

CGA G-5.3—2024

8TH EDITION

COMMODITY SPECIFICATION FOR HYDROGEN



Documents

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Hydrogen Technology Committee

NOTE—Technical changes from the previous edition are underlined.

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1 Scope

This publication describes the specification requirements for gaseous and liquid hydrogen including hydrogen for fuel cell applications.

2 Definitions

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

2.1 Publication terminology

2.1.1 Shall

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

2.1.2 Should

Indicates that a procedure is recommended.

2.1.3 May

Indicates that the procedure is optional.

2.1.4 Will

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

2.1.5 Can

Indicates a possibility or ability.

2.2 Technical definitions

2.2.1 Container

Portable compressed gas cylinders and liquid containers made in accordance with Title 49 of the U.S. *Code of Federal Regulations* (49 CFR) Parts 100-180; Transport Canada (TC); or the American Society of Mechanical Engineers (ASME) specifications [1, 2, 3].¹

3 Classification

3.1 Types

Gaseous hydrogen is denoted as Type I, and liquid hydrogen as Type II.

3.2 Total hydrogen percent

Common purity nomenclature for hydrogen can be referred to with respect to the number of nines, indicated as percent of purity as shown in Table 1. In addition to the quality verification levels (QVLs) shown in Table 2, hydrogen is sometimes specified by total hydrogen percent. Table 1 shows hydrogen of decreasing levels of total impurities.

3.3 Quality verification levels (QVLs)

Table 2 presents the component maxima in parts per million (ppm [v/v]) unless shown otherwise for the QVLs of hydrogen. A blank indicates no maximum limiting characteristic. The absence of a value in a listed QVL does not imply that the limiting characteristic is or is not present, but merely indicates that the test is not required for compliance with the specification. Typical uses are listed in Table 3.

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

3.4 Fuel cell grade

Tables 2, 3, and 4 provide guidelines for hydrogen fuel cell applications. One such application is retail hydrogen sales for fuel cell vehicles. SAE J2719, *Hydrogen Fuel Quality for Fuel Cell Vehicles* specifies hydrogen impurities that are detrimental to fuel cell vehicle systems [4].

Traditionally, QVLs are measured at bulk custody transfer points where piping leads to the customer equipment. In the case of fuel cell (FC) grade, hydrogen can be collected by sample container at the dispenser nozzle. Hydrogen suppliers may choose to provide higher purity hydrogen with lower QVL values than required for FC grade.

NOTE—Hydrogen supply to the motor fuel dispensing station shall meet or exceed the minimum standards shown in Table 2 as some contamination of the hydrogen at the dispenser nozzle to vehicle interface with atmospheric gases, moisture, and particulates is unavoidable.

The QVL limits shown in Table 2 are the minimum requirements that shall be met by the hydrogen motor fuel supplier. In most cases, hydrogen in compliance with the FC QVL values in Table 2 also complies with the impurities listed in Table 4 based on the current hydrogen production methods.

The hydrogen system shall be constructed of materials that do not add impurities to the hydrogen supply. Improperly specified polymeric materials can outgas sulfur compounds. Compressors can add hydrocarbons or particulate material if not properly designed.

Specifications for motor fuel hydrogen sold in the United States shall also comply with the Department of Commerce regulations in the National Institute of Standards and Technology (NIST) Handbook 130, *Uniform Laws and Regulations in the Areas of Legal Metrology and Fuel Quality*, Section IV [5].

3.5 Purging equipment and piping

By standard practice, the supplier ensures the QVL of hydrogen. If otherwise required, alternative control procedures are described in 4.3.1, 4.3.2, and Sections 5 and 6. Other control procedures not listed in this publication are acceptable if agreed upon between the supplier and the customer.

WARNING: *Hydrogen is flammable and can act as an asphyxiant by displacing the amount of oxygen necessary to support life. For additional information, see ANSI/CGA G-5, Hydrogen [6].*

Table 1—Common purity nomenclature

Common name	Minimum hydrogen concentration ¹⁾	Impurity limit excluding helium (ppm)
3 nines	99.9%	1000
4 nines	99.99%	100
5 nines	99.999%	10
6 nines	99.9999%	1
¹⁾ Helium is not normally considered as an impurity in hydrogen. Helium can be present up to 40 ppm in some bulk hydrogen supply systems but is typically not monitored or accounted for in hydrogen analysis.		