

Ignition Risk of Hydrocarbon Liquids and Vapors by Hot Surfaces in the Open Air

API RECOMMENDED PRACTICE 2216
THIRD EDITION, DECEMBER 2003

REAFFIRMED, OCTOBER 2015



AMERICAN PETROLEUM INSTITUTE

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Downstream Segment

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FOREWORD

Recommended Practice 2216 *Ignition Risk of Hydrocarbon Liquids and Vapors by Hot Surfaces in the Open Air* was prepared under the auspices of the API Safety and Fire Protection Subcommittee. It is intended to provide information concerning the technical basis for auto-ignition of hydrocarbon vapors by hot surfaces in the open air. This information may be used to determine whether or not hot surfaces are potential sources of ignition should a release of hydrocarbon vapors or liquids occur and to develop safe practices for controlling or preventing such ignition. Other documents referenced in this publication provide supplemental information applicable to this subject.

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Ignition Risk of Hydrocarbon Liquids and Vapors by Hot Surfaces in the Open Air

1 GENERAL

1.1 SCOPE

This recommended practice provides information concerning the potential for ignition of hydrocarbons that are exposed to hot surfaces in the open air. Hydrocarbon liquids, when heated sufficiently, can ignite without the application of a flame or spark. The ignition of hydrocarbons by hot surfaces may occur when oil is released under pressure and sprays on a hot surface or is spilled and lies on a hot surface for a period of time. Understanding the mechanism and dynamics of auto-ignition is an important step in preventing or controlling the ignition of hydrocarbons by hot surfaces in the open air. In addition to the information provided herein, appropriate industry standards and other information may assist users to understand the potential hazards of hydrocarbon auto-ignition (such as spontaneous combustion) not specifically covered by this publication and implement appropriate prevention and control measures.

1.2 APPLICABILITY

Hot surfaces, in areas where hydrocarbon liquids or vapors are present and may be released, are often presumed to be the sources of ignition should fires occur. However, it is generally recognized by the petroleum industry that hot surfaces, even at temperatures considerably above the auto-ignition temperatures (AIT) of the hydrocarbons involved, are not always capable of igniting flammable vapor-in-air mixtures. This publication provides information applicable to the better understanding and controlling of hot surface ignition hazards.

1.3 NON-APPLICABILITY

This recommended practice does not cover every possible hazard or situation that may involve ignition of hydrocarbon liquids and vapors from hot surfaces. This publication does not apply to the ignition of hydrocarbons when certain conditions occur, such as spontaneous combustion (see 2.2). The mechanism for spontaneous combustion is entirely different from that required for ignition of hydrocarbon vapors from contact with hot surfaces in open air. This publication also does not apply to the ignition of hydrocarbon vapors when contacted by heated or glowing metal such as welding slag or by direct impact of super-hot exhaust fumes or gases. In addition, this publication does not cover ignitions arising from hydrocarbon liquids trapped behind rust or oil soaked or saturated insulation or rust covering hot surfaces.

2 DEFINITIONS

2.1 Auto-ignition: 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.

2.2 Auto-ignition Temperature (AIT): The AIT of a substance is the minimum temperature required to initiate or cause self-sustained combustion (exothermic reaction) independent of an external ignition source. As used in this publication, it is the minimum temperature at which auto-ignition occurs under the specified conditions of the ASTM E 659 test¹ (see Section 6). The terms, “*auto-ignition temperature*,” “*ignition temperature*,” “*self ignition temperature*,” “*autogenous ignition temperature*,” and “*spontaneous ignition temperature*,” are used synonymously in this publication. ASTM E 659.

3 AUTO-IGNITION TEMPERATURE TESTING

3.1 GENERAL

This recommended practice covers the technical basis for the risk of ignition of hydrocarbons by hot surfaces based on AIT and the practical implications thereof. An understanding of AIT is important when hydrocarbon vapors or liquids are exposed to hot surfaces or when handling very hot hydrocarbon liquids. It should be understood that ignition of flammable hydrocarbon vapors by a hot surface at the minimum ignition temperatures (for the specific hydrocarbon) is not likely. Experimental studies, testing and practical experience have shown that hot surfaces must typically be hundreds of degrees above published minimum ignition temperatures to ignite freely moving hydrocarbon vapor in the open air. Even properly operating automotive vehicle catalytic exhaust systems, in most instances, do not create a surface temperature sufficiently high enough to ignite hydrocarbon vapors in the open air². Whether or not flames will develop when a hydrocarbon contacts a hot surface depends not only on the surface temperature, but also on the extent (size) of the hot surface, its geometry and the ambient conditions³.

The following information, covering AIT research, is intended to assist in understanding why the ignition of hydrocarbon vapors by hot surfaces (at published minimum AITs), is highly improbable.

3.2 AUTO-IGNITION TEMPERATURE TESTING CRITERIA

Although the definition for “auto-ignition temperature” is specific, the values observed when testing specific hydrocarbons will be different depending on the conditions at the time of testing and the test method used. AITs observed under one set of conditions may be changed substantially by different conditions⁴. Some of the variables that affect AITs are the molecular structure of the hydrocarbon mixture (i.e., gaso-