

The Power of Trust.
The Future of Energy.



Powertech: Hydrogen Expertise Storage Needs

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Powertech Hydrogen Expertise - Testing

World's leading test agency for high pressure hydrogen components

- Operate the equivalent of 4 hydrogen fueling stations for hydrogen gas cycle testing of OEM 700 bar fuel systems

Test all carbon fiber tank designs worldwide

- Also use various Type 3 and Type 4 designs for test facilities



Powertech Hydrogen Expertise - Stations



Powertech: Hydrogen Storage Expertise



Test essentially all carbon fiber designs used worldwide in vehicles, transport applications, and stationary storage

Use Type 3 and Type 4 designs as ground storage in test facilities, and in hydrogen station designs

Develop standards for carbon fiber tank applications . Powertech is Chair of:

- ISO 15869 draft standard for hydrogen vehicle tanks
- ANSI/CSA HGV2 draft standard for hydrogen vehicle fuel tanks



Examples of hydrogen storage (up to 950 bar) at Powertech

Status of Hydrogen Storage Technologies

Our experience in building hydrogen stations is that for the higher storage pressures (over 700 bar) only carbon fiber designs are cost-effective.

Current carbon fiber designs using 2.25x burst factor proven adequate – both for vehicles and ground storage

- Since 1992 carbon fiber has been in use for CNG vehicle cylinders per NGV2
- Since 1995 carbon fiber has been used for CNG and hydrogen ground storage cylinders per CSA B51
- ASME Section X, Appendix 8 now allows 2.25 factor for ground storage

Currently many hundreds of thousands of carbon fiber composite cylinders in service in vehicle, ground storage, bulk transport, and air breathing applications.

Service conditions for ground storage are the least severe, compared to portable, transport, or vehicle applications

Challenges to Hydrogen Storage Technologies

Single largest cost of a hydrogen fueling station is the high pressure hydrogen ground storage.

Single largest cost component of a carbon fiber tank is not the resin or liner or manufacturing process, but the cost of the carbon fiber itself.

- Research should focus on ways of reducing carbon fiber cost, or improving the batch quality of the existing fibers

Lack of understanding in codes and standards concerning ground storage service conditions

- For high pressure hydrogen storage, the challenges are not technical in terms of service conditions – they are cost-related
- Safety has been proven by use of carbon fiber composites under conditions far more severe than relatively benign ground storage applications

RD&D Requirements for Cost Reduction

1. Establish actual pressure cycle conditions experienced by ground storage at fueling station – use high-use CNG stations as reference
 - Purpose is to establish test conditions for tanks with the objective of reducing fatigue life requirements
2. Investigate carbon fiber manufacturing processes to identify ways of reducing production costs and improving batch quality (less variation in tensile strength)
 - Purpose is to either reduce costs or reduce fiber use through improved quality
3. Develop practical in-field inspection technologies to periodically re-test or re-qualify ground storage tanks for extended service life
 - Purpose is to extend life of tanks
4. Conduct accelerated stress rupture tests using thin-walled carbon fiber pressure vessels periodically subjected to fatigue stresses
 - Purpose is to extend life of tanks beyond 15 years