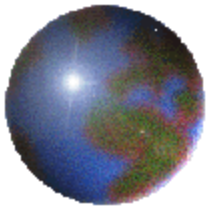

Hydrogen Fueled Vehicle Global Technical Regulation (GTR) and Research & Development

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September 2010

NHTSA
www.nhtsa.gov

Overview

- Global Technical Regulation (GTR) goals and safety requirements
- GTR elements
- Research and Development efforts
- NHTSA R&D update

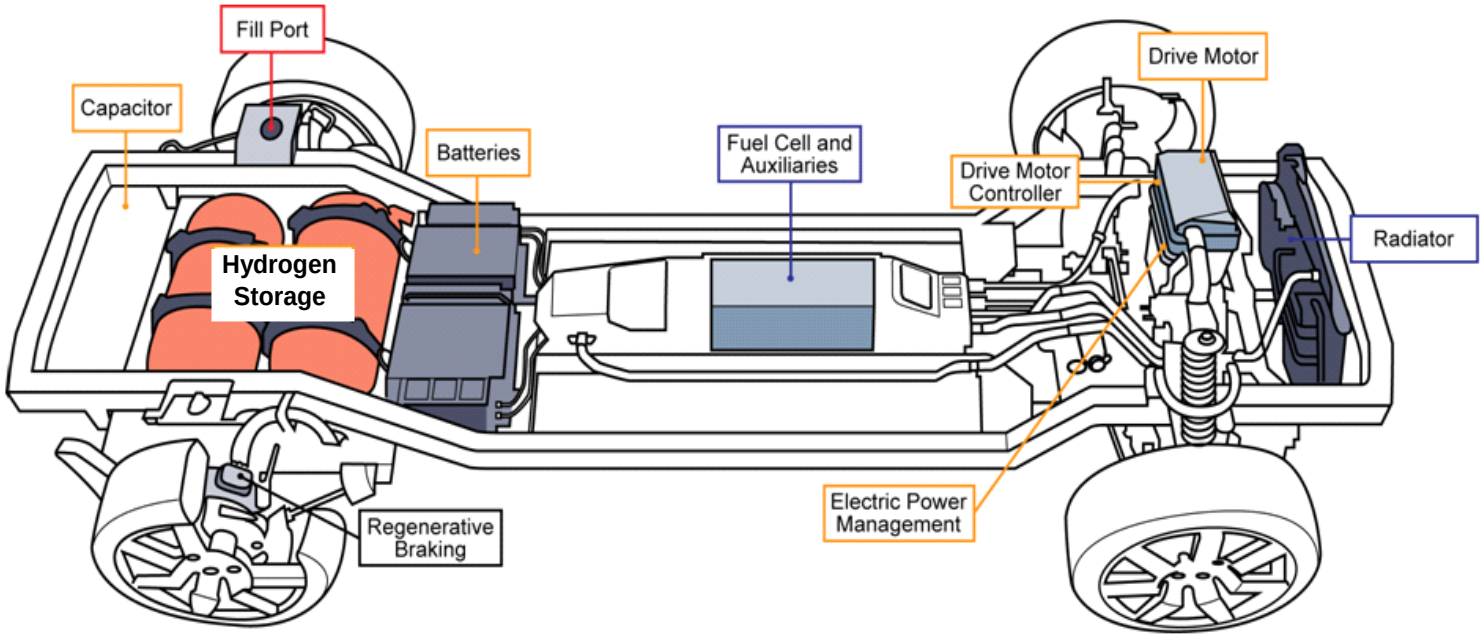
Harmonization of Vehicle Regulations

- US/NHTSA participates in international harmonization activities under the United Nations World Forum for the Harmonization of Vehicle Regulations (WP.29) and the 1998 Global Agreement
  - 30 contracting parties, including: Canada, China, the EC, India, Japan, and South Africa.
  - Global Technical Regulations (GTRs) under the 1998 Agreement is guided by three governing principles:
    - Data-driven & science-based
    - Performance-based
    - Transparent

Hydrogen Fueled Vehicle GTR Objectives

- Attains equivalent levels of safety as those for conventional gasoline powered vehicles
- Performance based (not design specific)
- Data driven and science-based
- Objectively measurable compliance

Example of a Fuel Cell Vehicle



GTR Elements

1. High pressure fuel container system

2. Fuel system at vehicle level: in-use and post-crash hydrogen leakage limits

3. Electrical integrity of high voltage system: in-use and post-crash

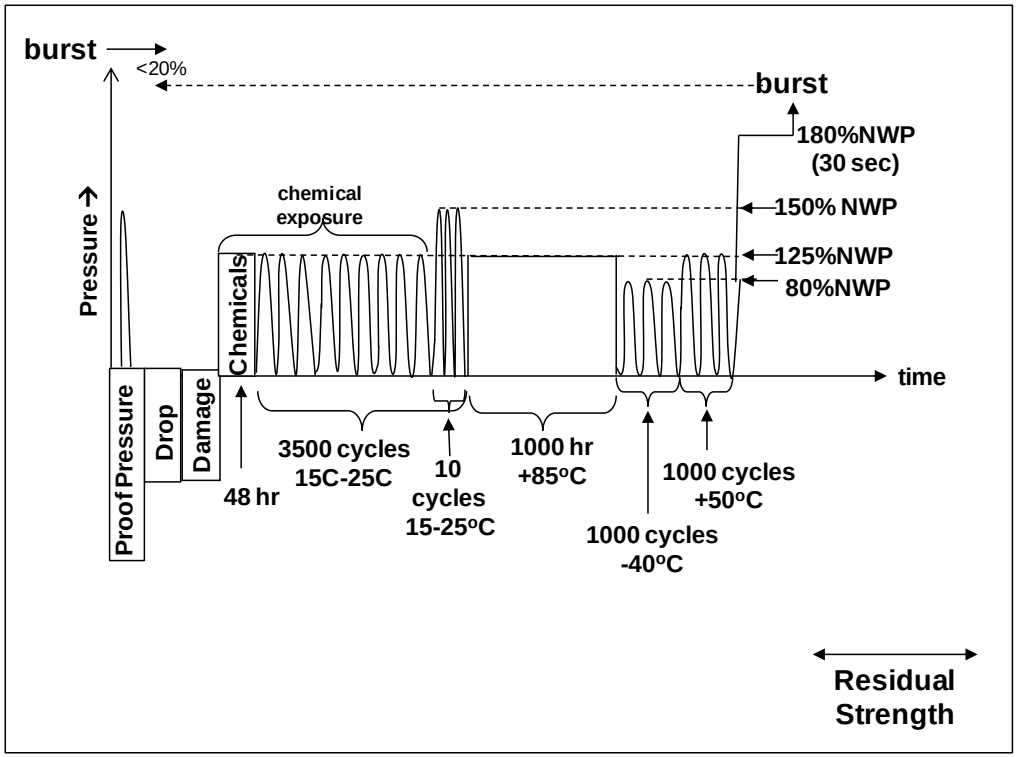
- Type approval components

GTR - Requirements

- High pressure fuel container system
  - Verification Test for Performance Durability: *sequential hydraulic cycling tests*
  - Verification Test for Expected On-Road Performance: *sequential pneumatic/hydraulic cycling tests*
  - Verification Test for Service Terminating Performance: *fire test*
- Fuel system integrity
  - In-use: fuel leakage mitigation
  - post crash: maximum allowable leakage limit
- Electrical Safety
  - High voltage safety for in-use and post crash

Verification Test for Performance Durability

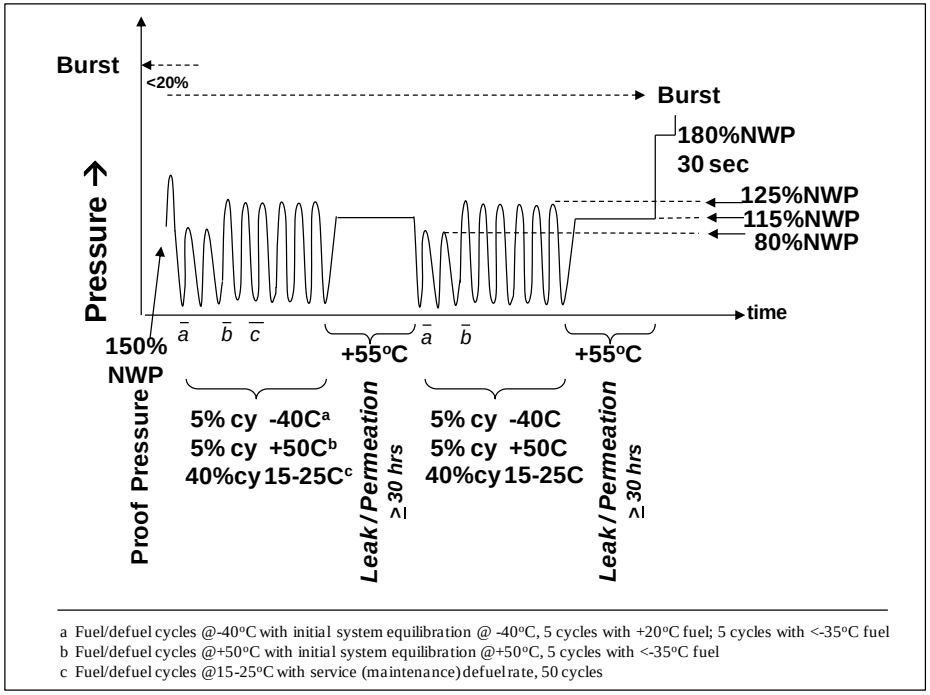
Sequential hydraulic cycling tests



- Proof pressure test
- Drop (impact) test
- Surface damage
- Chemical exposure and ambient temperature pressure cycling tests
- High temperature static pressure test
- Extreme temperature pressure cycling
- Residual proof pressure test
- Residual strength burst test

Verification Test for On-Road Performance

Sequential pneumatic/hydraulic cycling tests

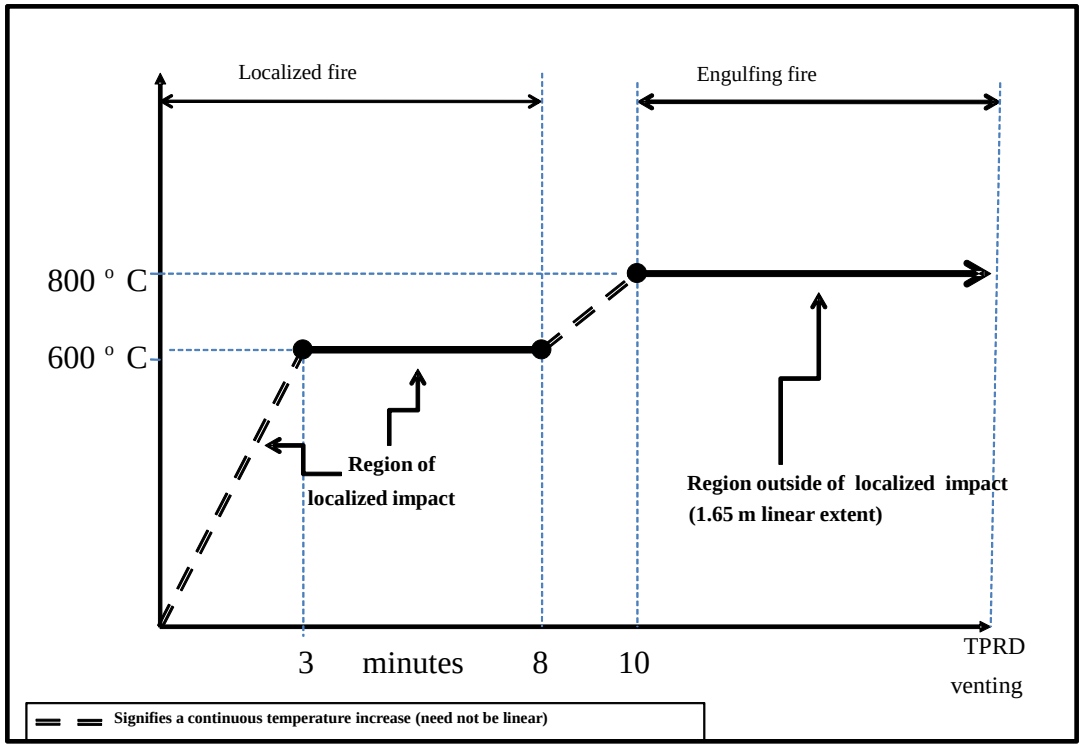


a Fuel/defuel cycles @-40ºC with initial system equilibration @ -40ºC, 5 cycles with +20ºC fuel; 5 cycles with <-35ºC fuel
b Fuel/defuel cycles @+50ºC with initial system equilibration @+50ºC, 5 cycles with <-35ºC fuel
c Fuel/defuel cycles @15-25ºC with service (maintenance) defuel rate, 50 cycles

- Proof pressure test
- Ambient and extreme temperature gas pressure cycling test (pneumatic)
- Extreme temperature static gas pressure leak/permeation test (pneumatic)
- Residual proof test
- Residual strength burst test (hydraulic)

Fire Test

Combined localized and engulfing fire



Research & Development Activities

- US DOE/SAE and vehicle manufacturers: cumulative hydraulic and pneumatic cycling tests
- Japan: hydrogen fire behavior, vehicle fire research, vehicle post crash with surrogate fuel research and test report
- Hysafe: analysis on permeation
- Transport Canada and NHTSA: research on localized fire and mitigation technologies
- NHTSA: research on container, hydrogen leakage in vehicle, vehicle crash test and post crash electrical safety

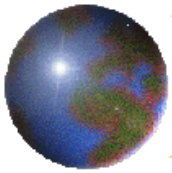
Research & Development Activities

Additional R&D on fuel container at NHTSA:

- Cumulative Life Cycle Testing of Hydrogen containers
  - Upper and lower extreme temperature for cycling - c*omplete*
  - Leak/permeation hold time -2011
  - Pneumatic cycle count - 2011
- End-of-Life testing of aged CNG containers - residual strength testing of 10 – 15 year old cylinders - 2012
- Joint DOE, NREL, CVEF on the effort to enforce removal of defective and expired containers from service by education and outreach programs - 2013

Conclusion

- GTR has made significant progress by the contribution of experts and R&D efforts and has been a good instrument in leveraging resources for R&D and data sharing
- Additional R&D still needed
  - Fire test, cycling tests, whole vehicle level safety tests
- Giving the technology is still emerging, continuing cooperation on R&D is necessary and encouraged
  - Refine the GTR requirements/test procedures
  - R&D for new technologies and materials



谢谢您！