

ANSWERS ABOUT ISSUES ON R94 AMENDMENT

French Experts

May 2009

- **Accident analysis**
- **Harmonization of Frontal impact**
- **Test severity of R94 amendment**
- **Assessment of occupant restraint system with PDB test**
- **Testing with the current PDB design**
- **Passive Safety Benefit**
- **Design of future vehicle**

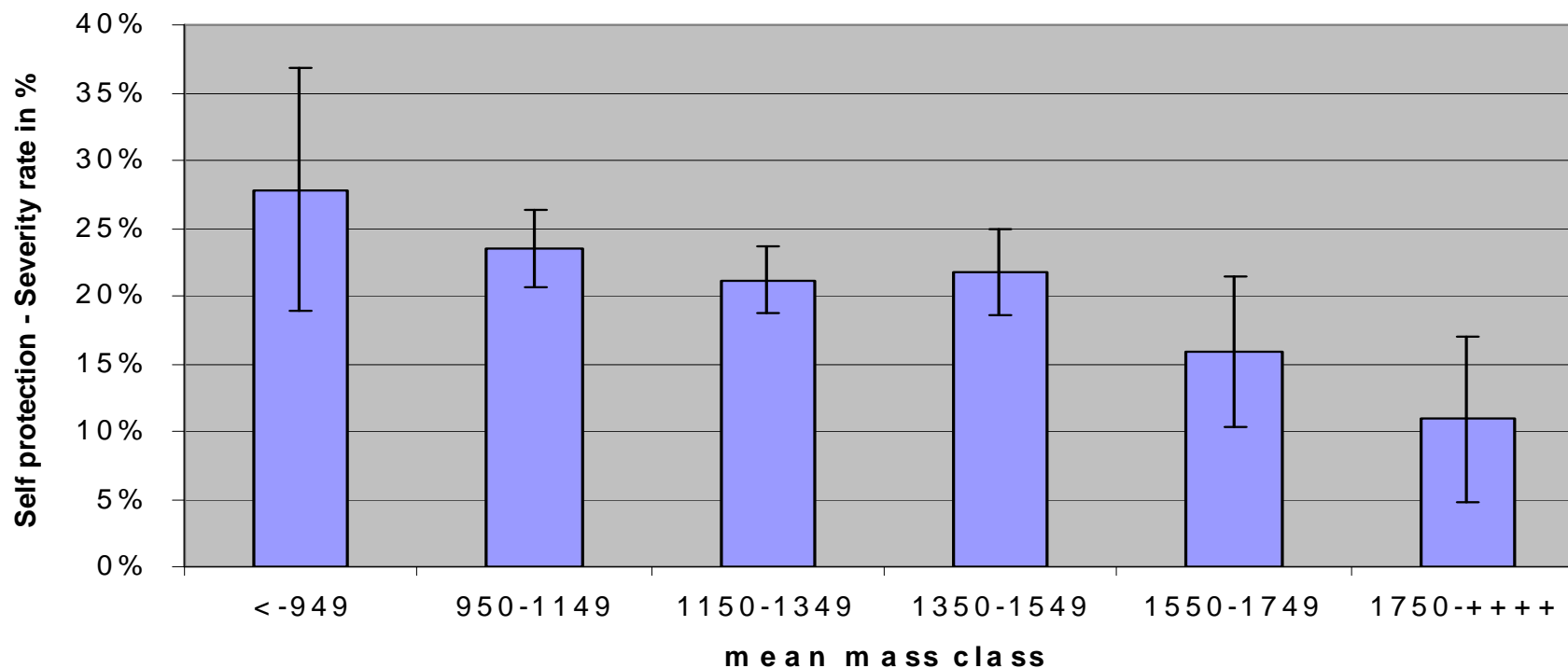
Issue 1: ACCIDENT ANALYSIS

**Is an accident analysis needed to update
information on changing vehicle fleet?**

PROBLEM IDENTIFICATION



BAAC 2005-2008, car occupants, belted, front seats, frontal impact against car (n=2871) Severity rate according to mean mass class, conception >1999 or model year >2003



➤ SEVERITY RATE IS MASS DEPENDENT FOR R94 CAR DESIGN

PROBLEM IDENTIFICATION

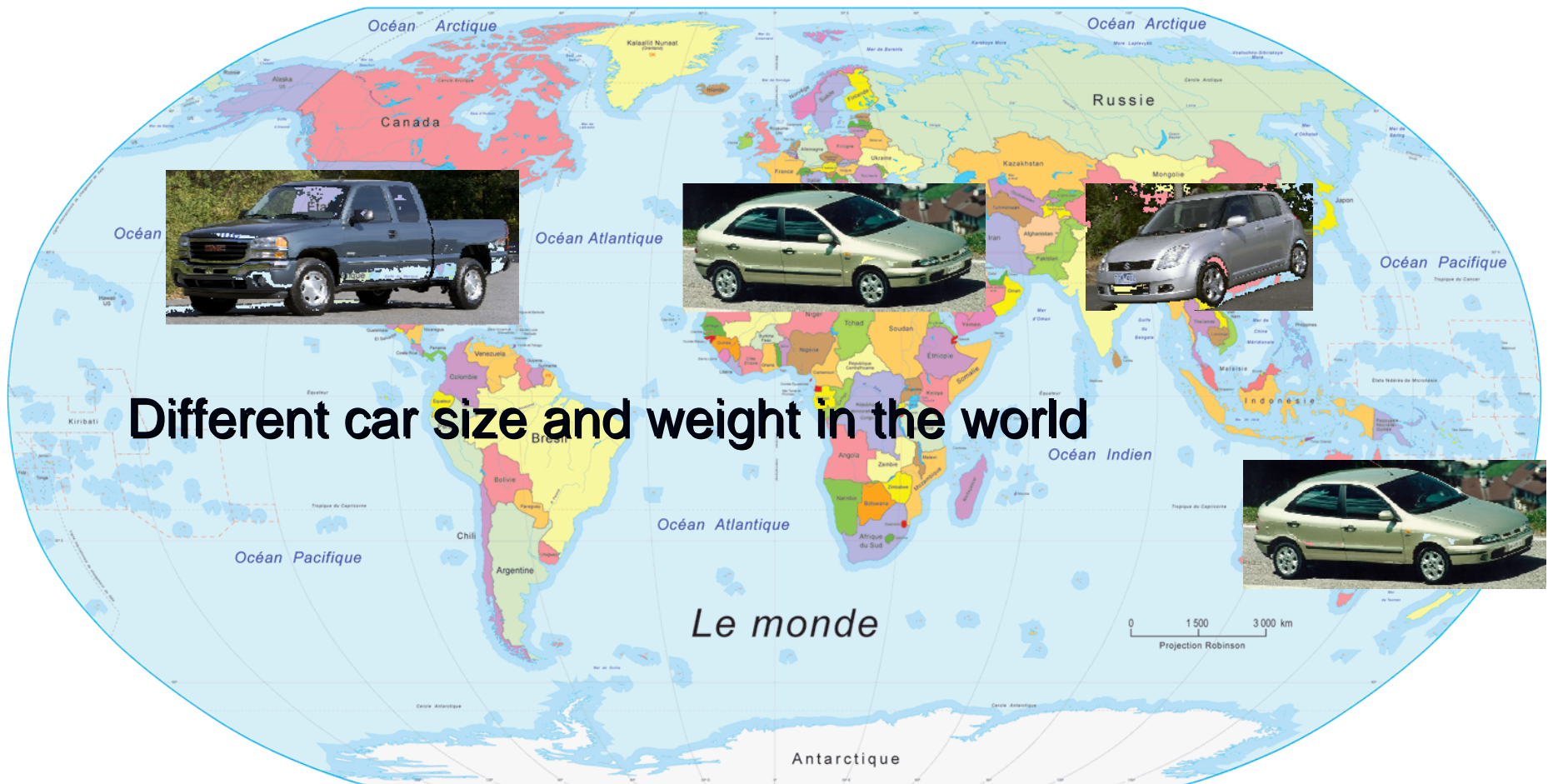


➤ self protection level differences were also observed in crash tests



- Different front end force and compartment force design lead to incompatible energy distribution in car to car configuration
- Problem still exists for “R94 fleet” generation
- Problem was confirmed by different worldwide organizations, different working groups and countries.

Issue 2: Harmonisation of frontal impact procedure



Different car size and weight in the world

⇒ **Current obstacle is not adapted for harmonization**

- Different fleet, size vehicle and mass around the world
- Obstacle has problems with bottoming out and weak stiffness can not be adapted for worldwide harmonization
- PDB shows that it is convenient and adapted for light cars to heavy vehicles

Issue 5:
**Validate that PDB Test guarantees
a minimum EES test severity for
all vehicles**

PDB GUARANTEE MINIMUM EES



(VC-Compat test)



⇒ The Smart, known for its high stiffness factor doesn't put so much energy in the barrier.

PDB GUARANTEE MINIMUM EES



⇒ Large pick up known for its high front end stiffness doesn't put so much energy in the barrier



TEST SEVERITY

Current ECE R94

PDB Test @ 60 km/h

SMART

EES: 53 km/h

SILVERADO

EES: 51 km/h

**SILVERADO (2500 kg)
EES: 50 km/h**

SMART (950 kg)

EES: 43 km/h

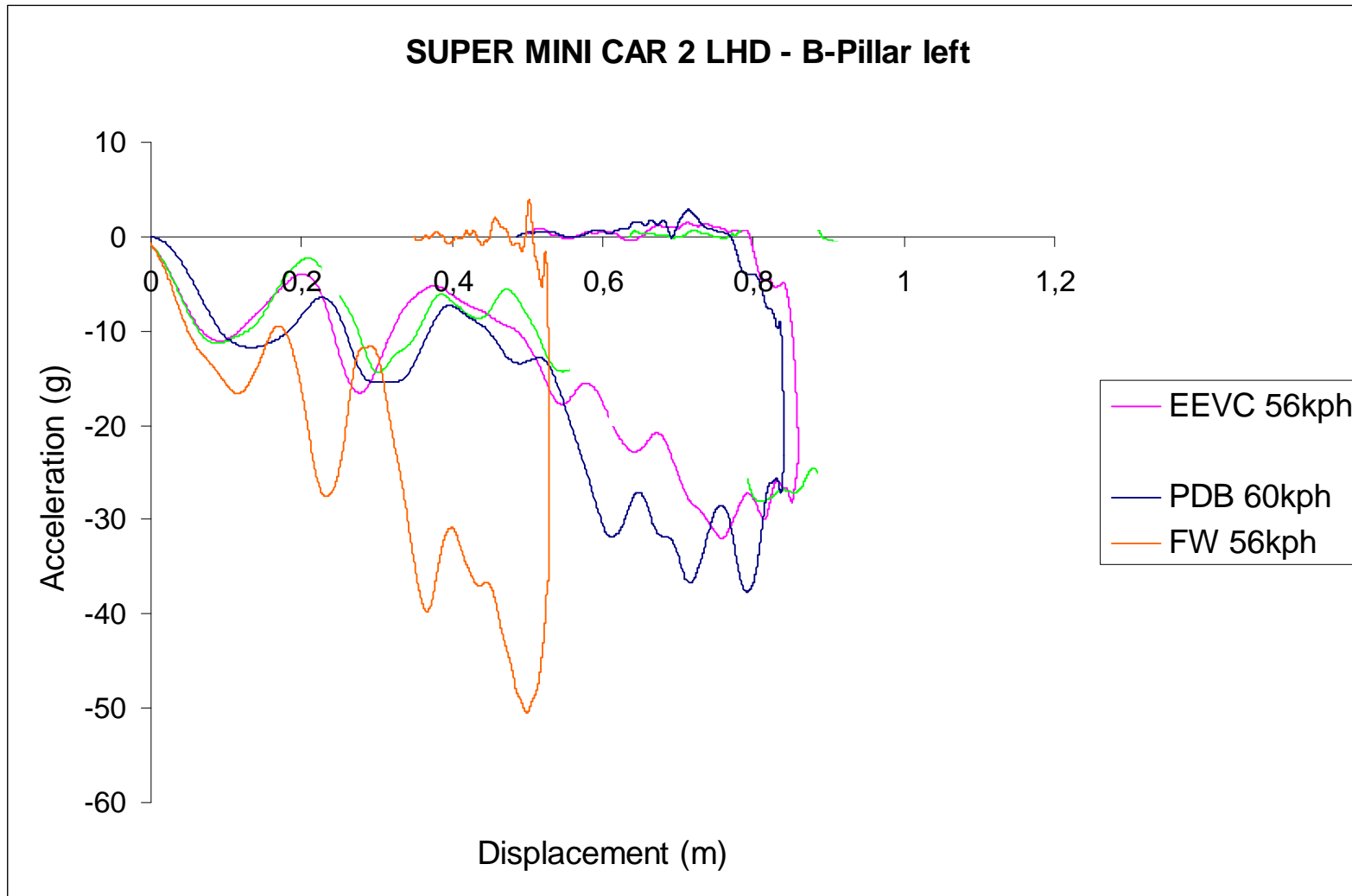
- Self protection of the light car elevated (+ 20%)
- Self protection of the heavy vehicle is quite constant

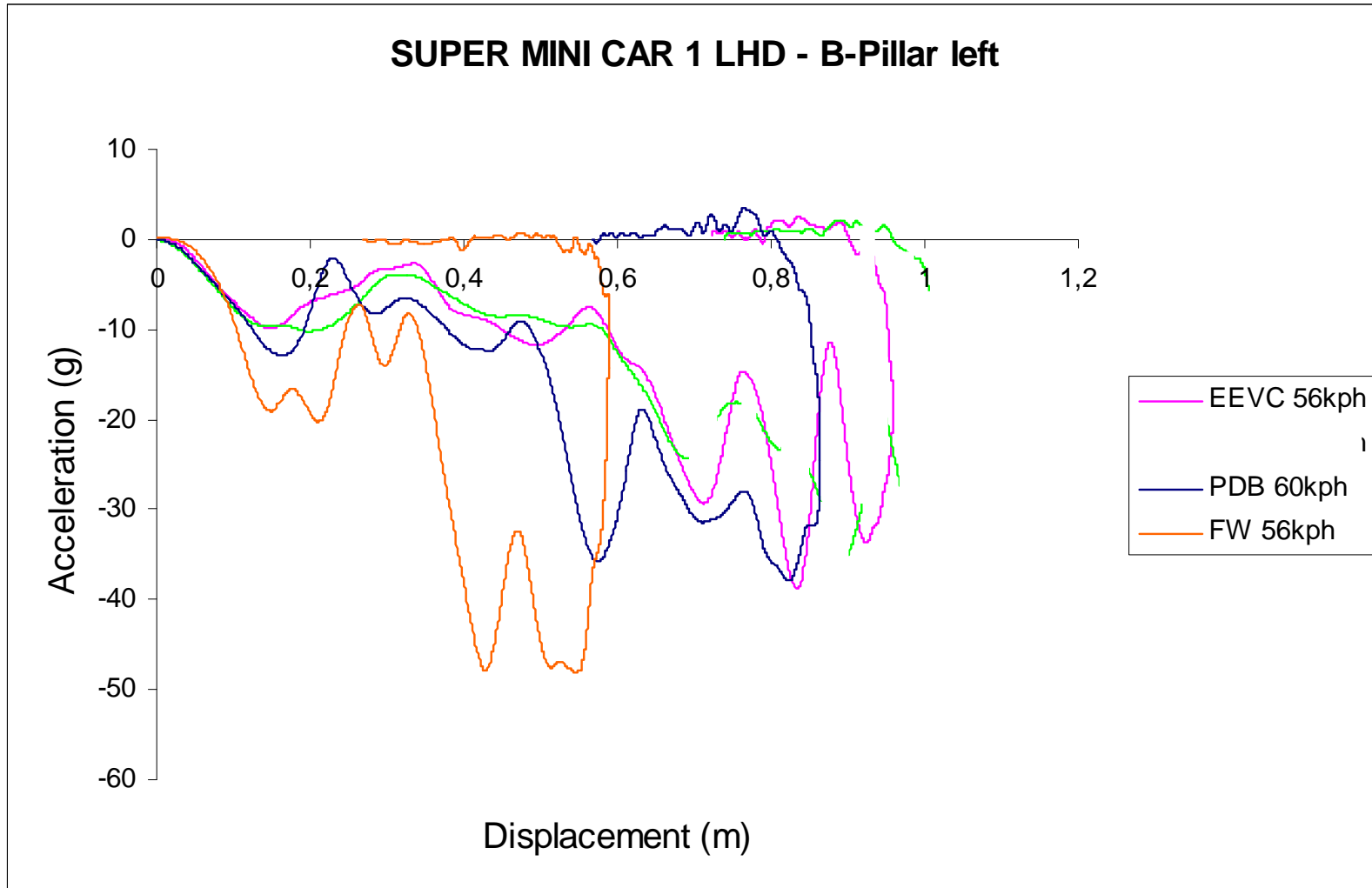
- Self protection level of a stiff light car is increased according to the combination of speed and deformable element stiffness.
- Self protection level of the stiff heavy car is not affected
- By design, PDB is able to guarantee a minimum self protection level (associated to reasonable and common design rules used by car makers).

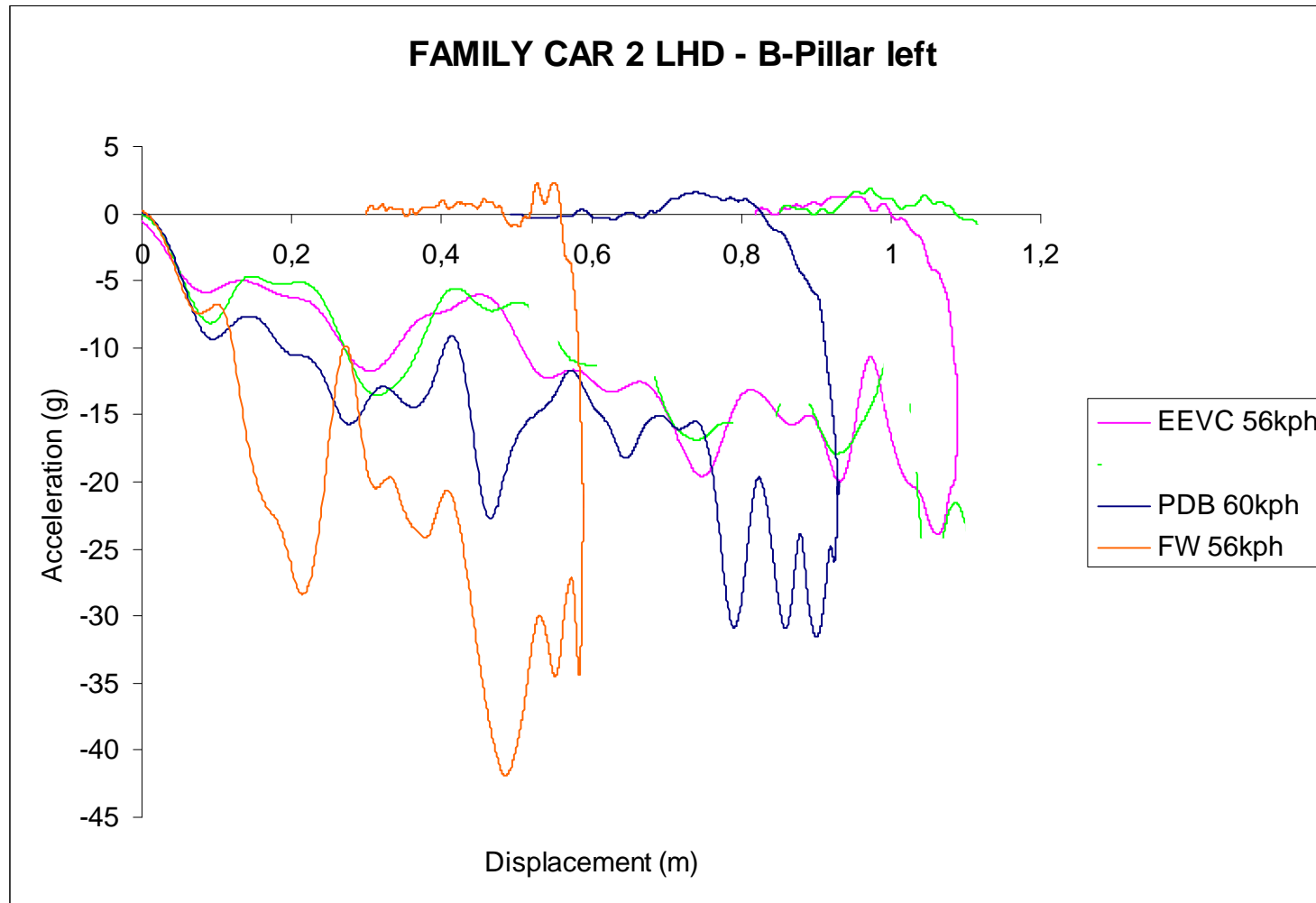
**Issue 7:
Validate that PDB provides the required
test requirements for interior
restraints**

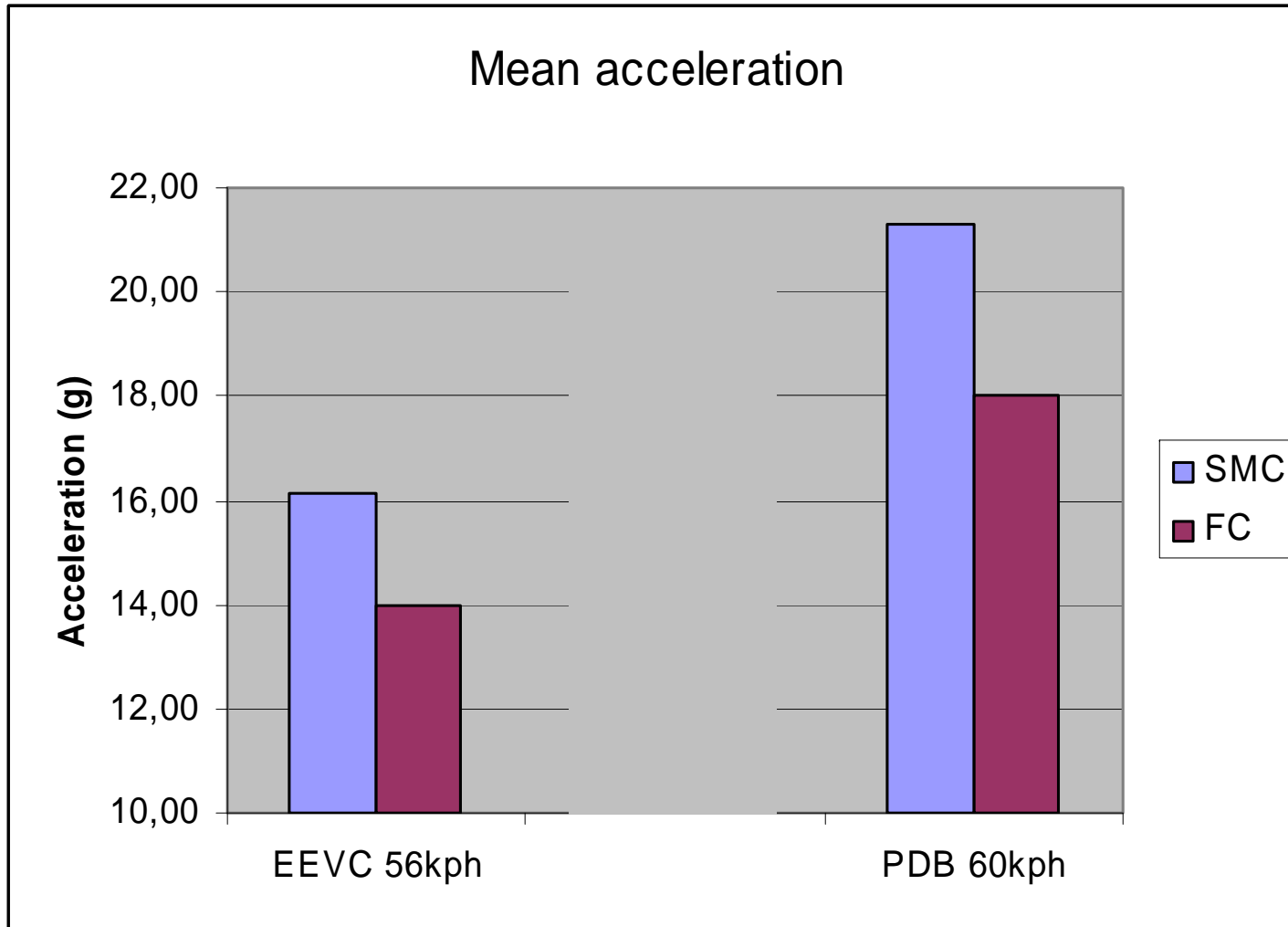
**Issue 4:
Assessment of occupant restraint
system with PDB Test**

2- SELF PROTECTION: VEHICLE SEVERITY

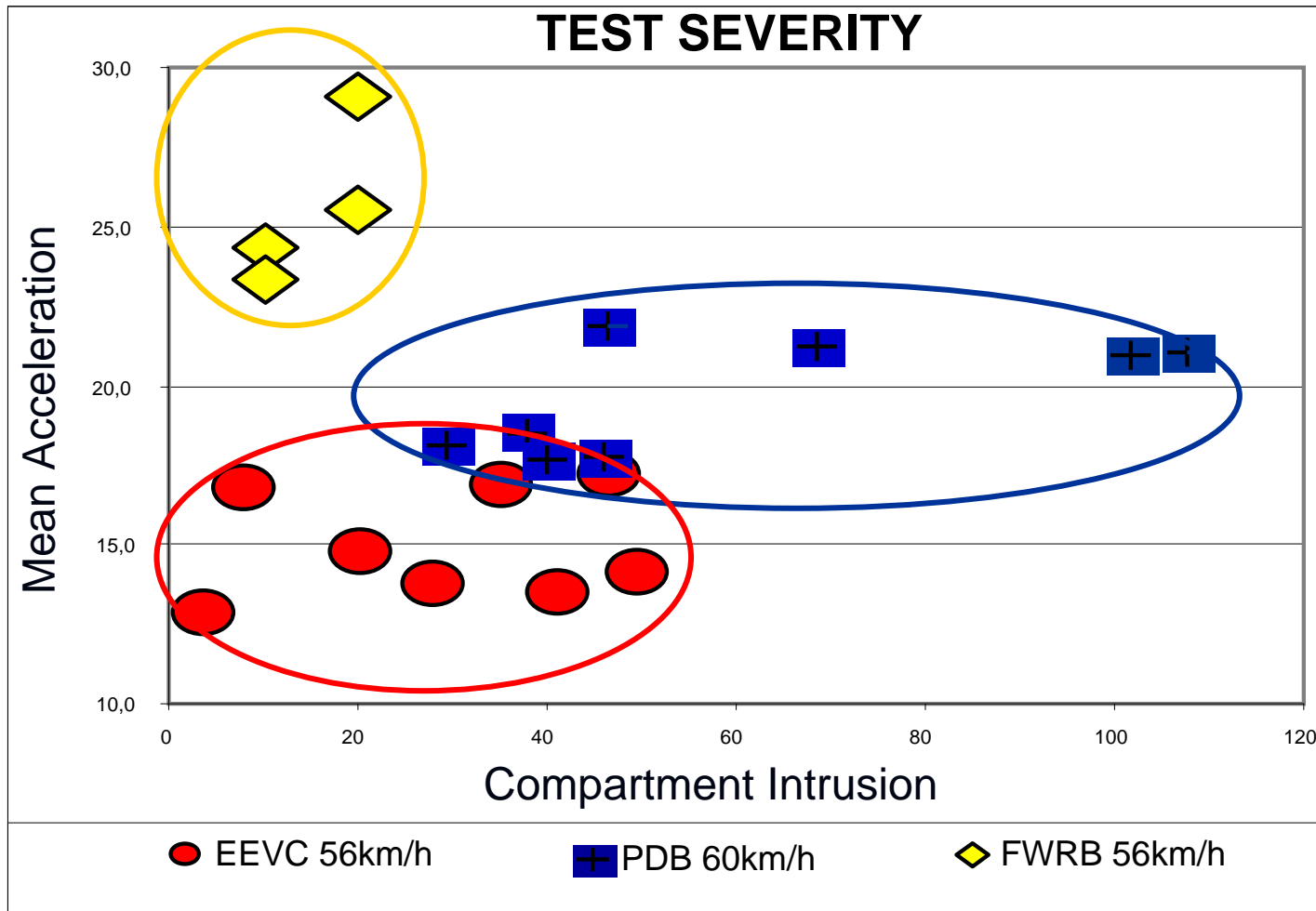






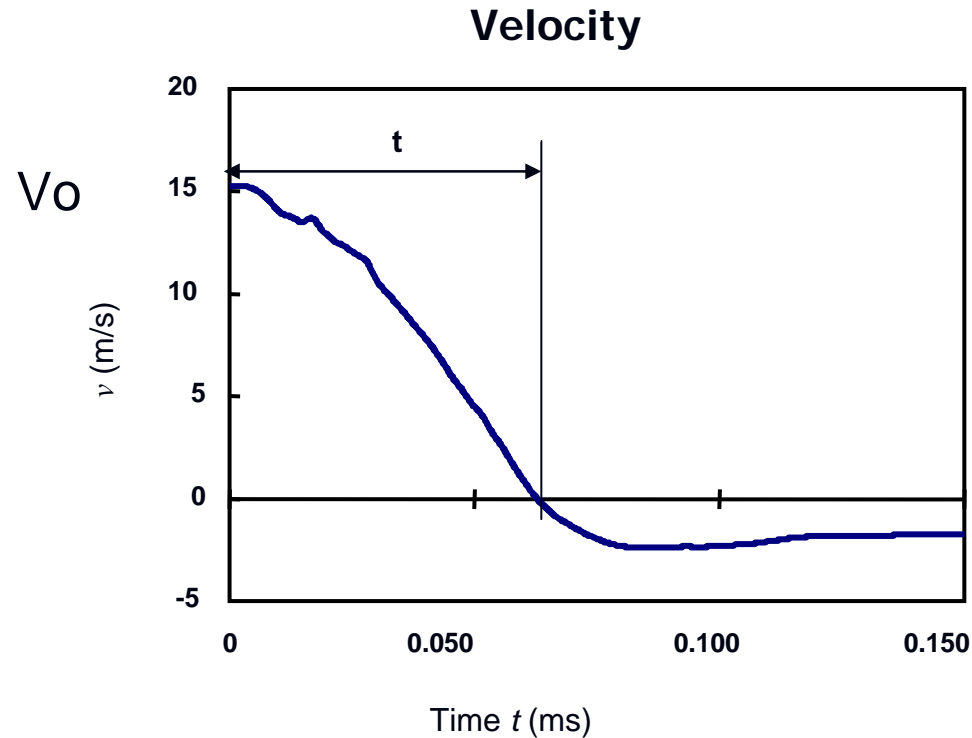


2- SELF PROTECTION: VEHICLE SEVERITY



⇒ PDB test combines acceleration and intrusion

MEAN ACCELERATION DEFINITION



$$\text{Mean acceleration} = V_0 / t$$

$$t = \pi / w$$

$$w = f(K / M)$$

$$K \nearrow \Rightarrow w \nearrow \Rightarrow t \searrow$$

⇒ According to physics, higher stiffness leads to higher acceleration

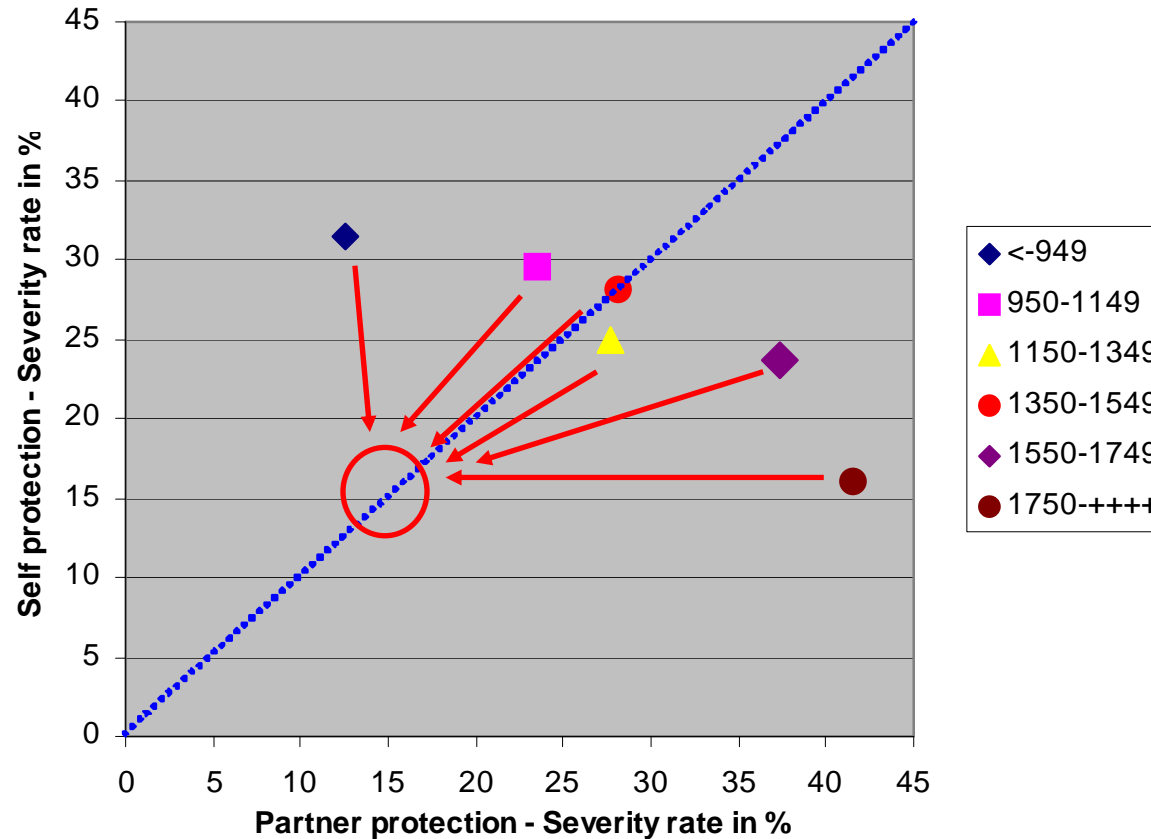
- Combination of higher test speed and higher obstacle stiffness lead to higher acceleration severity for occupants
- PDB test combines in one test the two causes responsible for road injuries in the real world
- Confirmed by laws of physics and tests performed

Issue 6: BENEFITS

WHAT R94 AMENDMENT COULD DO?



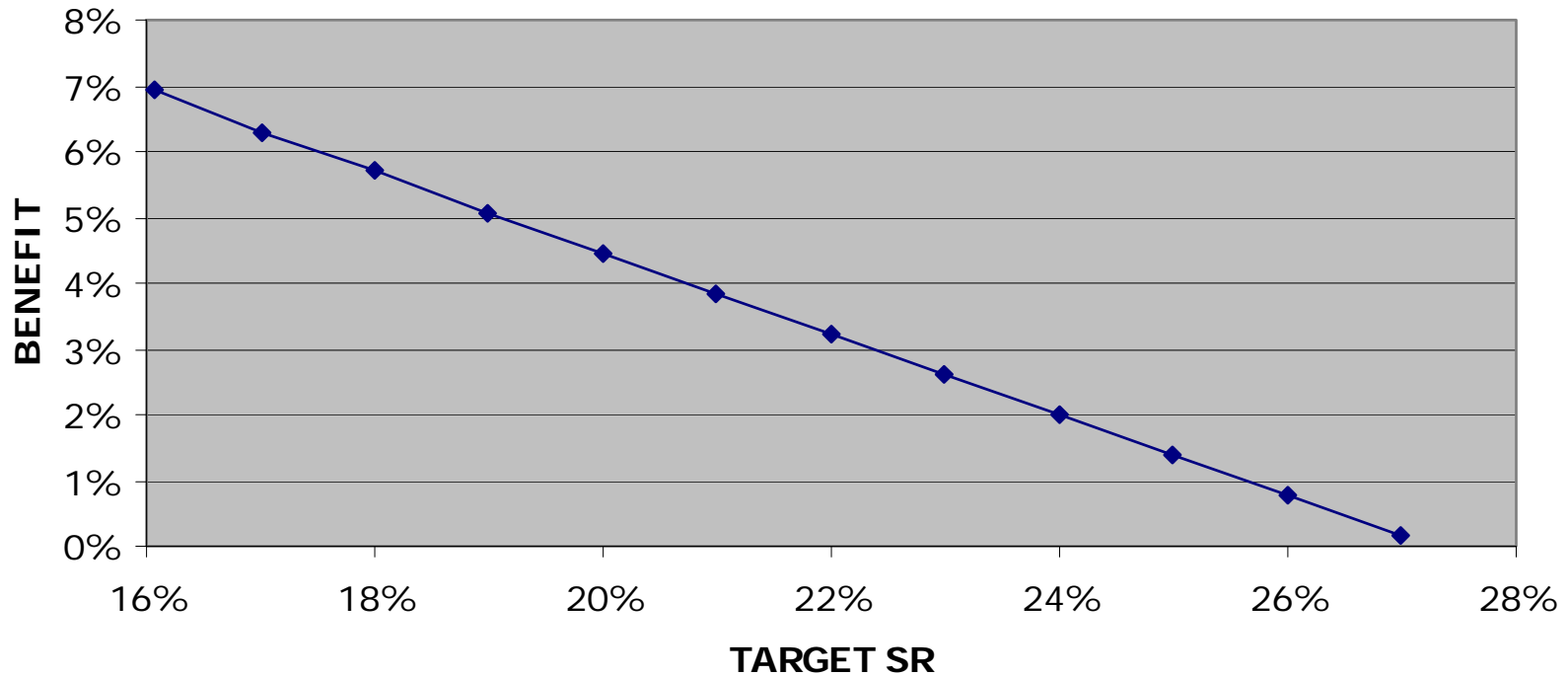
BAAC 2005-2008, car occupants, belted, front seats, head on collisions, car to car (N=1875), according to mean mass classes, conception >1999 or model year >2003 for both cars



TARGET TO BE DEFINE



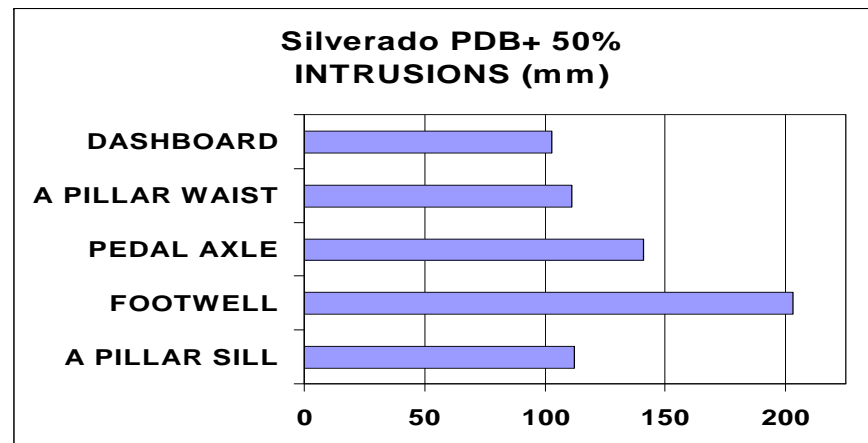
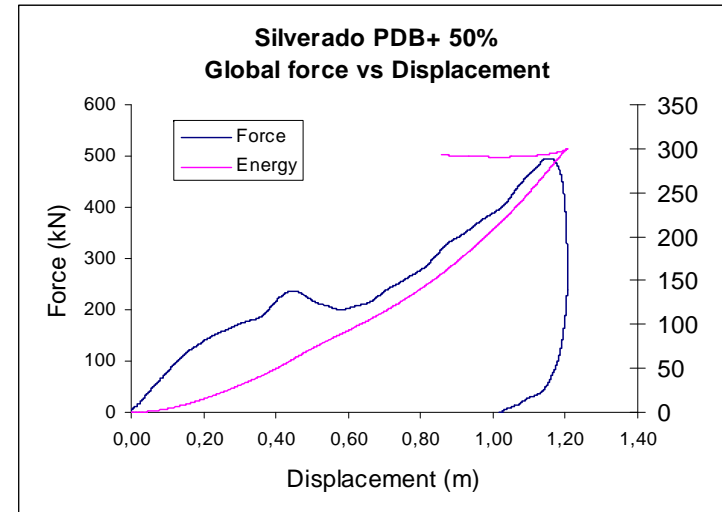
**BENEFIT OF THE HARMONISATION OF FRONTAL PROTECTION
ACCORDING TO THE VALUE OF THE TARGET SEVERITY RATE (SR).
Reduction of the the number of fatal and severely injured car
passenger. SETRA 2005 2006 2007 2008.**



- In 2007, benefits should have reached 7 % of fatalities and severely injured that represent 1700 persons by year

Issue 7: Design of future vehicles / Misuse of the PDB

Examples

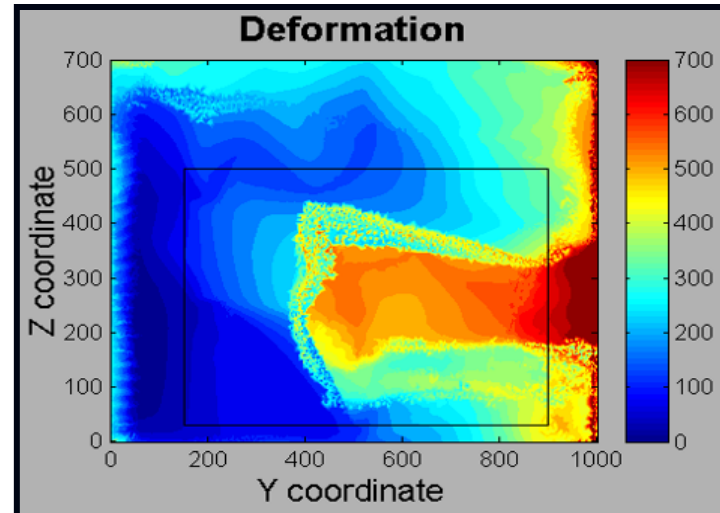
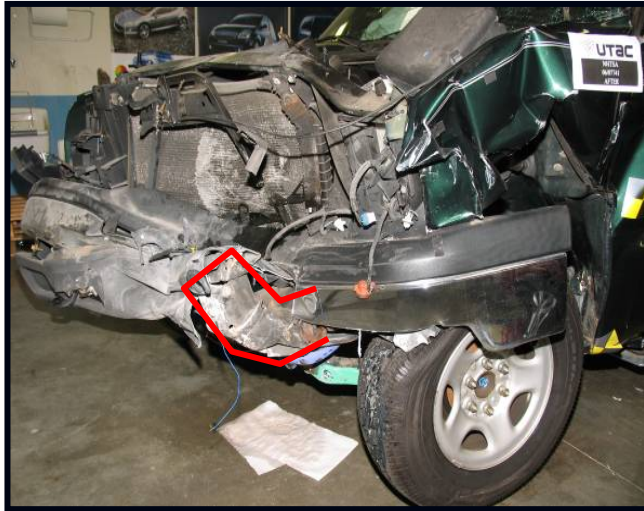


⇒ Weak compartment is detected



⇒ Possibility to detect weak compartment even if car is design with stiff front end

Examples



⇒ Stiff front end is also detected

Examples



- Chevrolet Silverado 2293 Kg



- Ford Escape 1791 Kg



- Ford F250 3291 kg

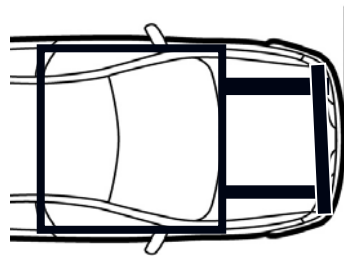


- Saturn Outlook 1916 Kg

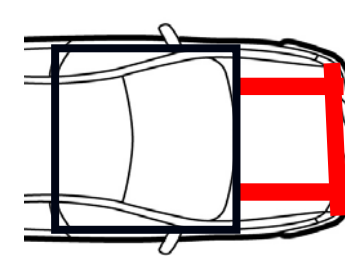
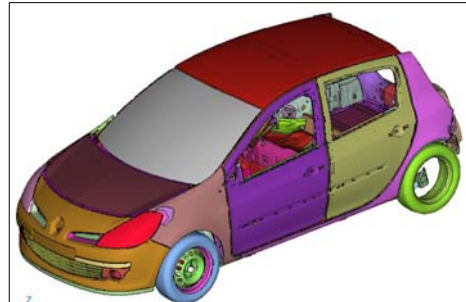


⇒ Different front designs were investigated

MISUSE OF PDB: LIGHT CAR

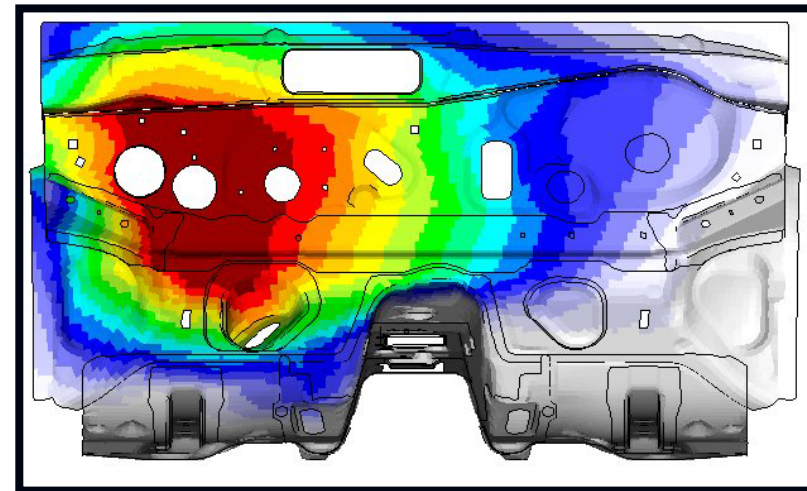
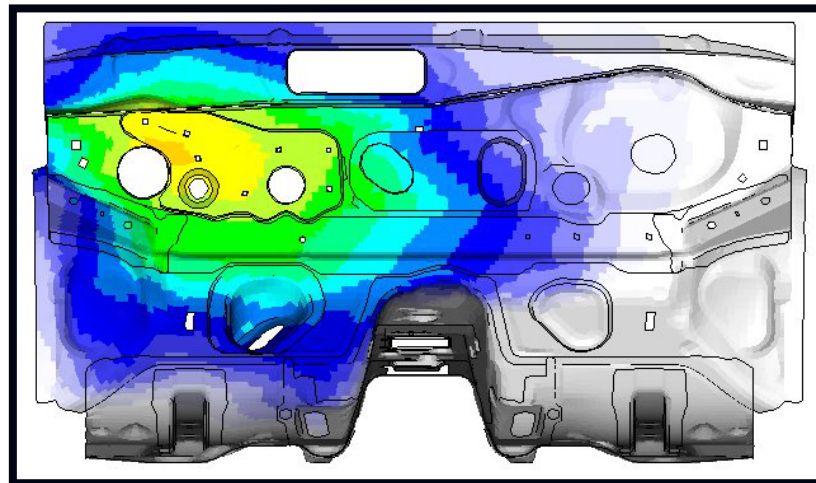


Standard



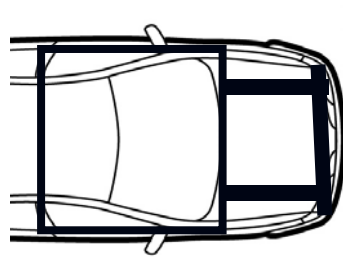
+ 12 kg

Reinforced

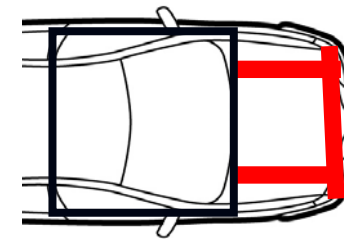
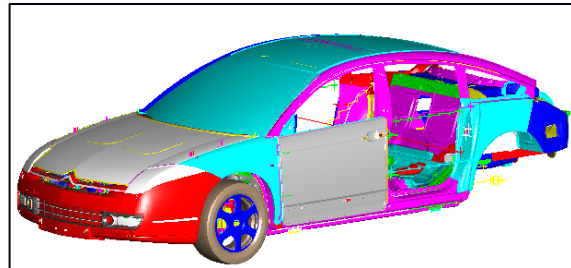


⇒ Front unit reinforcements lead to higher intrusions in the compartment

MISUSE OF PDB: LARGE CAR

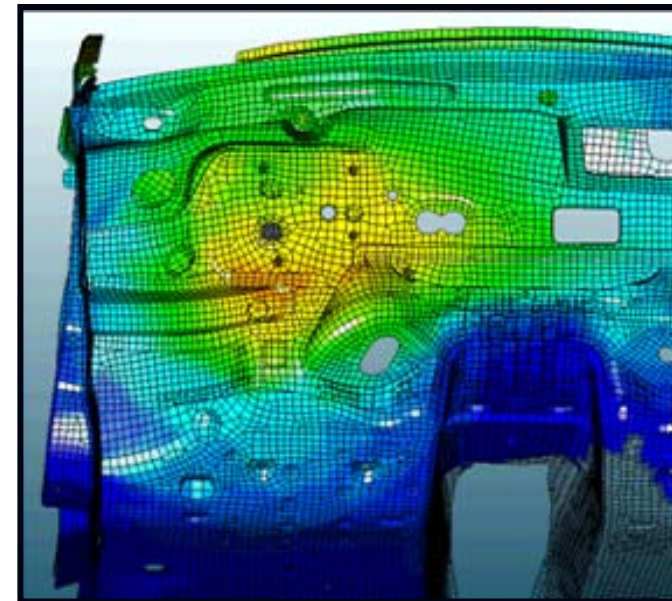
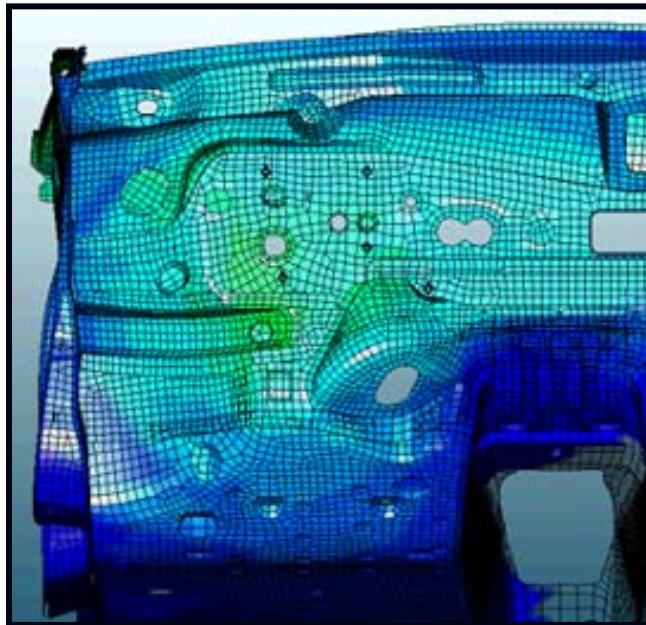


Standard



+16 kg

Reinforced



⇒ **Front unit reinforcement leads to higher intrusions in the compartment**

- Tests performed did not confirm the possibility to over deform the barrier, confirmed by simulations
- Possibility to detect weak compartment even if vehicle is designed with stiff front end
- Misuse of the PDB is not yet shown

**Issue 8:
Insufficient testing has been
performed to validate the
proposed barrier specification**

ACCIDENT ANALYSIS



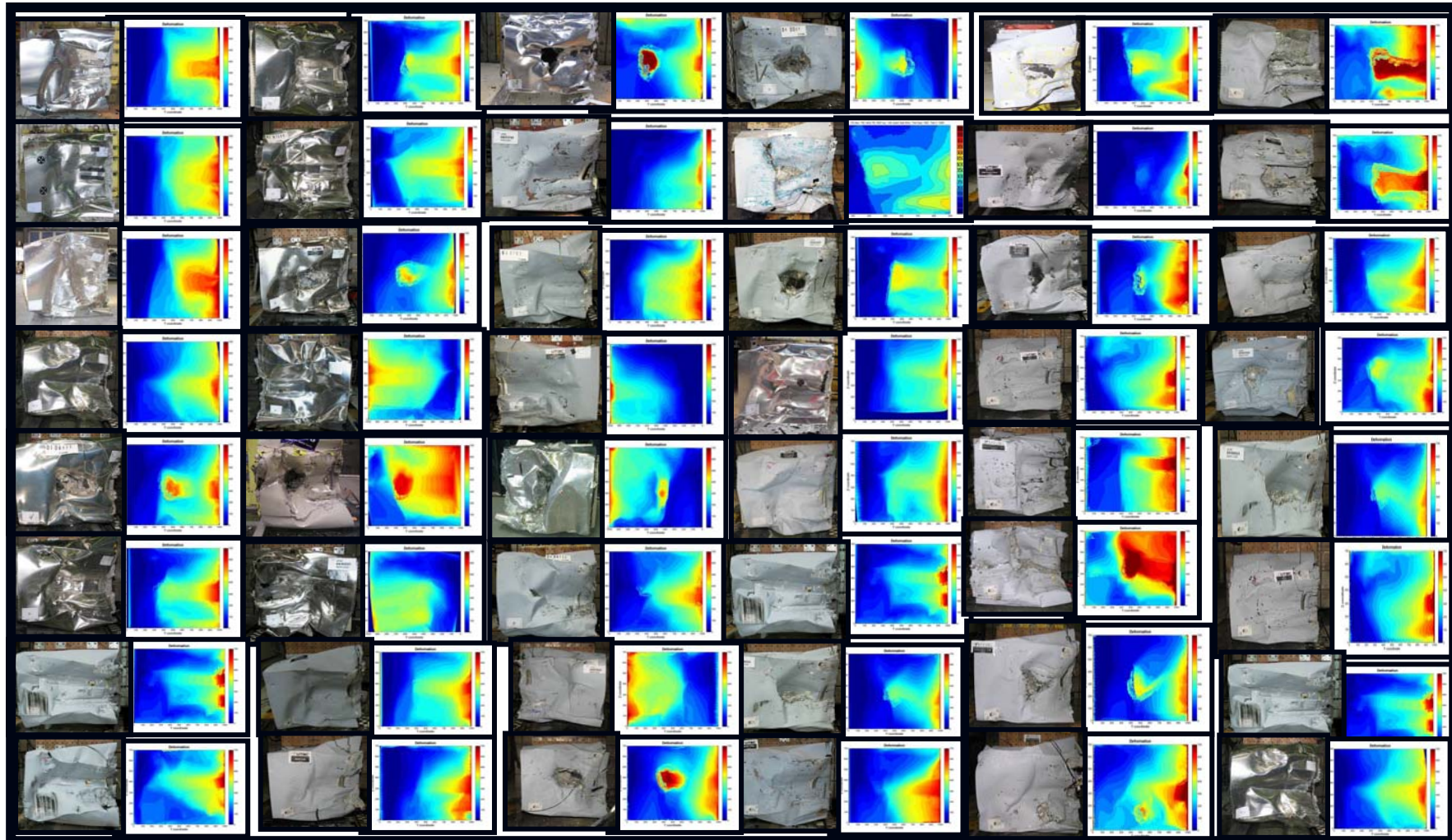
CAR TO CAR TEST INVESTIGATIONS

LITAC



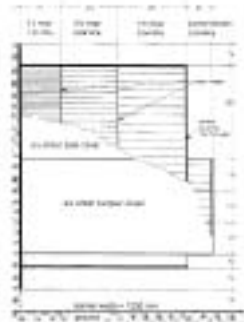
About 120 car to car tests performed

PDB TESTS

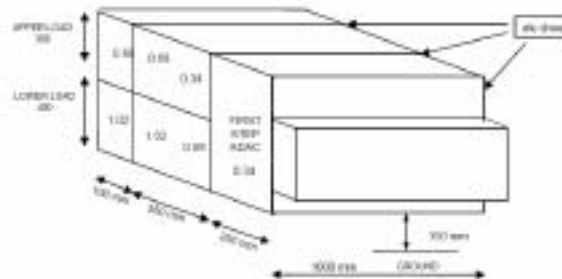


⇒ More than 80 tests have been performed since 2003

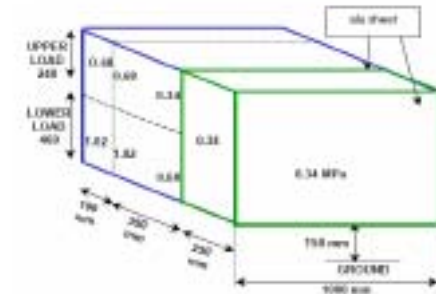
INSUFFICIENT TESTING: DIFFERENT BARRIER



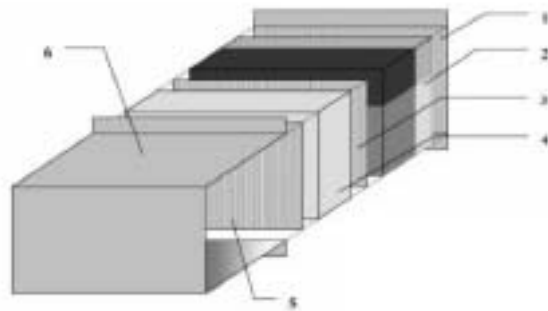
1996: ADAC Barrier
40% overlap



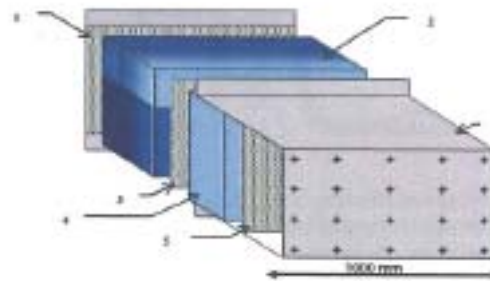
2000: PDB
750 mm overlap



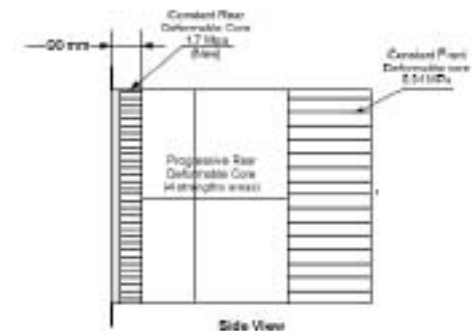
2002: PDB v6
750 mm overlap



2003: PDB v7
50% overlap



2006: PDB v8
50% overlap



2006: PDB +
50% or 100% overlap

⇒ Since 2003, tests performed are comparable

INSUFFICIENT TESTING: MAIN BARRIER CHANGES



- Concept of the PDB is not new, it has existed since 1996 (derived from the German ADAC barrier)
- 80 R94 amendment tests comparable and available performed by countries, laboratories, car makers and international working groups
- Eclectic cars / vehicles representing the “World fleet”

- There is still a car to car problem with current R94
- R94 amendment doesn't affect self protection level
- Misuse of the R94 amendment never observed
- Numerous tests are available and comparable for 6 years, performed with different vehicles from different continents
- R94 amendment has a high potential for future frontal test harmonization