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

Nha Nguyen
US Department of Transportation
National Highway Traffic Safety Administration
September 2010
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

- 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)

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

Combined localized and engulfing fire

- Region of localized impact (1.65 m linear extent)
- Region outside of localized impact
- Localized fire
- Engulfing fire

Signifies a continuous temperature increase (need not be linear)
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 - complete
  - 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！