Study of CNG Bus Rollover Test

Jan. 19 ~ 21, 2009

Ministry of Land, Transport and Maritime Affairs,
Korea Automobile Testing and Research Institute
Backgrounds

- Wide use of CNG Bus in public transport in Korea (estimated 15 thousands)
- Most of them are a type with CNG storages mounted on the roof
- Increase of upper part weights (6 fully charged Storages resulted in 1,200kg increase)
- A preliminary study shows that roll-over propensity increased by 18% due to upward movement of center of gravity
- Fire safety should be taken into consideration in addition to structural integrity

Study objectives

- Review of regulatory system
  - ECE R66 : Strength of superstructure
  - FMVSS 303 : Fuel system integrity of compressed natural gas vehicles
- Analysis of fuel system integrity
Bus Regulatory System

- Applied regulations
  - ECE R66 and Korea Safety Regulation for Road Vehicles Article 102-2;
    Large passenger vehicles with regard to the strength of their superstructure
    • Requirement: The superstructure of the vehicle shall have the sufficient strength to ensure that the residual space during and after the rollover test on complete vehicle is unharmed
  - FMVSS 303; Fuel system integrity of compressed natural gas vehicles
    • Requirement: the pressure drop in the high pressure portion of the fuel system, expressed in kilo Pascals (kPa), in any fixed or moving barrier crash from vehicle impact through the 60 minute period following cessation of motion shall not exceed: (1) 1062 kPa (154 psi), or (2) 895 (T/VFS); whichever is higher
Preparation of Test Vehicle

- 6 CNG storages (924 liter) pressure 210kPa, filled with nitrogen 60% and helium 40%
- Place a test vehicle on the platform above 800 mm from the ground tilting less than 0.087 rad/sec
Test Results

- Strength of superstructure: complied (rollover at 40 degree)

- Analysis of fuel system Integrity
  - Gas escaped from valves broken due to impact
  - Pressure drop in the high pressure portion exceeded the limit in FMVSS 303
Future Tasks

- **CNG bus**
  - ECE R66: No fuel system integrity requirement in bus rollover test
  - FMVSS 303: No rollover test requirement
    - in any fixed or moving barrier crash (frontal, rear and side impact test)
  - Status of CNG bus in use in other Contracting Parties?

- **Hydrogen-powered bus with storages on the roof**
  - Possibility of gas leakage after roll-over test
  - Fuel system integrity requirement to be considered in rollover test

- **Next step?**
  - Fuel system integrity requirement in ECE R66 and Korean Regulation