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Standard Terminology Relating to Hazard Potential of Chemicals[1]

This standard is issued under the fixed designation E 1445; 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 This standard is a compilation of terminology used in the area of hazard potential of chemicals. Terms that are generally understood or adequately defined in other readily available sources are not included.

1.2 Although some of these definitions are general in nature, many must be used in the context of the standards in which they appear. The pertinent standard number is given in parentheses after the definition.

1.3 In the interest of common understanding and standardization, consistent word usage is encouraged to help eliminate the major barrier to effective technical communication.

2. Referenced Documents

2.1 ~~*ASTM Standards:*~~

~~E476Test Method for Thermal Instability of Confined Condensed Phase Systems (Confinement Test)~~
~~E487Test Method for Constant-Temperature Stability of Chemical Materials[2]~~
~~E537Test Method for Assessing the Thermal Stability of Chemicals by Methods of Thermal Analysis[2]~~
~~E659Test Method for Autoignition Temperature of Liquid Chemicals[2]~~
~~E680Test Method for Drop Weight Impact Sensitivity of Solid-Phase Hazardous Materials[2]~~
~~E681Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)[2]~~
~~E698Test Method for Arrhenius Kinetic Constants for Thermally Unstable Materials[2]~~
~~E771Test Method for Spontaneous Heating Tendency of Materials[2]~~
~~E918Practice for Determining Limits of Flammability of Chemicals at Elevated Temperature and Pressure[2]~~
~~E1226Test Method for Pressure and Rate of Pressure Rise for Combustible Dusts[2]~~
~~E1231Practice for Calculation of Hazard Potential Figures-of-Merit for Thermally Unstable Materials[2]~~
~~E1232Test Method for Temperature Limit of Flammability of Chemicals[2]~~
~~E1491Test Method for Minimum Autoignition Temperature of Dust Clouds[2]~~
~~E1515Test Method for Minimum Explosible Concentration of Combustible Dusts[2]~~
~~E2012Guide for the Preparation of a Binary Chemical Compatibility Chart[2]~~
~~E2019Test Method for Minimum Ignition Energy of a Dust Cloud in Air[2]~~
~~E2021Test Method for Hot-Surface Ignition Temperature of Dust Layers[2]~~
~~E2046Test Method for Feaction Induction Time by Thermal Analysis[2]~~ ASTM Standards: [2]
E 476 Test Method for Thermal Instability of Confined Condensed Phase Systems (Confinement Test)
E 487 Test Method for Constant-Temperature Stability Of Chemical Materials
E 537 Test Method for The Thermal Stability Of Chemicals By Differential Scanning Calorimetry
E 582 Test Method for Minimum Ignition Energy and Quenching Distance in Gaseous Mixtures
E 659 Test Method for Autoignition Temperature of Liquid Chemicals
E 680 Test Method for Drop Weight Impact Sensitivity Of Solid-Phase Hazardous Materials
E 681 Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)
E 698 Test Method for Arrhenius Kinetic Constants for Thermally Unstable Materials Using Differential Scanning Calorimetry and the Flynn/Wall/Ozawa Method
E 771 Test Method for Spontaneous Heating Tendency of Materials
E 918 Practice for Determining Limits of Flammability of Chemicals at Elevated Temperature and Pressure

[1] This terminology is under the jurisdiction of ASTM Committee E27 on Hazard Potential of Chemicals and is the direct responsibility of Subcommittee E27.01 on Editorial and Nomenclature.

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~~[2] Annual Book of ASTM Standards, Vol 14.02.~~

[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.

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E 1226 Test Method for Pressure and Rate of Pressure Rise for Combustible Dusts
E 1231 Practice for Calculation of Hazard Potential Figures-of-Merit for Thermally Unstable Materials
E 1232 Test Method for Temperature Limit of Flammability of Chemicals
E 1491 Test Method for Minimum Autoignition Temperature of Dust Clouds
E 1515 Test Method for Minimum Explosible Concentration of Combustible Dusts
E 1981 Guide for Assessing Thermal Stability of Materials by Methods of Accelerating Rate Calorimetry
E 2012 Guide for the Preparation of a Binary Chemical Compatibility Chart
E 2019 Test Method for Minimum Ignition Energy of a Dust Cloud in Air
E 2021 Test Method for Hot-Surface Ignition Temperature of Dust Layers
E 2046 Test Method for Reaction Induction Time by Thermal Analysis

3. Terminology

3.1 *Definitions:*

adiabatic calorimeter, *n*—an instrument capable of making calorimetric measurements while maintaining a minimal heat loss or gain between the sample and its environment, which is verifiable by the capability to continuously measure the temperature differential between the sample and its surroundings. **(E 1981)**

adiabatic decomposition temperature rise, $(T)_d$, *n*—an estimation of the computed temperature which a specimen would attain if all of the enthalpy (heat) of decomposition reaction were to be absorbed by the sample itself. High values represent high hazard potential. ~~**(E1231)**~~ **(E 1231)**

anvil, *n*—the smooth, hardened surface upon which the test sample or cup containing the sample rests. ~~**(E680)**~~ **(E 680)**

Arrhenius equation—$k = Ze^{-E/RT}$ where k is the specific reaction rate constant in reciprocal minutes for first order, Z is the pre-exponential factor in reciprocal minutes, E is the Arrhenius activation energy in J/mol, R is the gas constant, 8.32 J/mol K, and T is the temperature in kelvin. ~~**(E698)**~~ **(E 698)**

autoignition, *n*—the ignition of a material commonly in air as the result of heat liberation due to an exothermic oxidation reaction in the absence of an external ignition source such as a spark or flame. ~~**(E659)**~~ **(E 659)**

autoignition temperature, *n*—the minimum temperature at which autoignition occurs under the specified conditions of test. ~~**(E659)**~~ **(E 659)**

DISCUSSION—Autoignition temperature is also referred to as spontaneous ignition temperature, self-ignition temperature, autogenous ignition temperature, and by the acronyms AIT and SIT. AIT is the lowest temperature at which the substance will produce hot-flame ignition in air at atmospheric pressure without the aid of an external energy source such as spark or flame. It is the lowest temperature to which a combustible mixture must be raised, so that the rate of heat evolved by the exothermic oxidation reaction will over-balance the rate at which heat is lost to the surroundings and cause ignition.

compatibility, *adj*—the ability of materials to exist in contact without specified (usually hazardous) consequences under a defined scenario. ~~**(E2012)**~~ **(E 2012)**

constant-temperature stability (CTS) value, *n*—the maximum temperature at which a chemical compound or mixture may be held for a 2-h period under the conditions of the test without exhibiting a measurable exothermic reaction. ~~**(E487)**~~ **(E 487)**

cool-flame, *n*—a faint, pale blue luminescence or flame occurring below the autoignition temperature (AIT). ~~**(E659)**~~ **(E 659)**

DISCUSSION—Cool-flames occur in rich vapor-air mixtures of most hydrocarbons and oxygenated hydrocarbons. They are the first part of the multistage ignition process.

critical half thickness, (a), *n*—an estimation of the half thickness of a sample in an *unstirred container,* in which the heat losses to the environment are less than the retained heat. This buildup of internal temperature leads to a thermal-runaway reaction. ~~**(E1231)**~~ **(E 1231)**

critical temperature, (T_c), *n*—an estimation of the lowest temperature of an *unstirred container* at which the heat losses to the environment are less than the retained heat leading to a buildup of internal temperature. This temperature buildup leads to a thermal-runaway reaction. ~~**(E1231)**~~ **(E 1231)**

DISCUSSION—This description assumes perfect heat removal at the reaction boundary. This condition is not met if the reaction takes place in an insulated container such as when several containers are stacked together or when a container is boxed for shipment. These figures-of-merit underestimate the hazard as a result of this underestimation of thermal conductivity.

deflagration index, (K_{St}), *n*—maximum *dP/dt* normalized to a 1.0 m^3 volume. It is measured at the optimum dust concentration. K_{St} is defined according to the following cubic relationship:

$$K_{St} = (dP/dt)_{max} V^{1/3}$$

where:
P = pressure, (bar)
t = time, (s)
V = volume, (m^3)