# Test Methods for Evaluating Material Compatibility in Compressed Hydrogen Applications - Polymer

GTR no. 13 Phase 2 IWG

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Representing: CSA CHMC 2 committee

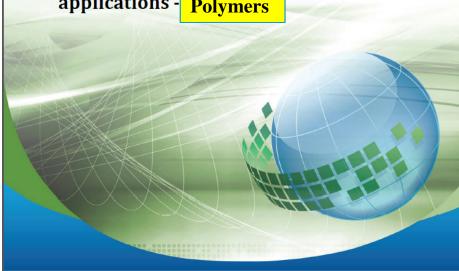
### CHMC 2 – Scope





ANSI/CSA CHMC 2-2018

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



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### Title

CHMC 2 – Test Methods for Evaluating Material
Compatibility in Compressed Hydrogen Applications

- Polymers

### **Scope**

This standard provides uniform test methods for evaluating material compatibility with compressed hydrogen applications. The results of these tests are intended to provide a basic comparison of materials performance in applications utilizing compressed hydrogen. This standard is not intended to replace sound engineering judgment; additional testing considerations may be necessary to fully qualify the design of a component manufactured for use in certain hydrogen applications.

This standard applies to polymer materials only.

# **CHMC 2 – Content Development Plan**



- ✓ **STEP 1:** Agree to high priority tests for polymer compatibility in hydrogen
- ✓ **STEP 2:** Develop high priority test methods for CHMC 2
  - » Assign sub-group with expertise to formulate method (may vary per application)
  - » Identify existing standards for high priority tests
  - » Evaluate if existing are sufficient to reference
  - » Provide test method recommendation to full committee

### □ STEP 3: Insert test methods into document and complete supporting sections

We have a draft CHMC 2 document and refining the content

- » Review test methods by full committee
- » Determine additional material considerations and rating scale
- » Develop other sections in the document (see CHMC 1 structure)
- » Prepare document for public review & ballot

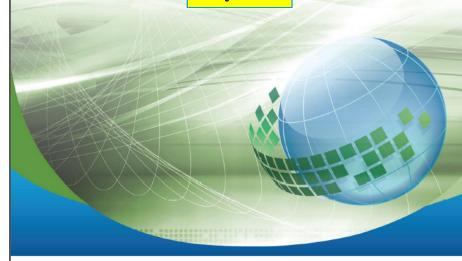
# CHMC 2 – STEP 1: Agree to high priority tests





ANSI/CSA CHMC 2-2018

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



**Contents** 

We have the polymer compatibility tests identified per industry and FMEA input

- 0. Introduction
- 1. Scope
- 2. Reference Publications
- 3. Definitions
- 4. General Requirements
- 5. Test Methods
- 6. Material Qualifications
  Annex

**5 Test Methods** 

- 5.1 Hydrogen Diffusion and Permeability
- 5.2 Physical Stability
- 5.3 Material Property Changes
- 5.4 Dynamic Wear
- 5.5 Material Contamination
- 5.6 Hydrogen Exposure, Cycling, and Aging

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# CHMC 2 - STEP 2: Develop high priority test methods



We have test

methods

developed for

each polymer

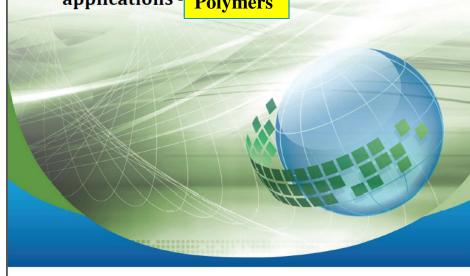
compatibility

test



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#### CHMC 2 Test Method

→ Describe test pur

#### 1.1 Apparatus

→ Describe test equ

#### 1.2 Test environme

→ Describe pressure

### 1.3 Specimen Prep

→ Describe test sam

#### 1.4 Test Procedure

→ Describe test step

### 1.5 Reporting

→ Describe test rest

CHMC 2 Test Method: Physical Stability of Polymers in Hydrogen Environments

#### Density or Specific Gravity Measurements of Polymers

This test method gives the details of the procedure to evaluate the density changes of specimens of elastomeric or solid polymeric materials due to swelling or shrinking upon exposure to hydrogen environments. Dimensional and density measurements will be made prior to and after conditioning in the designated test gas (in this case hydrogen).

Test equipment will

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Oxygen	
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### CHMC 2 Test Method: Physical Stability of Polymers in Hydrogen Environments

This test method gives the details of the procedure to evaluate the change in dimensions and mass of specimens of elastomeric or rubbery materials due to swelling or shrinking upon exposure to hydrogen environments. Dimensional and mass measurements will be made prior to and after conditioning in the

#### 1.1 Apparatus

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#### CHMC 2 Test Method: Dynamic Wear of Polymers in Hydrogen Environments

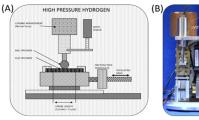
This test method covers laboratory procedures for determining the coefficient of friction, wear volumes, and wear rates for polymers and elastomers that have been subjected hydrogen environments. The method covers two conditions of testing: a) in-situ testing in a high-pressure hydrogen environment and b) ex-situ testing of post-exposure specimens of polymeric and elastomeric materials using a ball-on-flat linear reciprocating geometry similar to ASTM G133-95 (reapproved 2002).

### 1.2 Apparatus

→ Describe test equipment: in-situ vs. ex-situ

1.1.1 General description of liner reciprocating tribometer for wear and friction property testing

Figure 1A shows the general schematic of a linear reciprocating tribometer. The tribometer shown in Figure 1B is the final design of one-such device that can be used in-situ in a high-pressure hydrogen autoclave. Error! Reference source not found. shows the pin and sample geometry in greater detail. The system works by pressing a steel ball (See Error! Reference source not found. A, B) normally into an elastomeric sample that is horizontally-mounted on a linear reciprocating stage. w. The loading on the ball is applied through a series of dead weights set on top of the ball carriage system which is free to move in the vertical direction while a computer controlled stepper motor drive provides the horizontal linear motion of the sample stage up to 14 mm. Wear depth of the ball into the sample is measured in the vertical direction by means of a linear position sensor mounted on the ball carriage The motor drive is coupled to the sample stage by means of a capacitive load cell which measures the horizontal force on the stage induced by the friction of the ball on the sample. . The linear reciprocating motion of the sample stage achieves nearly constant velocity over 95% of the travel in both directions



# **CHMC 2 – Development Schedule Status**



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Committee Meeting (4 <sup>th</sup> Wednesday of Month)	X	X		X	X X	X	X	X	X	X			
STEP 2: Test Methods - Working Group Effort													
Prepare support sections - Chair / CSA Effort													
STEP 3: Merge Content - Full committee review							4			We are on-track for document ballot by			
CHMC 2 CSA DOC PREP - internal quality review (2 wks) - editorial team review (2 wks)							•			the end		-	
PUBLIC REVIEW													
EDITING per comments													
BALLOT													
BALLOT DISPOSITION													