
ASME
SETTING THE STANDARD
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Code for Hydrogen Pipelines

Hydrogen Pipeline Working Group Workshop

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Presentation Outline

- Approval for new code development
- Charge from BPTCS to B31 Standards Committee for Hydrogen Piping/Pipeline code development
- B31.12 Status & Structure
- Hydrogen Pipeline issues
- Research Needs
- Where Do We Go From Here?

Code for Hydrogen Piping and Pipelines

- B31 Hydrogen Section Committee to develop a new code for H_2 piping and pipelines
  - Include requirements specific to H_2 service for power, process, transportation, distribution, commercial, and residential applications
  - Balance reference and incorporation of applicable sections of B31.1, B31.3 and B31.8
  - Have separate parts for industrial, commercial/residential and pipelines
  - Include new requirements for construction, operation, and maintenance

Performance-Based vs. Prescriptive Standards

- Performance-Based
  - States goals and objectives to be achieved
  - Describes acceptable methods to determine goals and objectives have been met
  - Focuses on desired characteristics of final product
- Prescriptive
  - Prescribes materials, design, construction requirements without stating goals and objectives
  - Focuses on requirements for processes to produce the final product
- ASME standards include both prescriptive and performance-based elements

Hydrogen Standards Development Project Schedule

- Task force Recommendations- Complete
- BPTCS Action- Complete
- Technical Reports: Jul ’04 – Nov ’05
- Draft Standard Available: Nov ’05
- B31 Standards Committee: Nov ’05 – Nov’06
- Finalize Standard : Mar ’07
- Publish : 3rd Quarter ‘07

ASME B31.12 Structure and Basis

- B31.12 is divided into three subsections
  - Section A: Industrial Piping
  - Section B: Pipelines and Distribution Piping
  - Section C: Residential piping
- There is also a section for the common use and reference by sections A, B and C

Section B: Pipeline and Distribution Piping

- Model document for section B is ASME B31.8
- Anticipated operating ranges:
  - Pressure: full vacuum to 3,000 psig
  - Temperature: - 40˚F to 300˚F

Common Section

- This section of the code will be located at the front of the code book and contain the following information:
  - Scope of the code
  - Materials section
  - Welding and forming section
  - Operation and maintenance section
- The above sections will be referenced by Sections A, B and C.

Hydrogen Pipeline Issues

- Materials
  - Loss of 30% in toughness & 15% burst strength
  - Rapid hydrogen assisted fatigue crack growth
  - Sustained-load cracking in HAZ of welds

Hydrogen Pipeline Issues

- Materials (cont'd)
  - Are micro-alloyed steels more resistant to the effects of hydrogen environments
  - Do FRP pipes offer advantages over metallic pipe in hydrogen service

Hydrogen Pipeline Issues

- Materials (cont'd)
  - Liner material for FRP pipe
  - Design analysis method for FRP pipeline system
  - Expected design life of FRP Pipeline

Hydrogen Pipeline Issues

- Public Perspective & Education
  - Common perception of hydrogen
  - Public Education with real information

Research Needs

- Testing of all commonly used pipeline materials for loss of fatigue and impact strength in a high pressure hydrogen environment. Research the effects of pressure cycling on mechanical properties
- Testing of pipe welds for sustained-load cracking for all commonly used pipeline materials. Review as welded, post weld heat treated and annealed weld performance

Research Needs

- Determine if FRP pipes with metallic or plastic liners are viable alternatives for metallic pipes. Test joining methods for hydrogen compatibility. Develop a simplified analysis method for these pipes.
- Testing of commonly used plastic pipe materials for compatibility with high purity hydrogen environments. Test bonded and fusion joints for hydrogen resistance

Where Do We Go From Here?

- Near term, the ASME B31.12 Task Group will utilize “Design Factors” to make system design more conservative until actual material test data is available
- Encourage Risk Analysis of converted and new hydrogen pipeline systems
- Impose System Integrity Management using ASME B31.8S as a model

Where Do We Go From Here?

- Require in-service inspection, system maintenance and operator training with qualification for converted and new systems. Reference B31Q (not yet published)
- Review results of material testing programs, operating results and service histories and adjust ASME B31.12 as needed

Where Do We Go From Here?

- Education of the public through a joint effort by DOE in partnership with ASME.