

CGA G-17—2012

PHOSPHINE

FIRST EDITION



**COMPRESSED GAS
ASSOCIATION, INC.**

PREFACE

As part of a program of harmonization of industry standards, the Compressed Gas Association (CGA) has adopted the *Code of Practice Phosphine* jointly produced by the Asia Industrial Gases Association (AIGA) and the Japan Industrial and Medical Gases Association (JIMGA).

This standard is intended as an international harmonized publication for the worldwide use and application by all members of AIGA, CGA, the European Industrial Gases Association (EIGA), and JIMGA. The CGA edition has the same technical content as the AIGA/JIMGA edition, however, there are editorial changes primarily in formatting, units used and spelling. Also, any references to regional regulatory requirements have been replaced with the relevant North American requirements.

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This document is subject to periodic review, and users are cautioned to obtain the latest edition. The Association invites comments and suggestions for consideration. In connection with such review, any such comments or suggestions will be fully reviewed by the Association after giving the party, upon request, a reasonable opportunity to be heard. Proposed changes may be submitted via the Internet at our website, www.cganet.com.

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1 Introduction

Phosphine is a toxic, colorless gas with an odor of decaying fish at room temperature and atmospheric pressure. It is shipped as a liquefied compressed gas under its own vapor pressure of 502 psia (3.46 MPa, abs).¹ It is also supplied as a compressed gas mixture, diluted with other gases under pressure. It is flammable, pyrophoric, and highly toxic.

The use of phosphine has constantly been growing and this usage is expected to continue to escalate throughout the world. The issue of the safe handling of phosphine is a very important and relevant topic to the compressed gas industry as well as the user community of this electronic specialty gas.

Phosphine is used as a doping agent for silicon-based solid-state electronic devices. It is thermally diffused into the silicon layer using furnaces or by an ion implantation system (n-type dopant). It is also used to manufacture compound semiconductors such as light-emitting diodes (LEDs) by reaction with a metal organic compound, such as tri-methyl gallium forming a gallium phosphide layer. Phosphine is also used in the semiconductor industry to grow a capping layer. Phosphine can be inadvertently generated in mining and manufacturing processes involving phosphorous compounds and in paints and herbicides containing phosphorous compounds. Phosphine is also used as a fumigant for grain.

Phosphine can be safely handled if equipment is properly designed, maintained, and employees are trained. As a minimum, all personnel should have access to the phosphine material safety data sheet (MSDS) and training in the use of the MSDS and other reference material.

NOTE—In this publication, phosphine is understood to be in the gaseous phase unless otherwise stated.

2 Scope and Purpose

2.1 Scope

This publication is intended for the suppliers, distributors, and users of phosphine and its handling equipment. It includes guidance for design of equipment, cylinders and valve usage, handling controls and safety. Guidelines on the operational steps associated with the use of phosphine and phosphine mixtures as well as fire protection, gas detection, ventilation and related safeguards are also included. The manufacture, purification, and analysis of phosphine are beyond the scope of this publication, although the general guidance given is also relevant to these processes.

2.2 Purpose

Due to the high toxicity and flammability of phosphine where the consequences of improperly handling can cause injury, death and/or facility damage, this publication has been written. This publication will provide an understanding of the potential hazards involved in handling phosphine and the precautions to be taken to reduce risk potential.

3 Definitions [2]

Absolute pressure: is based on a zero reference point, the perfect vacuum. Measured from this reference, the standard atmospheric pressure at sea level is 14.7 psia (101.325 kPa, abs); however, local atmospheric pressure can deviate from this standard value because of weather conditions and the distance above or below sea level.

Apparatus: Accessory equipment, such as valves, pressure relief devices, regulators, nonreturn valve (check valve) used with compressed gas.

ADR/RID: European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) and Rail (RID).

¹ kPa and MPa shall indicate gauge pressure unless otherwise noted as (kPa, abs and MPa, abs) for absolute pressure or (kPa, differential or MPa, differential) for differential pressure. All kPa values are rounded off per CGA P-11, *Metric Practice Guide for the Compressed Gas Industry* [1].