



CSA technical committee updates
→ hydrogen and natural gas standards

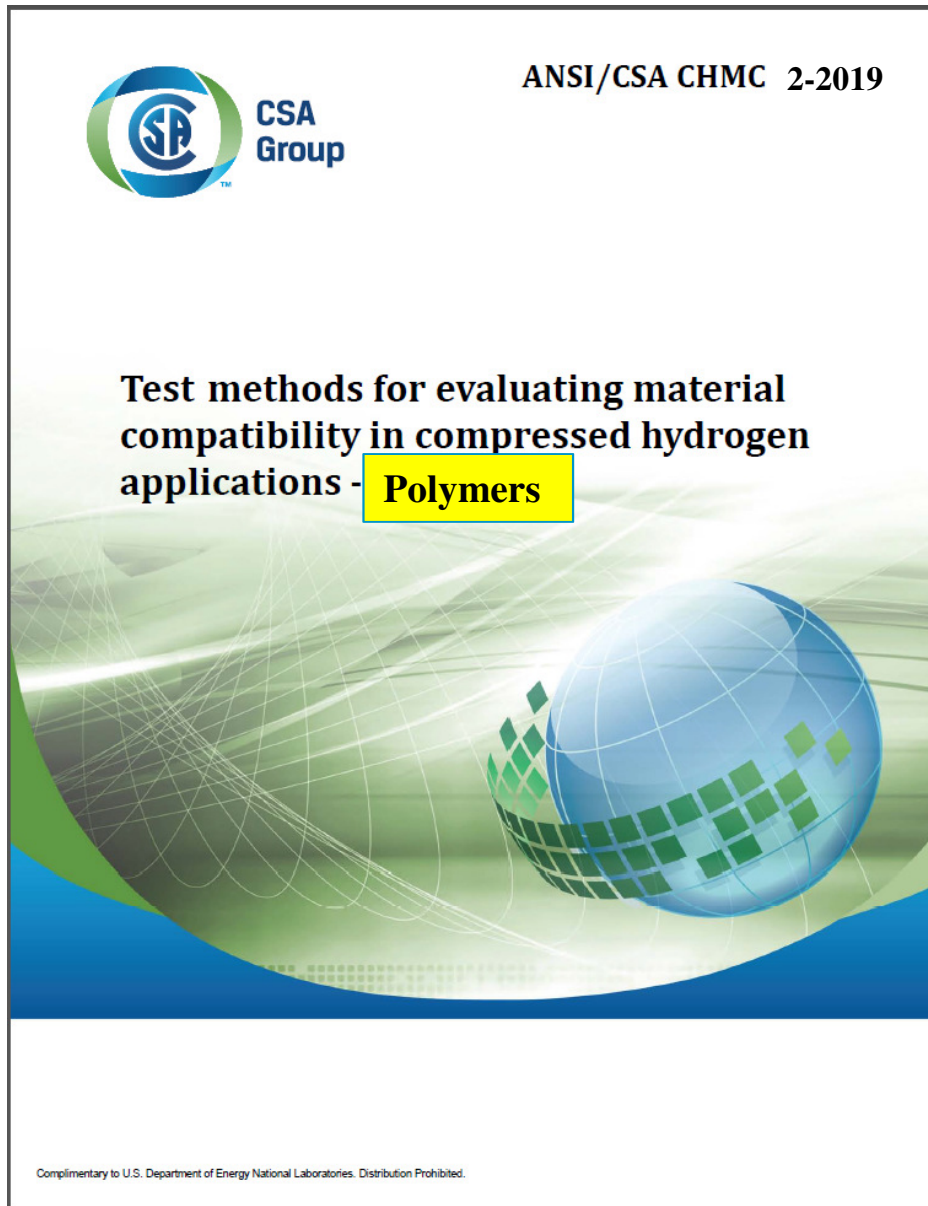
GTR no. 13 Phase 2 IWG

Mike Veenstra, Ford Motor Company

Topics of Presentation

- CSA CHMC 2 Status
- CSA/ANSI NGV 2-2019
 - Conformable Tank Requirements
- Summary of CSA Natural Gas and Hydrogen Standards

CHMC 2 Scope



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
 - » 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 ballot

CHMC 2 Content



ANSI/CSA CHMC 2-2019

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



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Contents

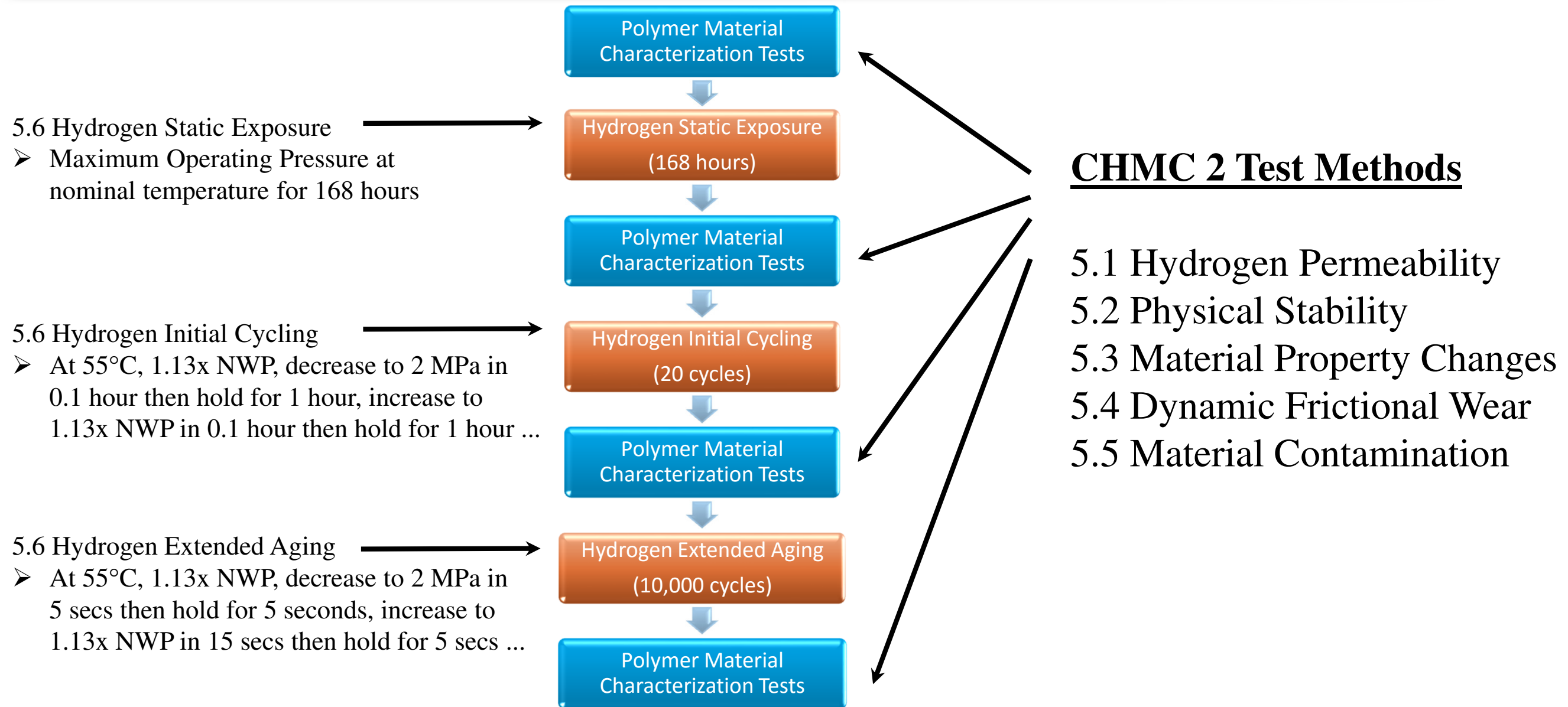
0. Introduction
 1. Scope
 2. Reference Publications
 3. Definitions
 4. General Requirements
 5. Test Methods
 6. Material Qualifications
- Annex

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

CHMC 2 Test Methods

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

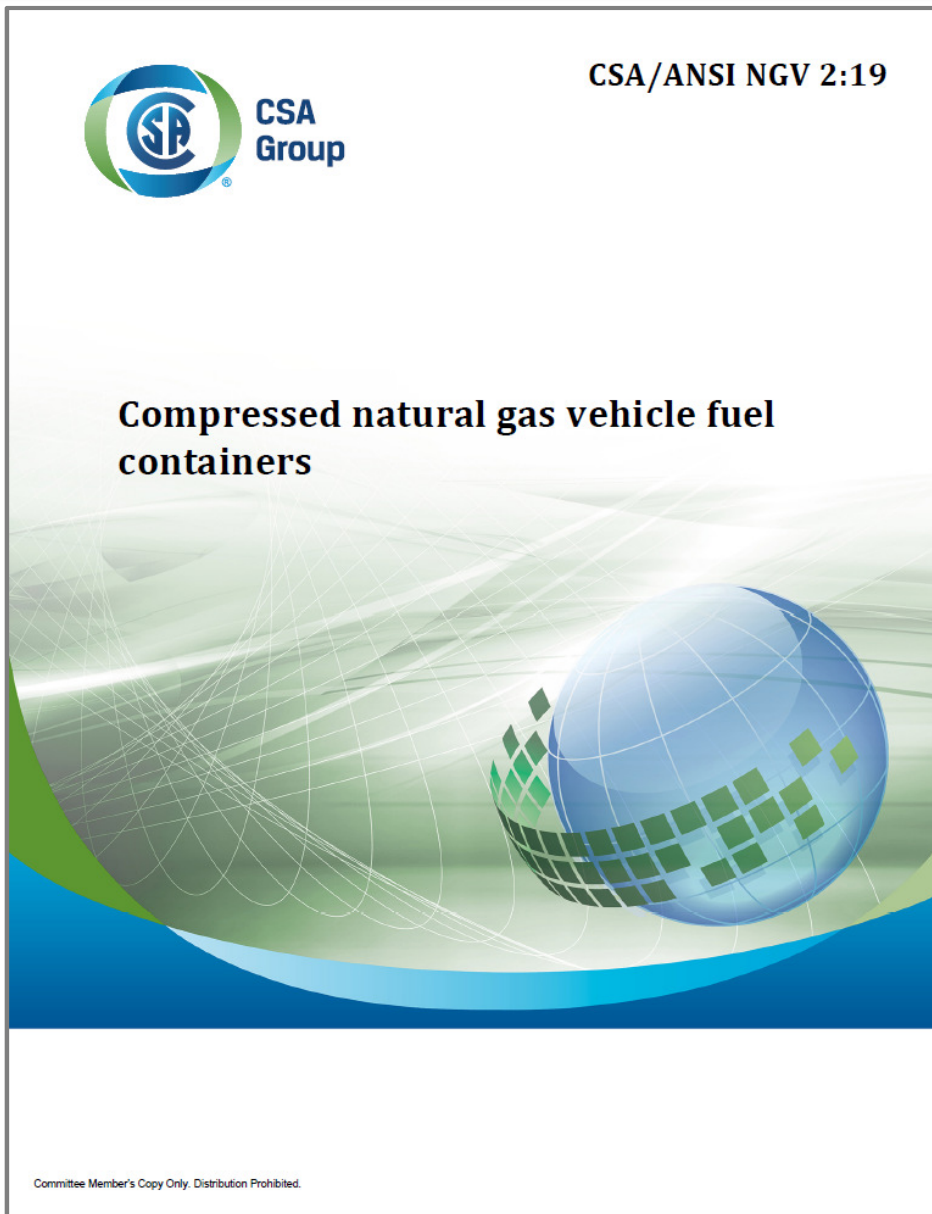
CHMC 2 Content



CHMC 2 – Next Steps

	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
Committee Meeting (4 th Wednesday of Month) <small>Started in March 2017</small>	X	X	X	X	X			X	X	X		X	X		
STEP 3: Merge Content - Full committee review															
CHMC 2 CSA DOC PREP - internal quality review - editorial team review															
INDUSTRY REVIEW															
PUBLIC REVIEW															
INDUSTRY REVIEW #2															
EDITING per comments															
BALLOT															
BALLOT DISPOSITION															
CHMC 2 Released															

CSA/ANSI NGV 2-2019 Scope



Title

*CSA/ANSI NGV 2:19 – Compressed natural gas vehicle fuel **containers***

Scope

NOTE: Standards are considered voluntary.

*This **Standard** contains requirements for the material, design, manufacture, and testing of serially produced, refillable Type NGV 2 containers intended only for the storage of compressed natural gas for **vehicle operation**. These containers are to be permanently attached to the vehicle. This Standard applies to containers up to and including **1000 L** (35.4 ft³) water capacity.*

CSA/ANSI NGV 2-2019 Content



CSA/ANSI NGV 2:19

**Compressed natural gas vehicle fuel
containers**



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Contents

1. Scope
2. Reference Publications
3. Definitions
4. Service Conditions
5. Compliance
6. Material Qualification tests and requirements
7. Wall Thickness
8. Threaded Openings
9. Inspection Requirements
10. Manufacture
11. Production Tests and Examination
12. Batch Tests
13. Rejected Containers and Liners
14. Pressure Relief Devices
15. Records of Manufacture
16. Manufacturer's Instruction
17. Marking and Dispatch
18. Quality Assurance
- 19. Design Qualification Tests**

Annex

CSA/ANSI NGV 2-2019 Content – Qualification Tests

- **19.3:** Ambient Cycling Test
- **19.4:** Environmental Test
- **19.5:** Extreme Temperature Cycling Test
- **19.6:** Hydrostatic Burst Test
- **19.7:** Composite Flaw Tolerance Test
- **19.8:** Drop Test
- **19.9:** Bonfire Test
- **19.10:** Accelerated Stress Rupture Test
- **19.11:** Penetration Test
- **19.12:** Permeation Test
- **19.13:** Natural Gas Cycling Test
- **19.14:** Leak Before Break Test
- **19.15:** Non-Destructive Examination
- **19.16:** Corrosion Resistance
- **19.17:** Mechanical Tests → Vibration and Mechanical Shock

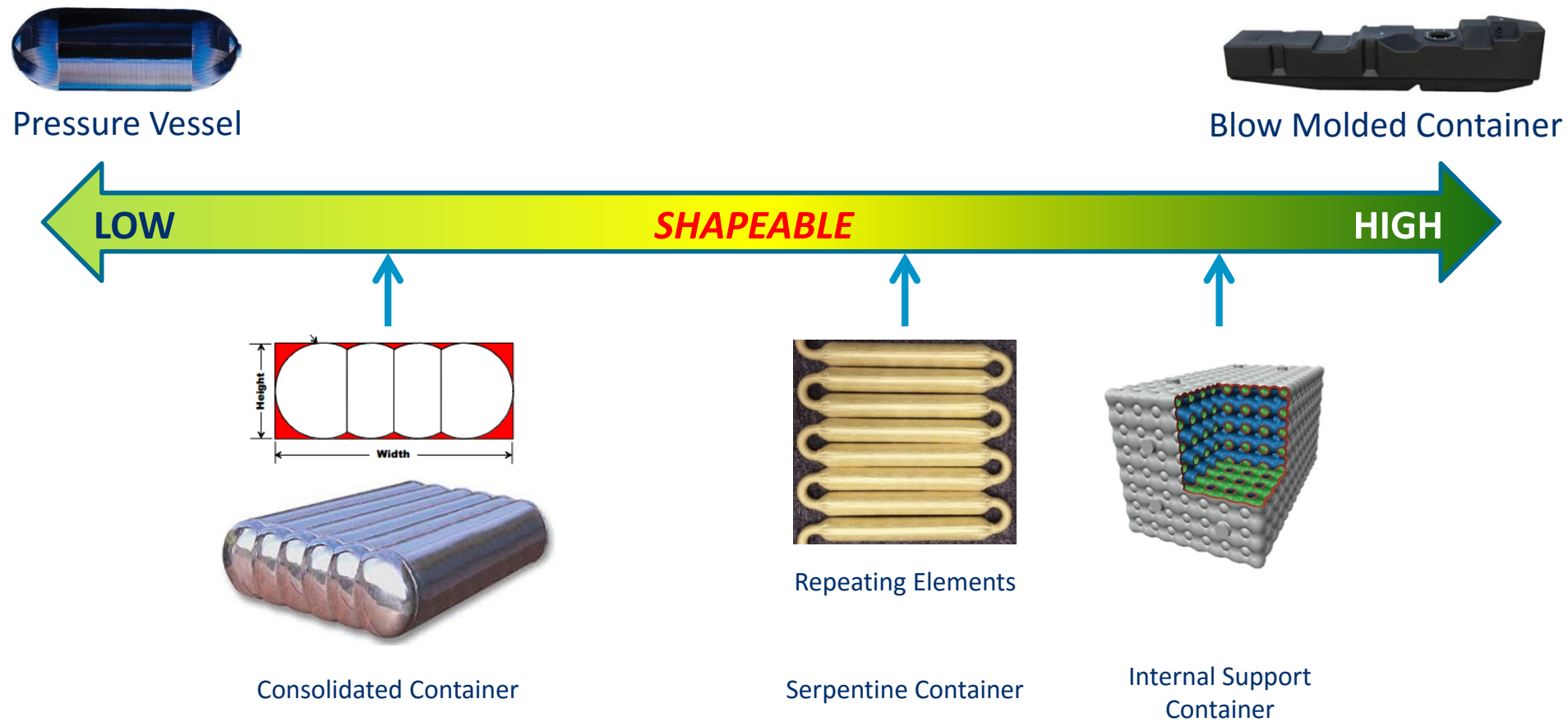
NEW for 2019

→ Localized Fire Test

→ Conformable Tanks

CSA/ANSI NGV 2-2019 Content – Conformable Tanks

What is conformable?



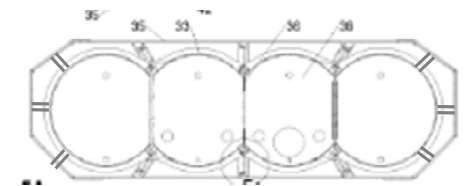
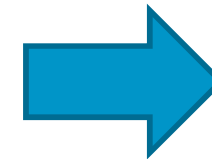
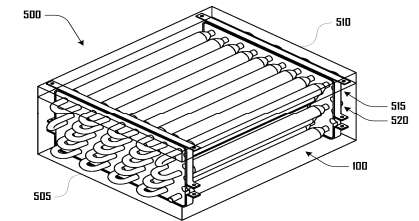
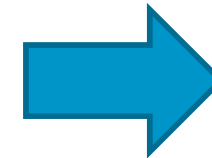
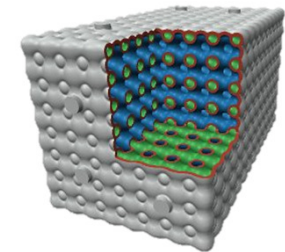
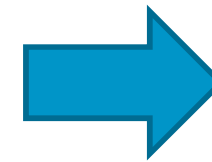
What is conformable?

NGV 2 DEFINITION: *Conformable container types are designated as follows:*

CT1: container or assembly of a non-spherocylindrical or non-spherical (i.e., irregular) shape **without a protective shell** (i.e., outside wall containing gas pressure);

CT2: container or assembly of possibly irregular shape **within a conformable protective shell** that is acting as a shield and **not directly assisting** the inner container with containing gas pressure; and

CT3: container or assembly of possibly irregular shape **within a conformable protective shell** that is acting as a shield and **directly assisting** the inner container with containing gas pressure.



CSA/ANSI NGV 2-2019 Content	CT - 1	CT - 2	CT - 3
▪ 19.3: Ambient Cycling Test	Uniform hold	Shell evaluation	Shell evaluation
▪ 19.4: Environmental Test	Same	Shell impact test	Shell impact test
▪ 19.5: Extreme Temperature Cycling Test	Same	Shell evaluation	Shell evaluation
▪ 19.6: Hydrostatic Burst Test	Same	Shell included	Shell included
▪ 19.7: Composite Flaw Tolerance Test	High stress focus	Shell assessment	High stress focus
▪ 19.8: Drop Test	Additional drops?	Shell included	Shell included
▪ 19.9: Bonfire Test	Additional tests?	Shell included	Shell included
▪ 19.10: Accelerated Stress Rupture Test	Same	Same	Same
▪ 19.11: Penetration Test	Same	Without Shell	Shell included?
▪ 19.12: Permeation Test	Same	Shell inner test	Shell inner test
▪ 19.13: Natural Gas Cycling Test	Same	Shell evaluation	Shell evaluation
▪ 19.14: Leak Before Break Test	Uniform hold	Shell evaluation	Shell evaluation
▪ 19.15: Non-Destructive Examination	Same	Same	Same
▪ 19.16: Corrosion Resistance	Same	Shell included	Shell included
▪ 19.17: Mechanical Tests	NEW	NEW	NEW

Summary of CSA Natural Gas and Hydrogen Standards

CSA Natural Gas Standards

Vehicle

- **CSA/ANSI NGV 1-2017:** Fueling Connection
- **CSA/ANSI NGV 2-2019:** Fuel Containers
- **CSA/ANSI NGV 6.1-2018:** Storage System
- **CSA/ANSI PRD-1-2013:** Pressure Relief Device
- **CSA/ANSI NGV 6.4-2014:** Container Inspection
- **CSA SPE-2.1-2018:** Defuel/Disposal Containers

Station

- **CSA/ANSI NGV 4.1-2018:** Dispensing Systems
- **CSA/ANSI NGV 4.2-2014:** Dispensing Hoses
- **CSA/ANSI NGV 4.3-2018:** Temperature Fueling
- **CSA/ANSI NGV 4.4-1999:** Dispensing Breakaway
- **CSA/ANSI NGV 4.6-1999:** Dispensing M. Valves
- **CSA/ANSI NGV 4.8-2012:** Station Compressors
- **CSA/ANSI NGV 5.2-2017:** Fueling Appliances

CSA Hydrogen Standards

Vehicle

- **CSA/ANSI HGV 2-2014:** Fuel Containers
- **CSA/ANSI HGV 3.1-2015:** Storage Components
- **CSA/ANSI HPRD-1-2013:** Pressure Relief Device
- **CSA/ANSI HGV 4.10-1-2012:** Fittings
- **CSA/ANSI CHMC 1-2014:** H2 compatibility - metals

Station

- **CSA/ANSI HGV 4.1-2013:** Dispensing Systems
- **CSA/ANSI HGV 4.2-2013:** Dispensing Hoses
- **CSA/ANSI HGV 4.3-2016:** Fueling Evaluation
- **CSA/ANSI HGV 4.4-1999:** Dispensing Breakaway
- **CSA/ANSI HGV 4.6-1999:** Dispensing M. Valves
- **CSA/ANSI HGV 4.7-1999:** Dispensing A. Valves
- **CSA HGV 4.9-2016:** Hydrogen Fueling Station