) mol weight 119.16; colorless liquid; subject to polymerization by heat or catalysts; freezing point, −23.21°C; boiling point, 165.38°C.

apparent density, *n*—the density calculated when the pycnometer is calibrated with water, weighed in air, and when the sample is weighed in air and no air buoyancy correction is used for either weighing, even though the density in vacuum of water is used in calculating the apparent volume of the pycnometer.

apparent density at 60°F, *n*—the weight in air of a unit volume of sample at 60°F; in this method, the weight is in pounds and the volume in U.S. liquid gallons. Average air in this method is assumed to have a density of 0.0012 g/cm^3.

DISCUSSION—This definition is not in conflict with that given in the current version of Definitions E12. **D2935; D16**

aromatic hydrocarbon, *n*—an organic chemical containing a benzene ring. Committee D16 scope includes moncyclic and polycyclic carbon-ring structures recovered or synthesized form any source, and which are intended primarily for use as solvents or raw materials for chemical synthesis.

aromatic hydrocarbon derivatives and related chemicals, *n*—Committee D16 scope includes chemicals such as: cycloalkanes such as cyclohexane which are intended primarily for use in chemical synthesis; phenols, arylthiols, and their homologs; heterocyclics such as pyridine and quinoline; and other chemicals synthesized from ring structures. Excluded from the scope are paraffinic and olefinic hydrocarbons, and those aromatic and cyclic aliphatic hydrocarbons that are intended primarily for fuels and lubricants.

at-line analysis, *n*—analytical procedure performed in a process environment using manually entered samples.

benzene, *n*—cyclohexatriene, benzol (obsolete) (C_6H_6) mol weight 78.11; clear, colorless, highly flammable liquid; characteristic odor; solidification point +5.5°C; boiling point 80.1°C.

benzene, carbon disulfide-free, *n*—benzene treated with alcoholic sodium hydroxide and used as a spectrophotometric reference standard.

benzene-535, refined, *n*—benzene with impurities limited to trace amounts by a solidification point of 5.35°C and having a total distillation range of no more than 1.0°C. Refer to Specification D2359 for complete specifications.

benzene-545, refined, *n*—benzene with impurities limited to trace amounts by a solidification point of 5.45°C and having a total distillation range of no more than 1°C. Refer to Specification D4734.

benzene-485, refined (nitration grade), *n*—benzene with impurities limited by a solidification point of 4.85°C and having a total distillation range of no more than 1.0°C. Refer to Specification D835 for complete specifications.

benzene, thiophene-free, *n*—benzene refined by special treatment and used as a reagent in ASTM standards.

bias, *n*—a persistent positive or negative deviation of a test method average value from the assumed or accepted true value. **D1129; D2777; D19**

bromine index, *n*—the number of milligrams of bromine consumed by 100 g of sample under given conditions. **D1492; D16**

carbon disulfide (CS_2), *n*—mol weight 76.14; clear, colorless, flammable, volatile liquid; boiling point, 45.6°C; freezing point, 111.6°C.

clear, *n*—free of turbidity.

cloud point of phenol, *n*—the temperature at which a separate phase forms when a homogeneous solution of phenol in water is allowed to cool at a prescribed rate from a temperature above that at which phase separation occurs. It may precisely be defined as follows: when a homogeneous solution of phenol and water is allowed to cool at a prescribed rate with stirring, the solution will show a slight cloudiness or turbidity as the cloud point is approached. On further cooling, the cloudiness will increase rapidly and the thermometer bulb, which is centrally located in the test tube, will suddenly become invisible. The temperature at which the thermometer bulb becomes invisible is taken as the cloud point. **D2147; D16**

cloudy, *n*—qualitative expression of turbidity.

confidence limits, *n*—the limits on either side of the mean value of a group of observations which will, in a stated fraction or percent of the cases include the expected value. Thus the 95 % confidence limits are the values between which the population mean will be situated in 95 out of 100 cases. **D3980; D01**

copper corrosion, *n*—a qualitative indication of reactive impurities in aromatic hydrocarbons. An iridescent, gray, or black discoloration of polished copper strip is considered cause for rejection.

corrosive substance, *n—in Committee D16 Standards*, material in industrial aromatic hydrocarbons that discolors or tarnishes polished copper.

cresol(s), *n*—methyl phenol, hydroxymethyl benzene (C_7H_8O) mol weight 108.13; colorless, yellowish, brownish, yellow, or pinkish liquid; phenolic odor. Three isomeric cresols exist.

cresylic acids, *n*—commercial mixtures of phenolic materials which may include phenol, cresols, xylenols, and other alkylated phenols.

cumene, *n*—(C_9H_{12}) mol weight 120.19; clear, flammable liquid; melting point, –96.0°C; boiling point, 152.4°C.

cyclohexane-995, *n*—cyclohexane with a purity of 99.5 weight % minimum determined by analysis by gas chromatography. Refer to proposed specifications for complete requirements.

degrees of freedom, *n*—the number of observations minus the number of constraints imposed upon the system. In general, only one constraint (for example, the mean value) is imposed and the total degrees of freedom are one less than the number of observations. **D3980; D01**

density in air, *n*—the weight per unit volume in vacuum minus the weight of a volume of air equal to the difference between the volume of the sample and the volume of brass weights equivalent to weight in vacuum of the sample.

dry point temperature, *n*—the temperature observed immediately after the liquid just disappears from the bottom of the flask during a distillation test.

effective carbon number (ECN), *n*—the response of a flame ionization detector (FID) to various organic function groups on a mass basis has been determined. This information is then combined to determine the response of the FID to various organic molecules relative to *n*-heptane. A specimen is analyzed by gas chromatography and the area of each component is corrected using the ECN-derived relative response factors. The corrected areas are then normalized to determine the results.

ethylbenzene (C_8H_{10}), *n*—mol weight 106.16; clear, colorless, flammable liquid; freezing point, –94.97°C; boiling point, 136°C.

evaporation residue, *n*—the nonvolatile impurities remaining after vaporizing a substance.

external standard calculation, *n*—a method of calculation for low-level components in a sample where the peak areas of the components of interest are compared to peak area of a standard of known composition analyzed under identical conditions.

freezing point, *n*—the temperature at which the liquid and solid states of a substance are in equilibrium at a given pressure (usually atmospheric). For pure substances it is identical with the melting point of the solid form. **Lange, 10th Ed.**[4]

homologues of phenol, *n*—compounds of the phenol series whose structure differs regularly by some radical (for example, -CH_3) from that of its adjacent neighbor in the series. Also *cresols* and *xylenols*.

hydrogen sulfide (H_2S), *n*—mol weight 34.08; flammable, poisonous gas with characteristic odor of rotten eggs.

industrial grade, *n*—a quality of aromatic hydrocarbons suitable for many industrial applications that have a tolerance for nonreactive impurities.

DISCUSSION—The classification covers intermediate levels of purity that may vary over a wide range for different materials.

inhibitor, *n*—a substance added to a material to retard or prevent deterioration.

initial boiling point, *n*—the temperature observed immediately after the first drop of distillate falls into the receiving cylinder during a distillation test.

internal standard calculation, *n*—a method of calculation for low-level components in a sample where the peak areas of the components of interest are compared to peak area of a compound, not originally present in the sample, which was quantitatively added to the specimen before analysis. The peak areas may be corrected for known differences in response by applying relative response factors.

isopropylbenzene—see **cumene**.

ketones, *n*—a class of organic compounds possessing a carbonyl group attached to two hydrocarbon groups. Acetone is the first member of this series.

meta-xylene, *n*—1,3-dimethylbenzene (C_8H_{10}) mol weight 106.16; clear, colorless, flammable liquid; freezing point, –47.87°C; boiling point, 139.3°C.

mixed xylenes, *n*—a mixture of C_8 aromatics including *m*-xylene, *o*-xylene, and *p*-xylene. Industry convention includes ethyl benzene as a 'mixed xylene' though ethyl benzene is not technically a xylene. Styrene is excluded.

moisture, atmospheric, *n*—ambient humidity that may be absorbed by hygroscopic material during sampling and testing and may lead to erroneous results.

molten state, *n*—the liquid phase of a solid substance existing above its melting point temperature.

naphtha, aromatic solvent, *n*—a concentrate of aromatic hydrocarbons including C_8, C_9 and C_{10} homologs.

DISCUSSION—Distillation end point of individual grades varies between 155 and 220°C to provide a range of volatility and solvency characteristics. Color of solvents is water-white to dark red depending on refining treatment.

naphthalene ($C_{10}H_6$), *n*—mol weight 128.16; monoclinic prismatic plates; commercially available as white scales, powder, balls, or cakes; odor of moth balls; solidification point, 80.1°C; sublimes above melting point.

nonaromatic hydrocarbons, *n*—one or more types of hydrocarbons identified as paraffins, cycloparaffins (naphthenes), and olefins. Generally, the saturated types, paraffins and cycloparaffins, constitute the impurities in the commercial grades of aromatic hydrocarbons.

nonvolatile matter, *n*—the oily, gummy, or resinous residue remaining after evaporating volatile hydrocarbon materials.

normalize, *n*—the practice of quantitation in gas chromatography of determining the peak area of each component in a

[4] Lange, N. A., *Handbook of Chemistry*, 10th Ed., McGraw Hill Book Co. Inc., New York, NY.

specimen, correcting the peak areas for differences in relative response if necessary, dividing the area (or corrected area) of each component by the total (corrected) area of all the components, and multiplying by 100 to obtain the percent concentration of each component.

on-line analysis, *n*—analytical procedure performed in a process environment using automatic or continuous sampling.

ortho-xylene, *n*—1,2-dimethylbenzene (C_8H_{10}) mol weight 106.16; clear, colorless, flammable liquid; freezing point, −25.18°C; boiling point, 144°C.

para-xylene, *n*—1,4-dimethylbenzene (C_8H_{10}) mol weight 106.16; clear, colorless, flammable liquid; freezing point, 13.26°C; boiling point, 137 to 138°C.

peroxides, *n*—a class of oxygen-containing compounds possessing a peroxyl-functional group. Hydrogen peroxide is the lowest member of this series.

phenol, *n*—hydroxy benzene, carbolic acid (C_6H_5OH) mol weight 94.11; colorless acicular crystals or white crystalline mass; characteristic odor; solidification point, 40.85°C; boiling point, 182°C.

phthalic anhydride, *n*—anhydride of phthalic acid ($C_8H_4O_3$) mol weight 148.11; white lustrous needles; odorless; solidification point, 130.8°C; boiling point, 295°C; sublimes.

phthalic anhydride-1308, refined, *n*—phthalic anhydride with impurities limited to ultra trace amounts as indicated by a solidification point of 130.8°C minimum refined to improve color characteristics. Refer to Specification D2403 for complete specifications.

platinum-cobalt color, *n*—color measured in reference to color standards prepared with solutions of cobalt chloride and potassium chloroplatinate. Color standards are identical with the description given in APHA publications[5] and is referred to as "APHA Color."

polymer(s), *n*—a large molecule formed by the chemical union of reactive units called monomers.

DISCUSSION—For Test Method D2121, polymers of styrene are those molecules that are insoluble in methanol.

polystyrene, *n*—a plastic based on a resin made by polymerization of styrene as the sole monomer. For use as a standard in colorimetry, the polystyrene shall contain no internal or external additives.

precision, *n*—the degree of agreement of repeated measurement of the same property, expressed in terms of dispersion of test results about the arithmetical mean result obtained by repetitive testing of a homogeneous sample under specified conditions. The precision of a test method is expressed quantitatively as a standard deviation computed from the results of a series of controlled determinations.

D2777; D19

n-propylbenzene, *n*—1-phenyl propane (C_9H_{12}) mol weight 120.19; used as a reference standard for identifying and determining C_9 aromatics; melting point, −99.2°C; boiling point, 159.2°C.

pyridine bases, *n*—a mixture of pyridine and substituted pyridines. The pyridine bases in tar acids refer to those that react with 0.02 *N* perchloric acid.

pyridine, refined, *n*—pyridine (including its impurities) having a total distillation range of 1.0°C. Refined to improve color characteristics. Refer to Specification D2323 for complete specifications.

quinoline, *n*—benzo(b)pyridine (C_9H_7N) mol weight 129.15; colorless, refractive oil which darkens on storage; hygroscopic; penetrating odor not as offensive as pyridine; freezing point, −15°C; boiling point, 237.7°C.

reagent blank, *n*—a reference standard or correction factor obtained by subjecting one or more reagents to test conditions.

reducing substances, *n*—impurities in pyridine that decolorize a solution of potassium permanganate of specified composition in Test Method D2031.

reference standard, *n*—primary or secondary standards used to calibrate testing apparatus and methods.

refined, *n*—treated to reduce impurities.

relative density (specific gravity), *n*—the ratio of the mass of a given volume of liquid at 15.56°C (60°F) to the mass of an equal volume of pure water at the same temperature. **D1298; D02**

repeatability, *n*—the precision of a test method expressed in terms of the agreement attainable between measurements made by a single operator using the same apparatus and techniques.

reproducibility, *n*—the precision of a test method expressed in terms of agreement expected between measurements made in different laboratories using similar apparatus and the same procedure.

slightly cloudy pyridine, *n*—quantitative index of turbidity observed with aqueous solution of pyridine, the latter containing trace amounts of oil.

solidification point, *n*—an empirical constant defined as the temperature at which the liquid phase of a substance is in approximate equilibrium with a relatively small portion of the solid phase.

DISCUSSION—Solidification point is distinguished from freezing point which is described in Test Method D1015. An interpretation of mole percent purity in terms of freezing point is given in Test Method D1016.

specific gravity in air, *n*—the ratio of the weight in air of a unit volume of a material at a stated temperature to the weight in air of equal density of an equal volume of gas free distilled water at a stated temperature.

standard deviation, *n*—a measure of the dispersion of a series of results around their mean, computed as the positive square

[5] *Standard Methods for the Examination of Water and Waste Water*, 14 Ed., American Public Health Association (APHA), p. 65.

root of the variance. The standard deviation is the basis for most statements of precision and may be obtained from an analysis of variance of results of an interlaboratory test program. **D3980; D01**

styrene monomer, *n*—ethenylbenzene, vinylbenzene, phenylethylene, ($C_6H_5CH = CH_2$) mol weight 104.15; clear, colorless, flammable liquid; characteristic odor; solidification point −30.6°C; boiling point 145.2°C. Refer to Specification D2827 for complete specifications.

sulfur dioxide (SO_2), *n*—mol weight 64.07; colorless, nonflammable gas with strong suffocating odor soluble in water and organic solvents.

synthesis grade, *n*—a quality of aromatic hydrocarbons and related chemicals representing the highest purity available on a commercial scale. It encompasses those materials identified with a quantitative index of purity.

4-tertiary butyl catechol, *n*—*p-tert*-butylcatechol ($C_{10}H_{14}O_2$) mol weight 166.2; colorless crystals; polymerization inhibitor for styrene, butadiene, and other olefins; boiling point, 285°C; melting point, 52°C.

thiophene, *n*—thiofuran (C_4H_4S) mol weight 84.13; a cyclic organosulfur; colorless, highly reactive liquid; freezing point, −38.5°C; boiling point, 84.12°C.

toluene, *n*—methyl benzene, toluol (obsolete) (C_7H_8) mol weight 92.13; clear, colorless, highly flammable liquid; odor somewhat like benzene; freezing point, −94.99°C; boiling point, 110.6°C.

toluene, nitration grade, *n*—toluene with maximum paraffin impurities of 1.5 volume % having a total distillation range of 1°C maximum. Refer to Specification D841 for complete specifications.

total distillation range, *n*—the temperature range, expressed in degrees Celsius, observed in vaporizing a material under specified conditions.

DISCUSSION—In the standard apparatus used for aromatic hydrocarbons, this temperature range is the difference between the dry point temperature and the initial boiling point.

total non-aromatics, *n*—are all components eluting before *ortho*-xylene, excluding benzene, toluene, ethylbenzene, *para*-xylene, *meta*-xylene and cumene for GC methods using a polar column such as polyethylene glycol. Any internal standard used for calibration is also excluded. Generally, non-aromatics are summed and reported as a group. If a non-aromatic is reported separately, the grouping would not include the separately reported non-aromatic and the remaining non-aromatics would be reported as total non-aromatics other than x. This definition is not intended to be correct for all possible cases and should only be used for determining if a high purity product meets specifications.

total C9+ aromatics, *n*—are cumene, plus all components eluting after *ortho*-xylene for GC methods using a polar column such as polyethylene glycol. Generally, C9+ aromatics are summed and reported as a group. In certain cases, one or more individual C9+ aromatics such as cumene or *p*-diethylbenzene (PDEB) may be reported separately. In those cases, the grouping would not include the separately reported component(s) and the remaining C9+ aromatics would be reported as total C9+ aromatics other than component(s). This definition is not intended to be correct for all possible cases and should only be used for determining if a high purity product meets specifications.

water solubility, *n*—the amount of material that is miscible or will dissolve in water at a given temperature.

xylene, *n*—a mixture of C_8 aromatic hydrocarbons.

DISCUSSION—The concentration range of individual components in xylene samples from coal tar and petroleum sources is indicated in the following tabulation:

Component	Weight %
Ethylbenzene	4–20
p-Xylene	9–20
m-Xylene	40–63
o-Xylene	5–22
C_9 Aromatics	0.3–1

xylene, nitration grade, *n*—xylene consisting principally of the meta isomer and having a total distillation range of no more than 5°C. Nonaromatic impurities is limited to a maximum of 4 volume %. Refer to Specification D843 for complete specifications.

xylene, 10°C, *n*—xylene having a total distillation range of no more than 10°C. This range brackets the boiling points of the three individual isomers and ethylbenzene. Refer to Specification D846 for complete specifications.

xylenol(s), *n*—dimethyl phenol(s), hydroxydimethylbenzene ($C_8H_{10}O$) mol weight 122.16; colorless crystalline powders. Five isomeric xylenols exist.

xylenes – three isomers, *n*—*m*-xylene (1,3-dimethylbenzene), *o*-xylene (1,2-dimethylbenzene) and *p*-xylene (1,4-dimethylbenzene).

SUMMARY OF CHANGES

Committee D16 has identified the location of selected changes to this standard since the last issue (D4790–11) that may impact the use of this standard. (Approved July 1, 2014.)

(1) Added definitions total non-aromatics and total C9+ aromatics.