CGA
Compressed Gas Association
The Standard For Safety Since 1913

8TH EDITION

CGA G-5.3—2024

COMMODITY SPECIFICATION FOR HYDROGEN

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 website, 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. For more information contact CGA. Phone: 703-788-2700, ext. 799. E-mail: customerservice@cganet.com.

Work Item 22-013
Hydrogen Technology Committee

NOTE—Technical changes from the previous edition are underlined.

EIGHTH EDITION: 2024
SEVENTH EDITION: 2017
SIXTH EDITION: 2011
FIFTH EDITION: 2004
FOURTH EDITION: 1997

Contents **Page**

1 Scope 1

2 Definitions 1

3 Classification 1
3.1 Types 1
3.2 Total hydrogen percent 1
3.3 Quality verification levels (QVLs) 1
3.4 Fuel cell grade 2
3.5 Purging equipment and piping 2

4 Quality verification systems 4
4.1 Production qualification tests 4
4.2 Analytical requirements of the production qualification tests 4
4.3 Lot acceptance tests 4

5 Sampling 5
5.1 Sample size 5
5.2 Gaseous samples 5
5.3 Liquid samples 5
5.4 Sampling compressed hydrogen at the dispenser 6

6 Analytical procedures 6
6.1 Parameters of analysis 6
6.2 Percent hydrogen 6
6.3 Water content 7
6.4 Total hydrocarbon content 7
6.5 Oxygen content 7
6.6 Argon, nitrogen, helium, and neon content 8
6.7 Carbon dioxide content 8
6.8 Carbon monoxide content 8
6.9 Mercury vapor content 9
6.10 Para content 9
6.11 Particulates 9

7 Moisture conversion data 9

8 References 12

Tables

Table 1—Common purity nomenclature 2
Table 2—Directory of limiting characteristics 3
Table 3—Typical uses 4
Table 4—Trace impurities detrimental to fuel cells, but not typically analyzed 4
Table 5—Moisture conversion data 9

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.