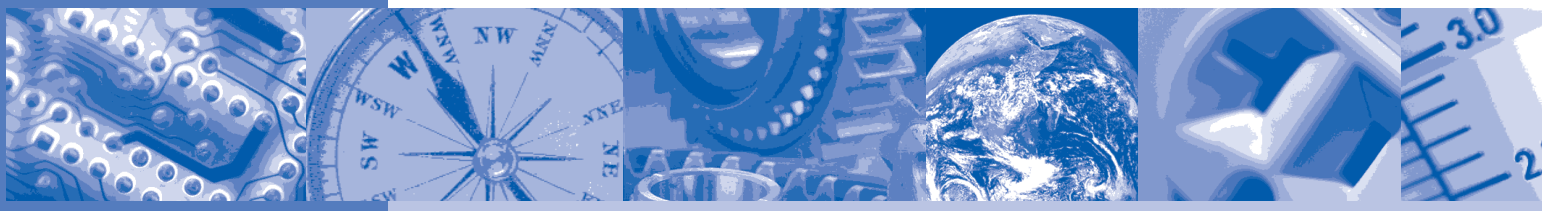
ISA–TR12.13.01–1999



Flammability Characteristics of Combustible Gases and Vapors

Approved 28 February 1999

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ISA
67 Alexander Drive
P.O. Box 12277
Research Triangle Park, North Carolina 27709

PREFACE

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FOREWORD

As a service to industry, the accompanying document, Bureau of Mines Bulletin 627 - Flammability Characteristics of Combustible Gases and Vapors, by Zabetakis 1965, is hereby reprinted in its entirety.

This compendium, formerly available from the U.S. Bureau of Mines, contains information essential to an understanding of detection, measurement and handling of flammable gases and vapors.

For further information, refer to ISA–TR12.13.02.

The reader should be aware that more recent LFL/UFL figures are available in NFPA 497, and IEC 60079-20.

ABSTRACT

This technical report includes theoretical and practical work carried out and collected by the U.S. Bureau of Mines relating to ignition and explosive properties of flammable gas mixtures. Flammability limits, under varying conditions of proportion, temperature and pressure, are presented.

While the primary emphasis is on methane-air mixtures as found in coal mines, a full treatment of many other gases and vapors is included.

KEY WORDS

Methane
Fire
Explosion
Flammability limits
Flammable
Combustible
LEL, UEL
LFL, UFL
Gas

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APPENDIX I

The following document, *Flammability Characteristics of Combustible Gases and Vapors*, is reprinted in its entirety by permission of the publisher, the Bureau of Mines, U.S. Department of the Interior.

Bulletin 627

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FLAMMABILITY CHARACTERISTICS OF COMBUSTIBLE GASES AND VAPORS, U.S. Bureau of Mines, Bulletin 627

By Michael G. Zabetakis

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FLAMMABILITY CHARACTERISTICS OF COMBUSTIBLE GASES AND VAPORS

by

Michael G. Zabetakis"

Abstract

This is a summary of the available limit of flammability, autoignition, and burning-rate data for more than 200 combustible gases and vapors in air and other oxidants, as well as of empirical rules and graphs that can be used to predict similar data for thousands of other combustibles under a variety of environmental conditions. Specific data are presented on the paraffinic, unsaturated, aromatic, and alicyclic hydrocarbons, alcohols, ethers, aldehydes, ketones, and sulfur compounds, and an assortment of fuels, fuel blends, hydraulic fluids, engine oils, and miscellaneous combustible gases and vapors.

Introduction

Prevention of unwanted fires and gas explosion disasters requires a knowledge of flammability characteristics (limits of flammability, ignition requirements, and burning rates) of pertinent combustible gases and vapors likely to be encountered under various conditions of use (or misuse). Available data may not always be adequate for use in a particular application since they may have been obtained at a lower temperature and pressure than is encountered in practice. For example, the quantity of air that is required to decrease the combustible vapor concentration to a safe level in a particular process carried out at 200°C should be based on flammability data obtained at this temperature. When these are not available, suitable approximations can be made to permit a realistic evaluation of the hazards associated with the process being considered; such approximations can serve as the basis for designing suitable safety devices for the protection of personnel and equipment.

The purpose of this bulletin is to present a general review of the subject of flammability, and to supply select experimental data and empirical rules on the flammability characteristics of various families of combustible gases and vapors in air and other oxidizing atmospheres. It contains what are believed to be the latest and most reliable data for more than 200 combustibles of interest to those concerned with the prevention of disastrous gas explosions. In addition, the empirical rules and graphs presented here can be used to predict similar data for other combustibles under a variety of conditions. This bulletin supplements Bureau bulletins (40)[N] and other publications (158).

"Physical chemist, project coordinator, Gas Explosion, Explosives Research Center, Bureau of Mines, Pittsburgh, Pa.

Work on manuscript completed May 1964.

[N]Italicized numbers in parentheses refer to items in the bibliography at the end of this report.