

**CGA G-5.3—2011**

**COMMODITY  
SPECIFICATION  
FOR HYDROGEN**

**SIXTH EDITION**



**COMPRESSED GAS ASSOCIATION, INC.**  
4221 Walney Road, 5th Floor  
Chantilly, VA 20151  
Phone: 703-788-2700  
Fax: 703-961-1831  
E-mail: [cga@cganet.com](mailto:cga@cganet.com)

**PLEASE NOTE:**

The information contained in this document was obtained from sources believed to be reliable and is based on technical information and experience currently available from members of the Compressed Gas Association, Inc. and others. However, the Association or its members, jointly or severally, make no guarantee of the results and assume no liability or responsibility in connection with the information or suggestions herein contained. Moreover, it should not be assumed that every acceptable commodity grade, test or safety procedure or method, precaution, equipment or device is contained within, or that abnormal or unusual circumstances may not warrant or suggest further requirements or additional procedure.

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 web site, [www.cganet.com](http://www.cganet.com).

This document should not be confused with federal, state, provincial, or municipal specifications or regulations; insurance requirements; or national safety codes. While the Association recommends reference to or use of this document by government agencies and others, this document is purely voluntary and not binding unless adopted by reference in regulations.

A listing of all publications, audiovisual programs, safety and technical bulletins, and safety posters is available via the Internet at our website at [www.cganet.com](http://www.cganet.com). For more information contact CGA at Phone: 703-788-2700, ext. 799. E-mail: [customerservice@cganet.com](mailto:customerservice@cganet.com).

Work Item 08-022  
Hydrogen Technology Committee

---

NOTE—Technical changes from the previous edition are underlined.

SIXTH EDITION: 2011  
FIFTH EDITION: 2004  
FOURTH EDITION: 1997  
THIRD EDITION: 1990

© 2011 The Compressed Gas Association, Inc. All rights reserved.

All materials contained in this work are protected by United States and international copyright laws. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical including photocopying, recording, or any information storage and retrieval system without permission in writing from The Compressed Gas Association, Inc. All requests for permission to reproduce material from this work should be directed to The Compressed Gas Association, Inc., 4221 Walney Road, Suite 500, Chantilly VA 20151. You may not alter or remove any trademark, copyright or other notice from this work.

<b>Contents</b>	<b>Page</b>
1 Scope .....	1
2 Classification .....	1
2.1 Types.....	1
2.2 Total hydrogen percent.....	1
2.3 Quality verification levels.....	1
2.4 Fuel cell grade.....	1
2.5 Quality tests.....	3
3 Quality verification systems.....	3
3.1 Production qualification tests.....	3
3.2 Analytical requirements of the production qualification tests.....	3
3.3 Lot acceptance tests.....	4
4 Sampling .....	4
4.1 Sample size.....	4
4.2 Gaseous samples.....	4
4.3 Liquid samples.....	5
4.4 Sampling compressed hydrogen at the dispenser .....	5
5 Analytical procedures .....	5
5.1 Parameters of analysis.....	5
5.2 Percent hydrogen .....	6
5.3 Water content .....	6
5.4 Total hydrocarbon content.....	6
5.5 Oxygen content .....	7
5.6 Argon, nitrogen, helium, and neon content.....	7
5.7 Carbon dioxide content.....	7
5.8 Carbon monoxide content .....	8
5.9 Mercury vapor content.....	8
5.10 Para content .....	8
5.11 Particulates.....	8
6 Containers .....	9
6.1 Hydrogen containers .....	9
6.2 Container preparation.....	9
6.3 Valves on hydrogen containers .....	9
7 Moisture conversion data .....	9
8 References .....	12
 <b>Tables</b>	
Table 1—Common purity nomenclature .....	1
Table 2—Directory of limiting characteristics .....	2
Table 3—Typical uses.....	3
Table 4—Trace impurities detrimental to fuel cells, but not typically analyzed .....	3
Table 5—Moisture conversion data [16] .....	10

This page is intentionally blank.

## 1 Scope

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

The term container as used in this publication shall refer to 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].<sup>1</sup>

## 2 Classification

### 2.1 Types

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

### 2.2 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.

**Table 1—Common purity nomenclature**

Common name	Minimum hydrogen concentration <sup>1)</sup>	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

<sup>1)</sup> 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.

### 2.3 Quality verification levels

Table 2 presents the component maxima in parts per million (ppm [v/v]) unless shown otherwise for the quality verification levels (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.

### 2.4 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, *Information Report on the Development of a Hydrogen Quality Guideline 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 can 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.

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