ANSI/CGA G-13—2016

STORAGE AND HANDLING OF SILANE AND SILANE MIXTURES

THIRD EDITION

Compressed Gas Association

The Standard For Safety Since 1913

PREFACE:

As part of a program of harmonization of industry standards, the Compressed Gas Association (CGA) has published CGA G-13, *Storage and Handling of Silane And Silane Mixtures*, jointly produced by members of the International Harmonization Council.

This publication is intended as an international harmonized standard for the worldwide use and application of all members of the Asia Industrial Gases Association (AIGA), Compressed Gas Association (CGA), European Industrial Gases Association (EIGA), and Japan Industrial and Medical Gases Association (JIMGA). Each association's technical content is identical, except for regional regulatory requirements and minor changes in formatting and spelling.

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Work Item 06-056
Specialty Gases Committee

NOTE— Due to the extensive changes in this standard, technical changes from the previous changes are not identified.

NOTE—Appendices A and B (Informative) are for information only.

NOTE—Appendices C and D (Normative) are requirements.

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SECOND EDITION: 2006
FIRST EDITION: 2000

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1 Introduction

The use of the pyrophoric gas silane as a source of silicon has grown with its consumption by semiconductor manufacturers, video display manufacturers, producers of solar cells, and allied technologies. Systems once imagined to be rare are now commonplace and are in use worldwide. Hazards of this material are noteworthy due to the ability of this material to self-ignite with visible flame upon release or in other cases to be released with either no ignition or delayed ignition. This material has been the subject of technical study by users and suppliers [1].[1] Studies conducted by the Compressed Gas Association (CGA) of the release of both large and small scale quantities of silane have produced new technical data [2, 3, 4]. The data have been used to establish minimum separation distances for delivery system installations as well as for the storage of this material. Distance limitations are used to lessen risk to property and personnel in the event of an inadvertent release. The distances determined recognize the probability for immediate ignition as well as the probability of latent ignition with its potential explosive effects. Although the uncontrolled release of compressed gas is a cause for concern, it is the application of engineering and administrative controls to prevent the release of material that allows the users to handle this material at a reduced level of risk. Suppliers and users have contributed to the development of these controls presented in this standard as a means to provide reasonable safeguards for handling this unique material that is characterized by its chemical and physical nature.

It is intended that this standard applies to storage and use of silane containers with the exception of small containers with 0.5 scf (14 L) or less of silane content.

2 Scope and purpose

2.1 Scope

This standard governs the installation of systems and sources that are used to store, transfer, or contain silane or silane mixtures. This standard includes guidance for siting, design of equipment, piping and controls, and the fabrication and installation of silane gas storage and closed-use systems. Additional guidance on operational steps associated with the use of silane and silane mixtures as well as fire protection, gas monitoring, ventilation, and related safeguards are provided.

2.1.1 Application

The requirements of this standard apply to pure silane and silane mixtures with a silane content greater than 1.37% [5]. A concentration of 1.37% has been chosen as it represents the lower flammable limit (LFL) for this material in air under conditions of normal temperature and pressure. Silane containers include tube trailers, International Organization for Standardization (ISO) modules, cylinder packs with manifolded cylinders, and individual cylinders. Silane mixes containing other hazardous components (e.g., toxics) may have additional requirements beyond this standard. These other requirements shall also be taken into consideration and may exceed requirements in this standard.

2.1.2 Limitations

This standard is not intended to provide requirements beyond the first point of control within a user's facility where connections are made to piping systems associated with internal transmission and/or use of this material.

The following subjects are outside the scope of this standard:

- Equipment downstream of a gas cabinet with the exception of valve manifold boxes (VMBs) when used;
- Off-site transportation of compressed gases regulated by the U.S. Department of Transportation (DOT), European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), or other regulatory authorities; and
- Requirements within the jurisdiction of local, state, provincial/territorial, and national regulatory authorities with laws or regulations that preempt the provisions of this standard. When such is the case, it is recommended that the authority having jurisdiction (AHJ) be guided by this standard in determining requirements.

[1] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

This standard is not intended to replace or fulfill the requirements of a Risk Management Program (RMP) as mandated under Section 112(r) of the *Clean Air Act*, generally referred to as the Environmental Protection Agency (EPA) RMP rule. A full RMP is comprised of a hazard assessment, a management system, a prevention program, and an emergency response program. Such programs and assessments shall be developed on a case-by-case basis in response to the requirements of the RMP and the circumstances found at each individual company where silane is stored or used.

2.2 Purpose

The purpose of this standard is to prescribe the controls for the installation of silane systems and the recommended methods for storage or transfer of silane or its mixtures from a source of supply to a point of use to provide protection against injury, loss of life, and property damage.

2.3 Equivalency

Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire-resistance, effectiveness, durability, and safety over those prescribed by this standard. Systems, methods, or devices to be used as equivalents shall be supported by technical documentation that demonstrates equivalency. The use of equivalencies shall be subject to approval by the AHJ.

3 Definitions

For the purpose of this standard, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall
Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should
Indicates that a procedure is recommended.

3.1.3 May
Indicates that the procedure is optional.

3.1.4 Will
Is used only to indicate the future, not a degree of requirement.

3.1.5 Can
Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Barricade construction
Room, building, or enclosed structure of such type, size, and construction as to limit in a prescribed manner the effect of an explosion on nearby buildings or within the building in which an explosion occurs.

3.2.2 Barrier, shield
Partition constructed of materials to isolate the hazard from contact with personnel.

NOTE—Barriers are designed with structural strength and arranged to resist physical forces.

NOTE—See Appendix A for information on personnel protection.

3.2.3 Burning velocity
Intrinsic property of burning gases or vapors expressed as the motion of the flame relative to the motion of the unburned gas.

3.2.4 Container

3.2.4.1 Cylinder
Seamless pressure vessel having a nominal water capacity up to 50 L.

3.2.4.1.1 Cylinder packs
Arrangement of cylinders into a cluster where the cylinders are confined into a grouping or arrangement with a strapping or frame system and connections are made to a common manifold.

For silane service, each cylinder shall be fitted with an individual shutoff valve. The frame system is allowed to be on skids or wheels to permit movement.

3.2.4.1.2 ISO module
Multi-modal assembly of cylinders, tubes, or bundles of cylinders that are interconnected by a manifold and assembled within a framework.

NOTE—The ISO module includes service equipment and structural equipment necessary for the transport of gases. The frame of an ISO module and its corner castings are specially designed and dimensioned for use in multi-modal transportation service on container ships, special highway chassis, and container-on-flatcar railroad equipment. An ISO module may also be referred to in regulations as a MEGC and its' equivalent.

3.2.4.1.3 Multiple-element gas container (MEGC)
Assembly of cylinders, tubes, or bundles of cylinders that are interconnected by a manifold and are assembled within a framework.

NOTE—The MEGC module includes service equipment and structural equipment necessary for the transport of gases.

3.2.4.2 Packages greater than 50 L
Any individual or manifolded collection of seamless pressure vessel(s) having a collective nominal water capacity greater than 50 L.

NOTE—These can include an ISO module, multiple-element gas containers (MEGCs), tubes, tube trailers, cylinder packs, nominal 450 L (ton tank), or other packages as defined by regulations or codes.

3.2.4.2.1 Ton tank(s)
Seamless pressure vessel having a nominal water capacity of 450 L.

3.2.4.2.2 Tube trailers
Truck or semitrailer on which a number of tubes have been mounted and manifolded into a common piping system.

3.2.4.2.3 Tubes
Seamless pressure vessel having a nominal water capacity exceeding 150 L but not more than 3000 L.

3.2.5 Deflagration
Exothermic reaction such as extremely rapid oxidation of a flammable dust or vapor in air in which the reaction progresses through the unburned material at a rate less than the velocity of sound.

NOTE—A deflagration will have an explosive effect.

3.2.6 Detonation
Exothermic reaction characterized by the pressure of a shock wave in material that establishes and maintains the reaction.

NOTE—The reaction zone progresses through the material at a rate greater than the velocity of sound. The principal heating mechanism is one of shock compression. A detonation will have an explosive effect.

3.2.7 Emergency response containment vessel (ERCV)
Nationally or regionally approved pressure vessel used to contain leaking gas cylinders for transportation.