GRSP Informal Working Group
Frontal Impact
Overview for Selecting Reference Collisions

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The Accident data provided to the working group has indicated that the casualty risk is related to the mass of the vehicles in the car-car collisions.

A reference or baseline requirement for frontal protection has not been identified.

The following slides provide some information and proposals for selecting a reference collision.
The new car sales from Europe 2005 was compared to the Swedish registrations in 2008.

Mass Distribution

Cumulative Distribution

Source: IMPROOVER Project, SIKA
» The GIDAS database has reconstructed values of collision speeds

Source – IMPROVER Project (Bast)
» From GIDAS (2000-2007) the impact speed distributions for each car in a car-car impact

Source: BASt
Reconstructed Single Vehicle Accidents
Speeds Leaving the Road
(Not Impact Speed)

Source – RISER Project
Reference Collision Options

» A baseline for frontal impact regulations can be based on:
  » 1) fixed percentile of accident conditions (speed, mass, energy, injuries)
  » 2) most common accident conditions (speed, mass, energy, injuries)

» Current R94 is based on a reference crash of 50 km/h and 50% offset represented by a 56 km/h impact with the EEVC barrier (Assumes mass ratio 1:1)
» Pre-impact energy

» R94 @ 56 km/h

» Car-Car approximated as FWB @ 50 km/h (Reference condition)

Car is expected to absorb in R94 the kinetic energy minus the energy in the barrier – 30 kJ barrier deformation energy (as an example)
» Preliminary Approach
  » Using the fleet mass and speed distributions to identify joint distribution of speed and vehicle mass
  » Assume that the impact speed is independent of vehicle mass
» Agreement on type of criteria for self protection levels
» More complete analysis is needed to finalize values for regulation
» The probability of a collision of a given vehicle (mass given by European Sales in 2005) for a given speed (using GIDAS vehicle impact speeds)

\[
P_{\langle \text{imp} \mid V+M \rangle} = P_{\langle \text{imp} \mid V \rangle} P_M
\]

- Conditional probability of an impact of vehicle mass \( M \) at velocity \( V \)
- Probability of impact speed \( V \)
- Probability of vehicle mass \( M \)
Joint Probability

\[ P \left( \frac{\text{imp}}{V+M} \right) = P \left( \frac{\text{imp}}{V} \right) P_M \]

Most common crash 55 km/h & 1500 kg

Impact Speed [km/h]

Vehicle Mass (kg)

Probability
Kinetic Energy for one vehicle from Joint Probability distribution
Summary of Crash Energies

Examples from preliminary analysis

- R94 @ 56 km/h
- FWB @ 50 km/h

Most Common 50%ile

Current minimum test energy absorbed by a vehicle in R94 (assuming 30 kJ absorbed by barrier)
Next Steps

» A criteria for selecting a reference collision is needed for further discussions of an update for R94
  » Most common impact? 50%ile for energy?

» The Informal Group for Frontal Impact needs to define the target for self protection

» An investigation of PENDANT frontal collisions is ongoing in Sweden to review distributions of overlap, delta V, AIS, etc.