

CGA H-13 — 2023

2ND EDITION

**HYDROGEN
PRESSURE SWING
ADSORBER (PSA)
MECHANICAL
INTEGRITY
REQUIREMENTS**



PREFACE

As part of a program of harmonization of industry standards, the Compressed Gas Association (CGA) has published CGA H-13, *Hydrogen Pressure Swing Adsorber (PSA) Mechanical Integrity Requirements*, 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.

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 at Phone: 703-788-2700, ext. 799. E-mail: customerservice@cganet.com.

Work Item 22-027
HYCO Committee

NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendix A (Normative) is a requirement.

NOTE—Appendix B (Informative) is for information only.

SECOND EDITION: 2023

FIRST EDITION: 2017

© 2023 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., 8484 Westpark Dr., Suite 220, McLean, VA 22102. You may not alter or remove any trademark, copyright or other notice from this work.

Contents	Page
1 Introduction.....	1
2 Scope and purpose	1
3 Definitions.....	1
4 Description of pressure swing adsorption systems	3
4.1 General.....	3
4.2 Pressure swing adsorption system limit	3
4.3 Adsorbents	3
4.4 Cyclic service versus noncyclic service.....	3
4.5 Feedgas considerations	4
5 General safety considerations.....	4
5.1 Purging equipment and piping.....	4
5.2 Impact of adsorbents on purging of vessel.....	5
5.3 Other maintenance considerations.....	5
6 General mechanical design and fabrication considerations	6
6.1 Vessel design and fabrication considerations	6
6.2 Pressure swing adsorption piping design considerations.....	7
7 Failure mechanisms and contributing factors.....	8
7.1 Mechanical fatigue.....	8
7.2 Hydrogen embrittlement	8
7.3 Corrosion.....	9
8 Inspection techniques.....	9
8.1 Online actions.....	10
8.2 Offline inspection.....	11
9 Fitness for service considerations	13
9.1 Inspection and maintenance history.....	13
9.2 Determination of fitness for service	13
10 Repair considerations.....	15
11 References	16
12 Additional references.....	17
 Figure	
Figure 1—PSA system schematic.....	4
Figure 2—Potential areas for fatigue failure of a PSA vessel	9
Figure 3—Weld surface profile example (dimensions in inches)	11
Figure 4—UT scan coverage plan example.....	11
Figure 5—Pressure vessels in cyclic service	14
 Appendix	
Appendix A—Fitness for service work flow (Normative)	18
Appendix B—Examples of fitness for service work flow (Informative)	22

1 Introduction

Industrial gas companies operate and maintain hydrogen production facilities. Pressure swing adsorption (PSA) exists as the primary method of product purification in most large-scale hydrogen production facilities. The maintenance and inspection of PSA equipment is critical to the overall reliability and safe operation of the facility. Mechanical integrity of the vessels, piping, and piping components is crucial to ensure that this equipment is fit for service.

2 Scope and purpose

This publication is an industry-wide guideline for in-service mechanical integrity of PSA units and is intended to contribute to the operational safety and reliability of these units. This publication is not intended to address the details of design and installation of PSA vessels and piping.

This publication applies to PSA units with reformer syngas, refinery off-gas, and other hydrogen-containing off-gases. This publication is focused on the parts of the PSA that are subjected to pressure cycles, although some consideration is given to the noncyclic portions of the PSA system. This publication is limited to piping and vessels designed and constructed to a recognized code or standard, for example:

- American Society of Mechanical Engineers *Boiler and Pressure Vessel Code (ASME Code)* [1];¹
- European Committee for Standardization CEN; European Standard EN 13445, *Unified Pressure Vessels* [2];
- Standardization Administration of China GB 150, *Pressure Vessels* [3];
- German Association of Steam Boiler, Pressure Vessel and Piping Manufacturers AD 2000, *Pressure Vessel Code* [4].
- British Standards Institution (BSI) PD 5500, *Specification for unlined, fusion welded pressure vessels* [5]; and
- Standards Australia AS1210, *Pressure Vessels* [6].

This publication applies to piping and vessels from the feed line isolation (i.e., flange or manual valve) to the valve skid, up to and including the surge drum or tie isolation (i.e., flange or manual valve) and the hydrogen product isolation (i.e., flange or manual valve), and downstream equipment. See Figure 1.

3 Definitions

For the purpose of this publication, 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.

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