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CSA/ANSI CHMC 2:19
National Standard of Canada
American National Standard

Test methods for evaluating material compatibility in compressed hydrogen applications — Polymers

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Test methods for evaluating material compatibility in compressed hydrogen applications — Polymers

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Preface

This is the first edition of CSA/ANSI CHMC 2, *Test methods for evaluating material compatibility in compressed hydrogen applications — Polymers*.

This Standard is considered suitable for use for conformity assessment within the stated scope of the Standard.

This Standard was prepared by the Subcommittee on Test Methods for Evaluating Material Compatibility in Compressed Hydrogen Applications, under the jurisdiction of the Technical Committee on Hydrogen Transportation and the Strategic Steering Committee on Transportation, and has been formally approved by the Technical Committee.

This Standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

This Standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

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1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
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   b) *relevant clause, table, and/or figure number;*
   c) *wording of the proposed change; and*
   d) *rationale for the change.*

CSA/ANSI CHMC 2:19
Test methods for evaluating material compatibility in compressed hydrogen applications — Polymers

0 Introduction

Gaseous hydrogen is soluble in polymer materials, and this dissolved hydrogen can alter the mechanical properties and attributes of these materials. The effects of hydrogen on polymers can vary significantly due to the diversity of this category of materials. The magnitude of the hydrogen effect is strongly dependent on a large number of variables related to the material, the environment, and the mechanical loading conditions. Polymers provide critical functions in hydrogen systems, and failures in these functions can result in severe incidents. In general, polymers are characterized by a chain-like composition consisting of repeating molecular subunits and often include additives and fillers for processing and property modifications.

The test methods described in this Standard are intended to provide an assessment of the influence of gaseous hydrogen on a given polymer. These test methods can be used to determine the compatibility of a given polymer material with gaseous hydrogen within a specified window of material and environmental variables.

This Standard is divided into three parts. Together, these three parts determine the compatibility of a given material with compressed hydrogen gas environments. Clause 4 defines the specific environmental variables within which the material will be qualified; these variables are temperature, hydrogen gas pressure, and hydrogen gas purity. Clause 5 provides specific test methods for conducting mechanical property measurements in gaseous hydrogen. Test results generated using Clause 5 are valid only within the bounding conditions of temperature, hydrogen gas pressure, and hydrogen gas purity, as described in Clause 4. Clause 6 provides an approach for evaluating material compatibility based on the results generated from Clause 5. Clause 6 also provides guidance by which the compatibility of the material with hydrogen can be quantified and categorized. The Standard also includes three annexes. Annex A sets out additional considerations regarding transducers exposed to gaseous hydrogen, Annex B provides an example of diffusion and permeability test apparatus, and Annex C gives an overview of the effects of high pressure and hydrogen on polymers.

1 Scope

1.1

This Standard provides uniform test methods for evaluating material compatibility in compressed hydrogen applications. The results of these tests are intended to provide a basis for comparison of materials performance in applications using compressed hydrogen.

1.2

This Standard applies to polymer materials only.

Note: *In this Standard, the term "polymer" refers to synthetic polymers, such as thermoplastics and elastomers, that have been manufactured for liner or sealing applications.*

1.3

This Standard is not intended to replace sound engineering judgment or component testing in hydrogen applications; additional testing considerations based on applicable standards and relevant failure modes should be conducted to fully qualify the polymer in the design of a component manufactured for use in certain hydrogen applications.

1.4

In this Standard, "shall" is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the Standard; "should" is used to express a recommendation or that which is advised but not required; and "may" is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

1.5

All references to pressure throughout this Standard are to gauge pressures, unless otherwise specified.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

ASTM International

D412-16
Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension

D638-14
Standard Test Method for Tensile Properties of Plastics

D2240-15e1
Standard Test Method for Rubber Property — Durometer Hardness

G133-05 (2016)
Standard Test Method for Linearly Reciprocating Ball-on-Flat Sliding Wear