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INVESTIGATION OF TEST SEVERITY TO SOLVE COMPATIBILITY PROBLEM OF MODERN CARS

(energetical approach)

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OUTLINE

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1. AIM OF THE PRESENTATION

2. TEST CONFIGURATIONS INVESTIGATED

3. HYPOTHESIS AND PARAMETERS INVESTIGATED

4. TEST SEVERITY COMPARISON

5. CONCLUSION

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Problems

- Accident analysis highlighted problem of compatibility between modern light and heavy cars designed to respect R94 regulation.

What it is needed to solve the problem?

- A change, adapted to light and heavy cars should be introduced as soon as possible in the regulation to switch towards a harmonized fleet
- Improve test severity harmonization between light and heavy cars for the structure and the restraint systems

Application to a test method

- According to previous remarks, the future regulation must integrate a better severity harmonization between light and heavy car (similar EES and delta V)

  This presentation investigates the capacity of the two main test candidates to answer this problem and improve the current regulation in a reasonable approach.

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TEST CANDIDATES

- R94: represents the current regulation and the reference

- R94 amendment (PDB at 60 kph): proposed in Geneva, tentative for solving current problem shown by accident analysis and could be the basis for partner protection introduction.

- MDB Test is shown as a possibility to be introduce in a long term approach as a regulation - two closing speed were investigated:

  - 90 km/h corresponding to a similar severity than R94 amendment for a mass around 1500 kg

  - 112 km/h. This closing speed was proposed by different organizations and probably comes from 2 * 56 km/h.

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Test configuration investigated:

- R94 (reference)
- R94 amendment
- MDB@90
- MDB@112

	R94	R94 Amendment	MDB@90	MDB@112
Trolley mass (kg)	-	-	1500	1500
Test speed / closing speed (km/h)	56	60	90	112
Overlap (%)	40	50	50	50
Deformable element face	ODB	PDB	PDB	PDB

Current R94 barrier face was not investigated because results would have been worse in MDB test.

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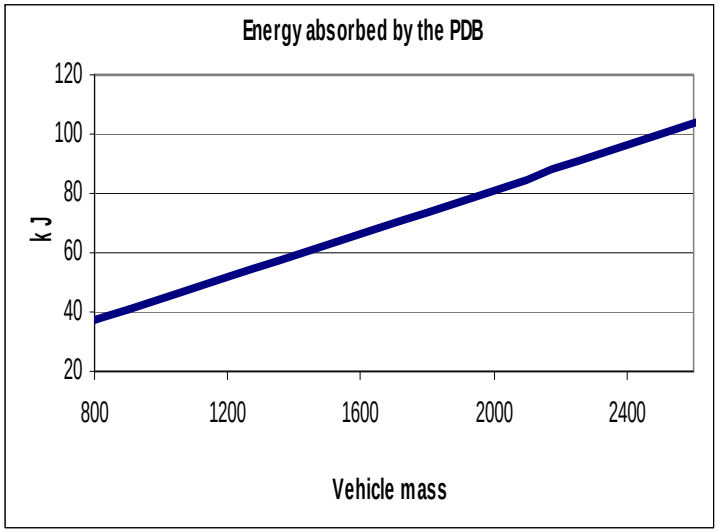
For all test configuration is calculated the order of magnitude:

- EES in kph vs Mass (to evaluate severity for the structure)
- Delta V in kph vs Mass (to evaluate severity for the restraint system)

Hypothesis:

Energy absorbed by the ODB barrier: 45 kJ

Energy absorb by the PDB, see figure ⇨



Two categories of car mass representing an issue in different part of the world were investigated in more detail :

- Light car: 1000 kg (S)
- Heavy car: 2400 kg (H)

MAIN DIFFERENCE BETWEEN MDB AND ODB

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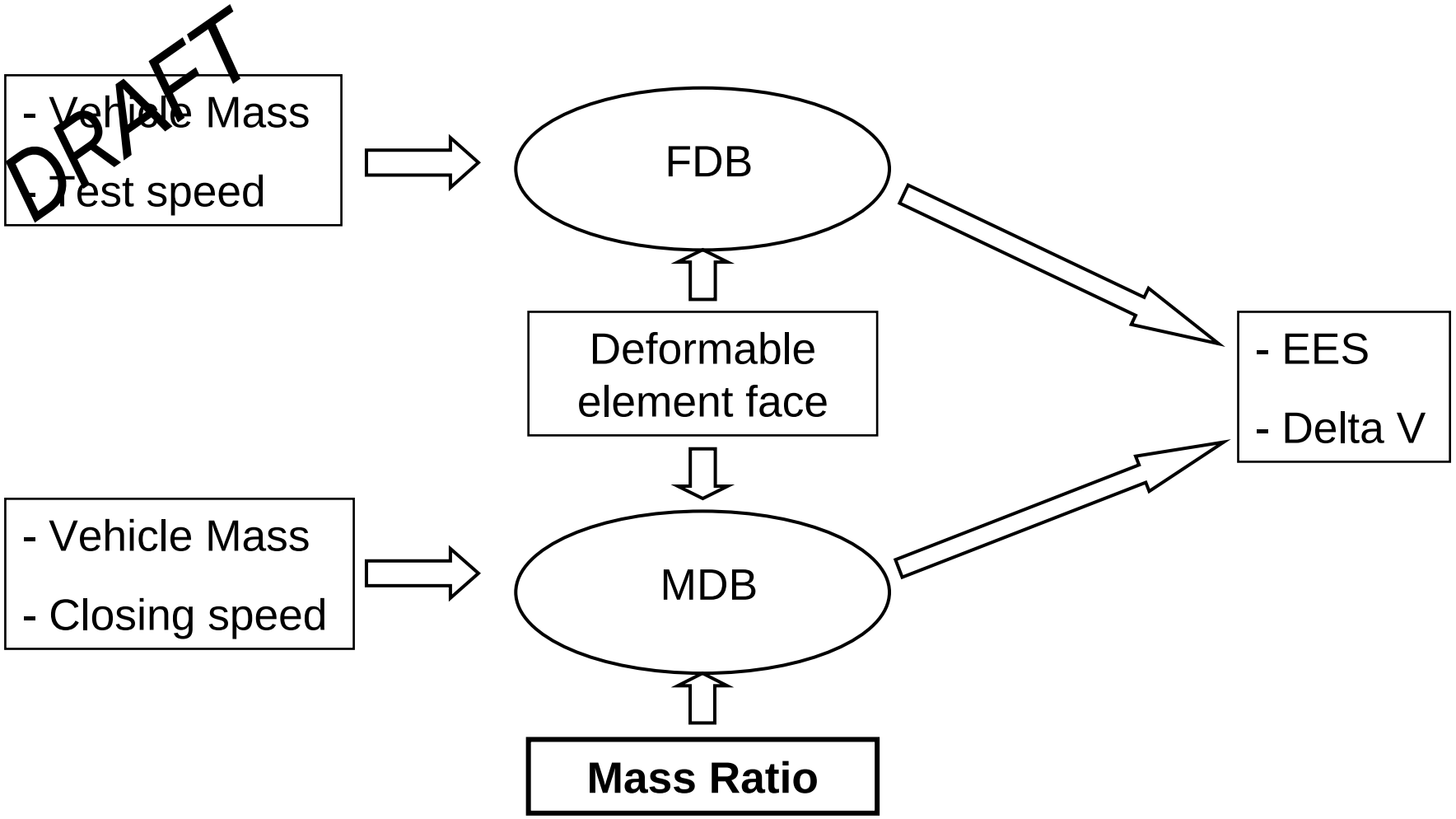
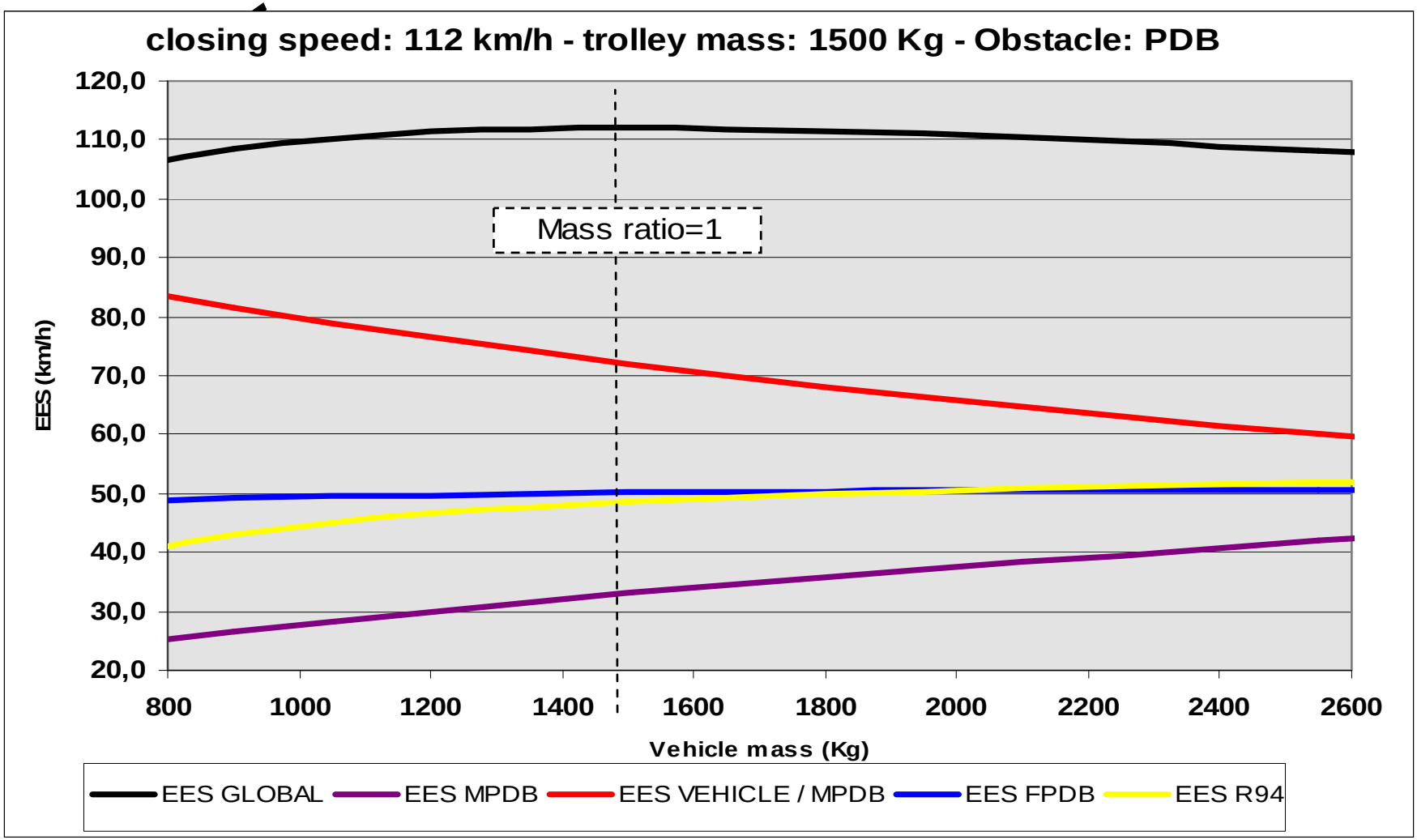
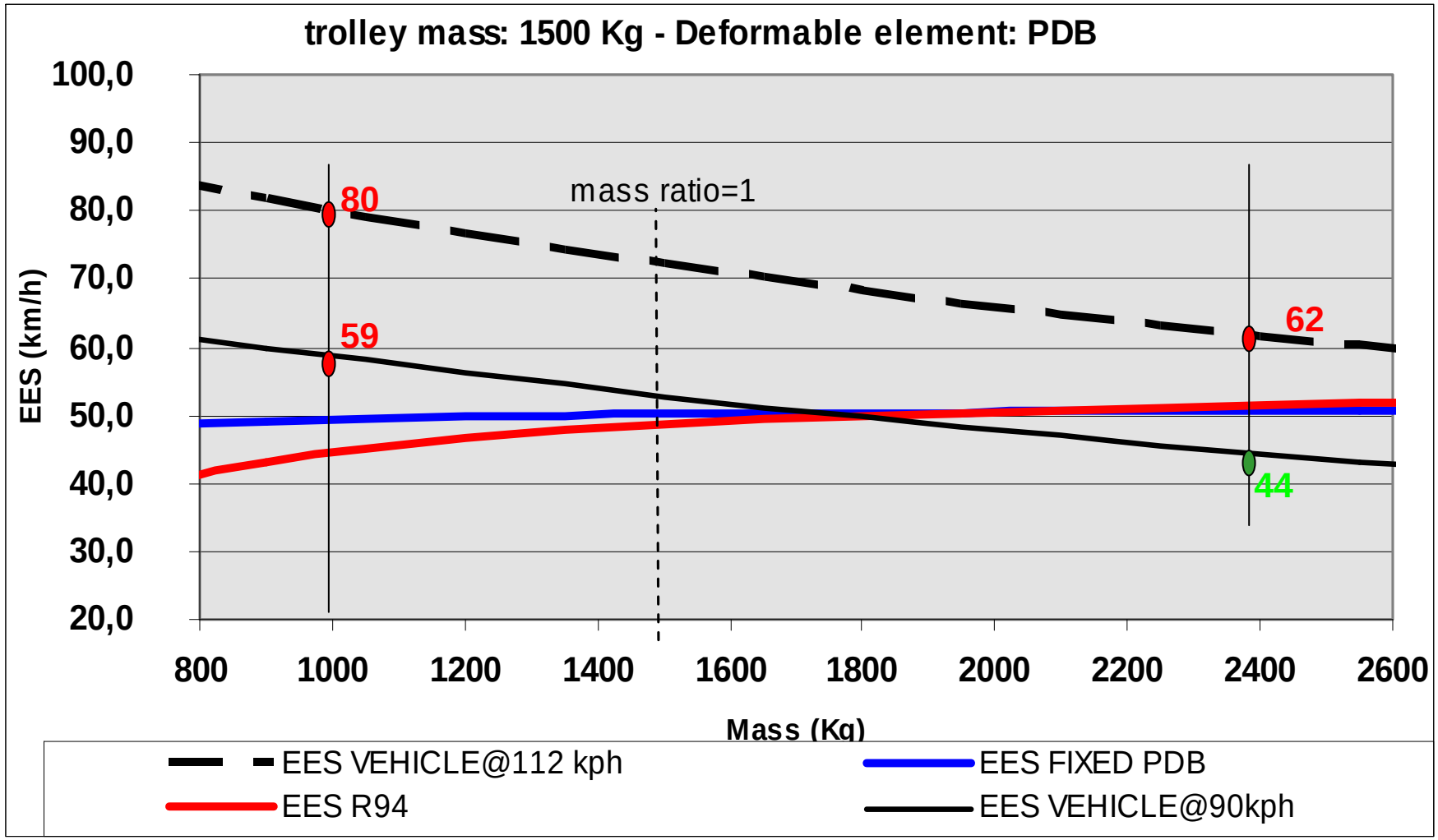


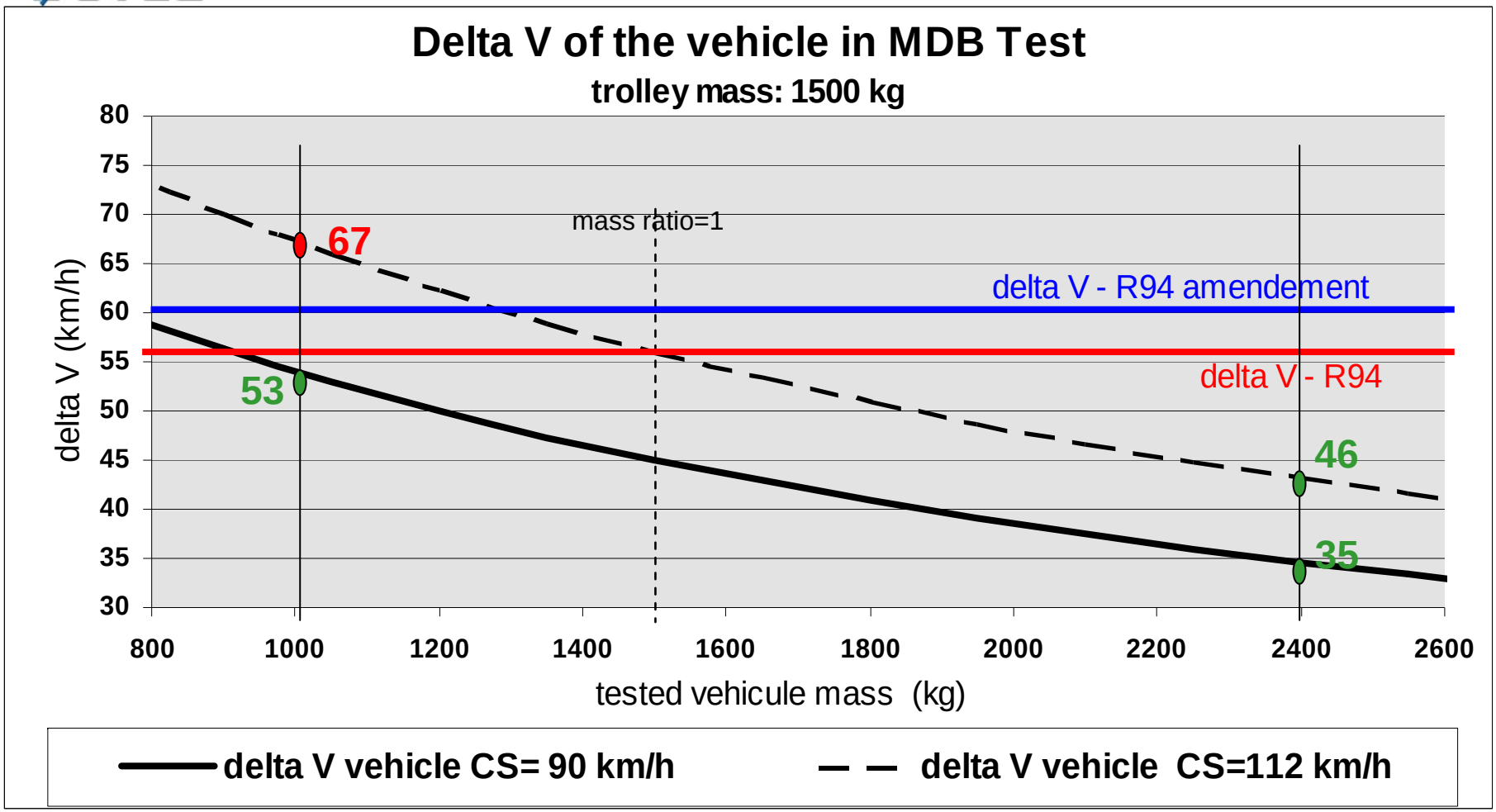
⇨Mass ratio parameter must be take into account to calculate test severity in addition of the energy absorbed by the barrier



- Momentum conservation introduces important and linear differences



- MDB@112 is severe for light and heavy cars
- MDB@90 is severe for light cars



- MDB@90 is less severe for all car mass
- MDB@112 is severe for light cars

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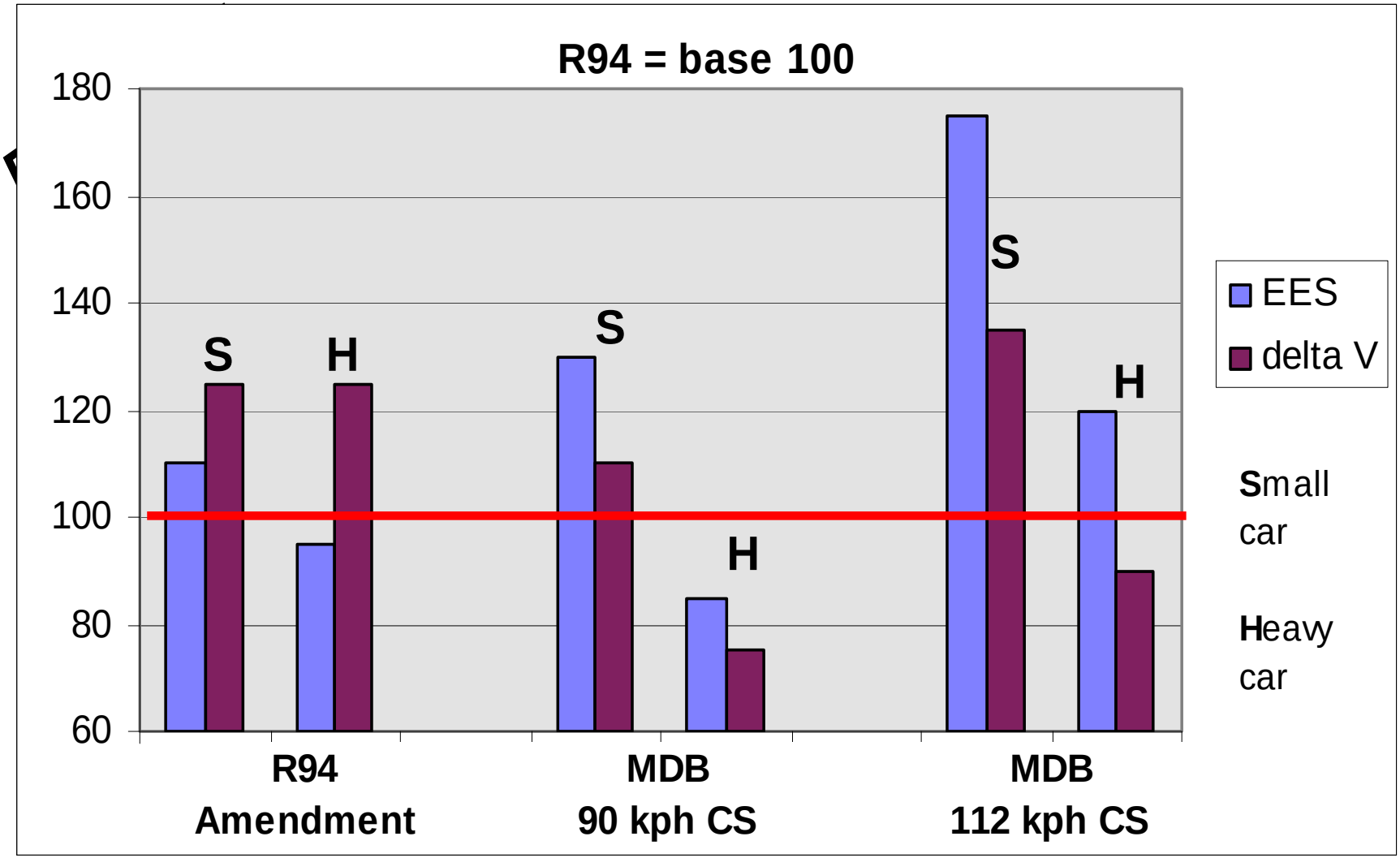
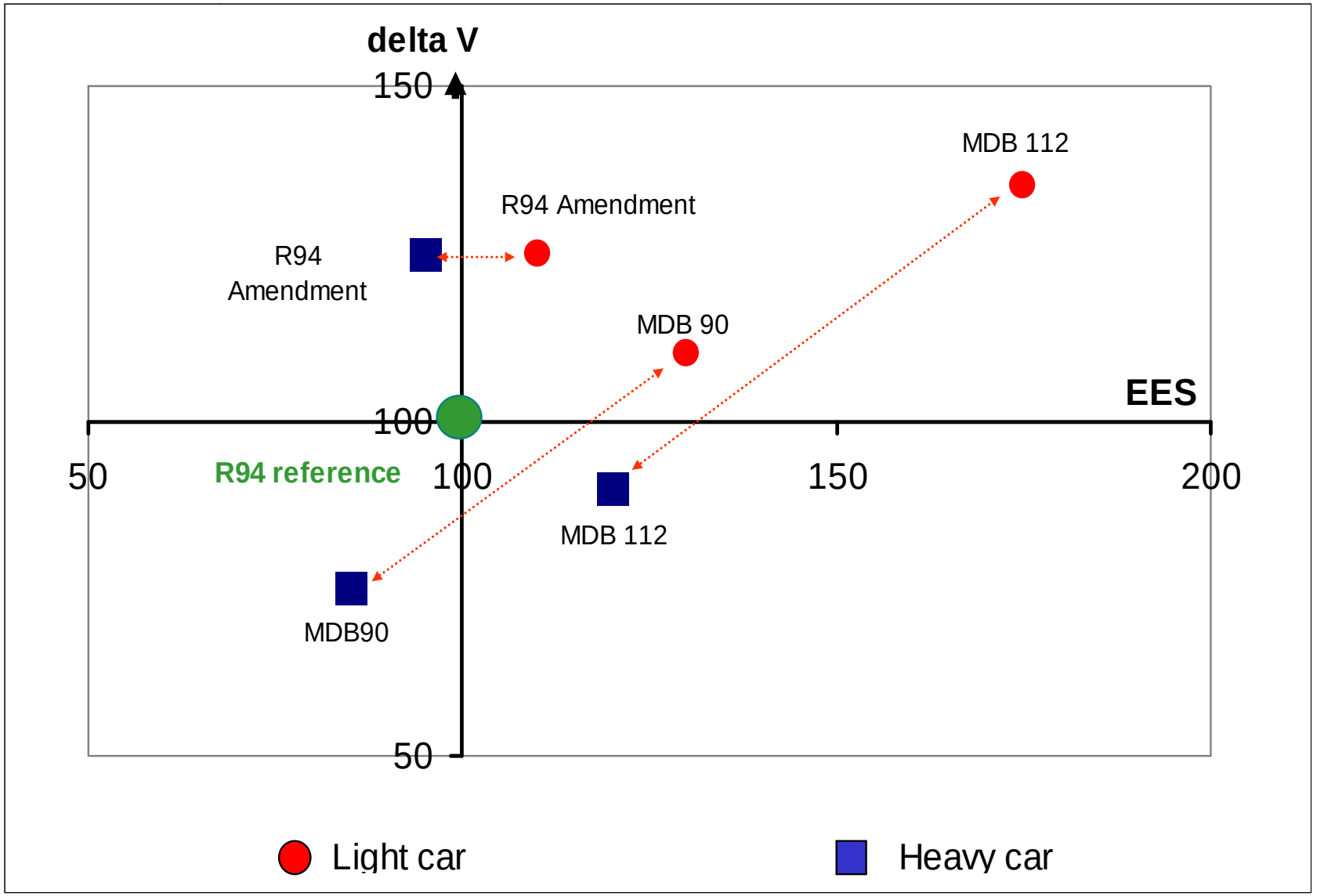
Delta V and EES in kph		Small car 1000 kg	Heavy car 2400 kg	Severity comparison with R94	
R94 (reference)	Delta V	56	56	Basis: 100	
	EES	45	51		
R94 amendment	Delta V	60	60	125	125
	EES	49	50	110	95
MDB @ 90	Delta V	53	35	110	75
	EES	59	44	130	85
MDB @ 112	Delta V	67	46	135	90
	EES	80	62	175	120

- According to momentum conservation, important severity differences are observed in MDB test configuration between light and heavy cars



- Above the line 100, the test is severe than current R94


delta V
150
100
50
EES
50
100
150
200
R94 reference
MDB 112
R94 Amendment
R94
Amendment
MDB 90
MDB 112
MDB90
Light car
Heavy car

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Severity Parameter (SP)

SP parameters is the combination of EES and delta V to give an approximation of the global test severity

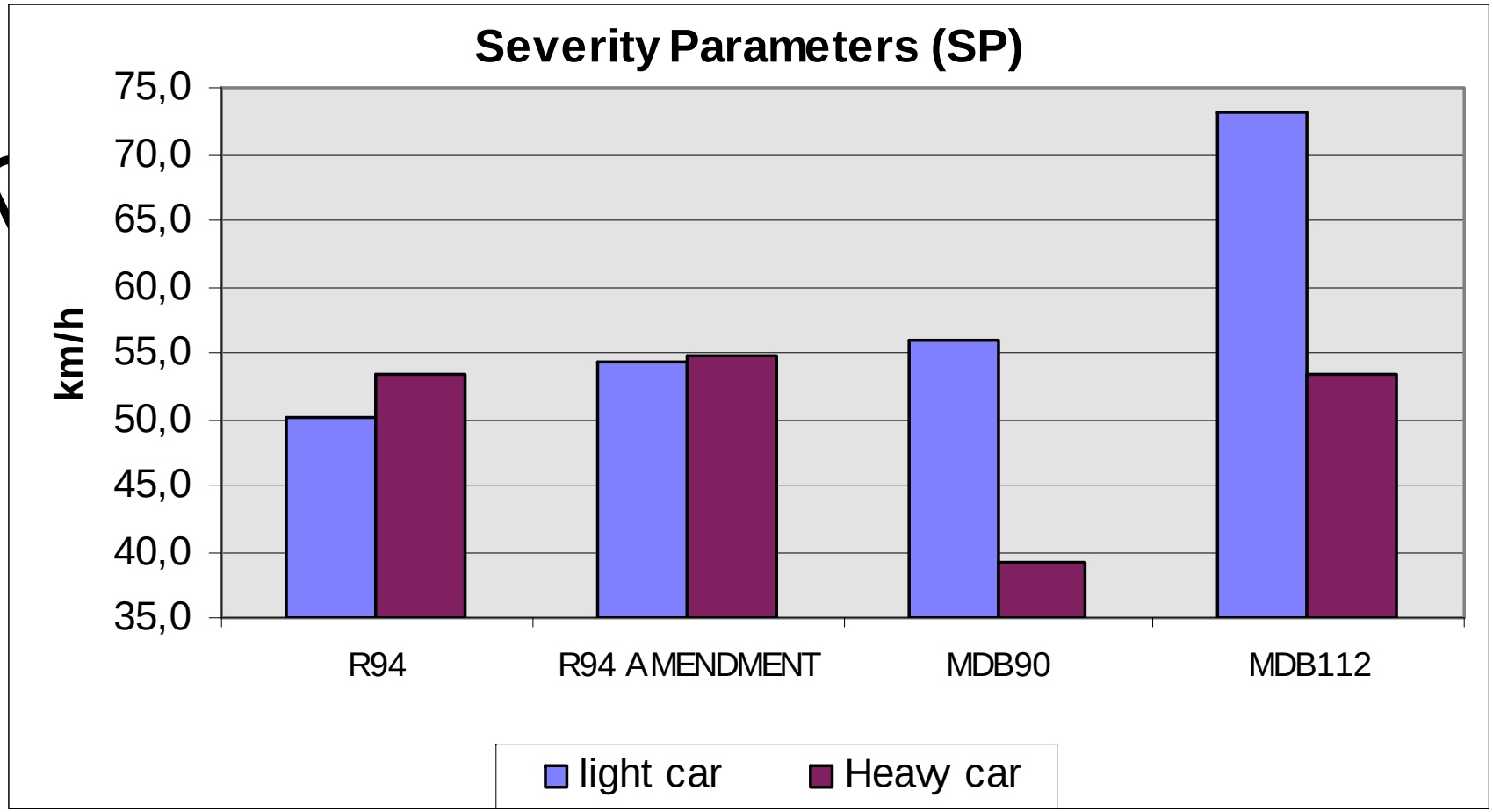
SP = (EES*delta V) km/h

Harmonisation Parameters (HP)

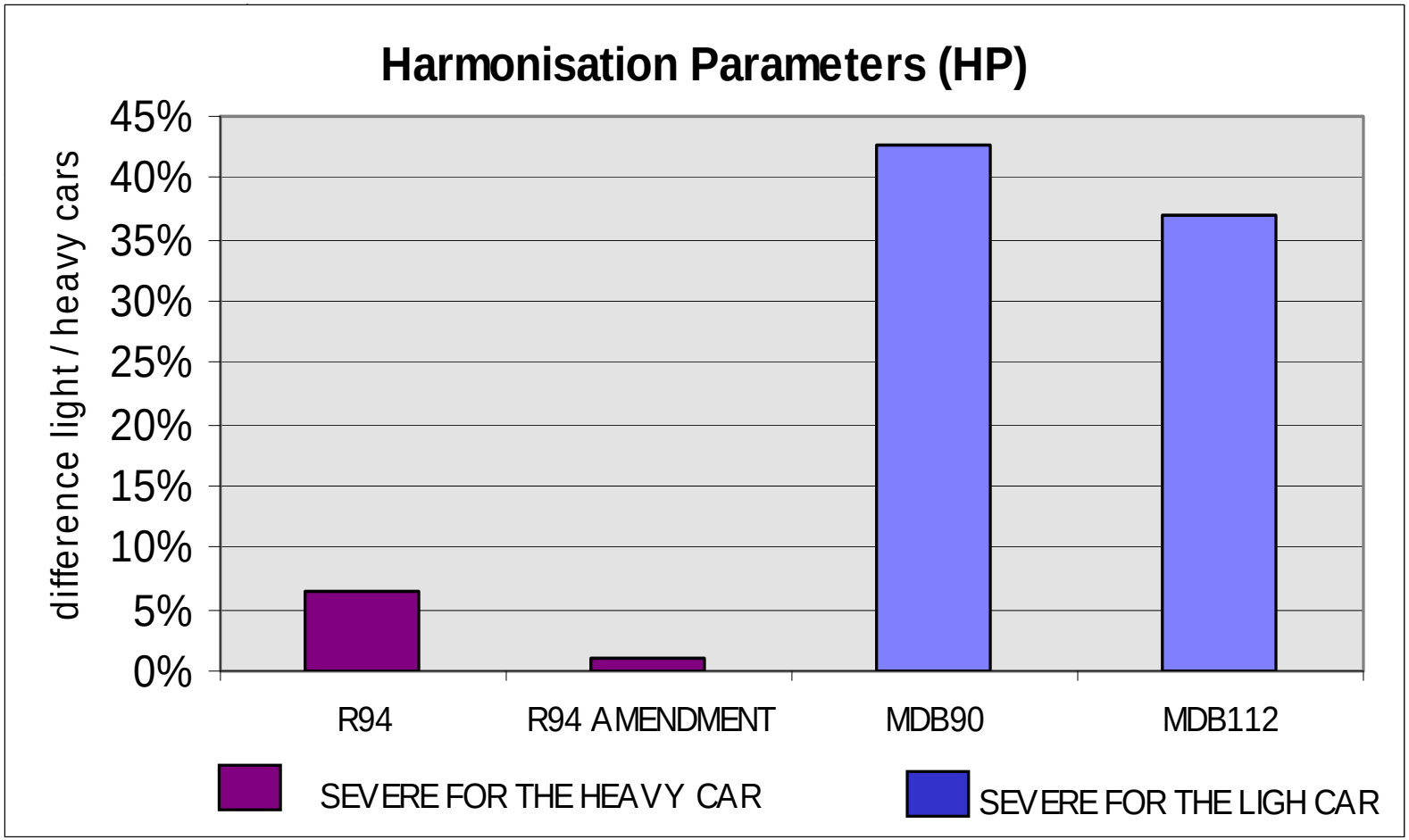
HP parameters is the difference of severity between light and heavy cars (%)

For the same test configuration :

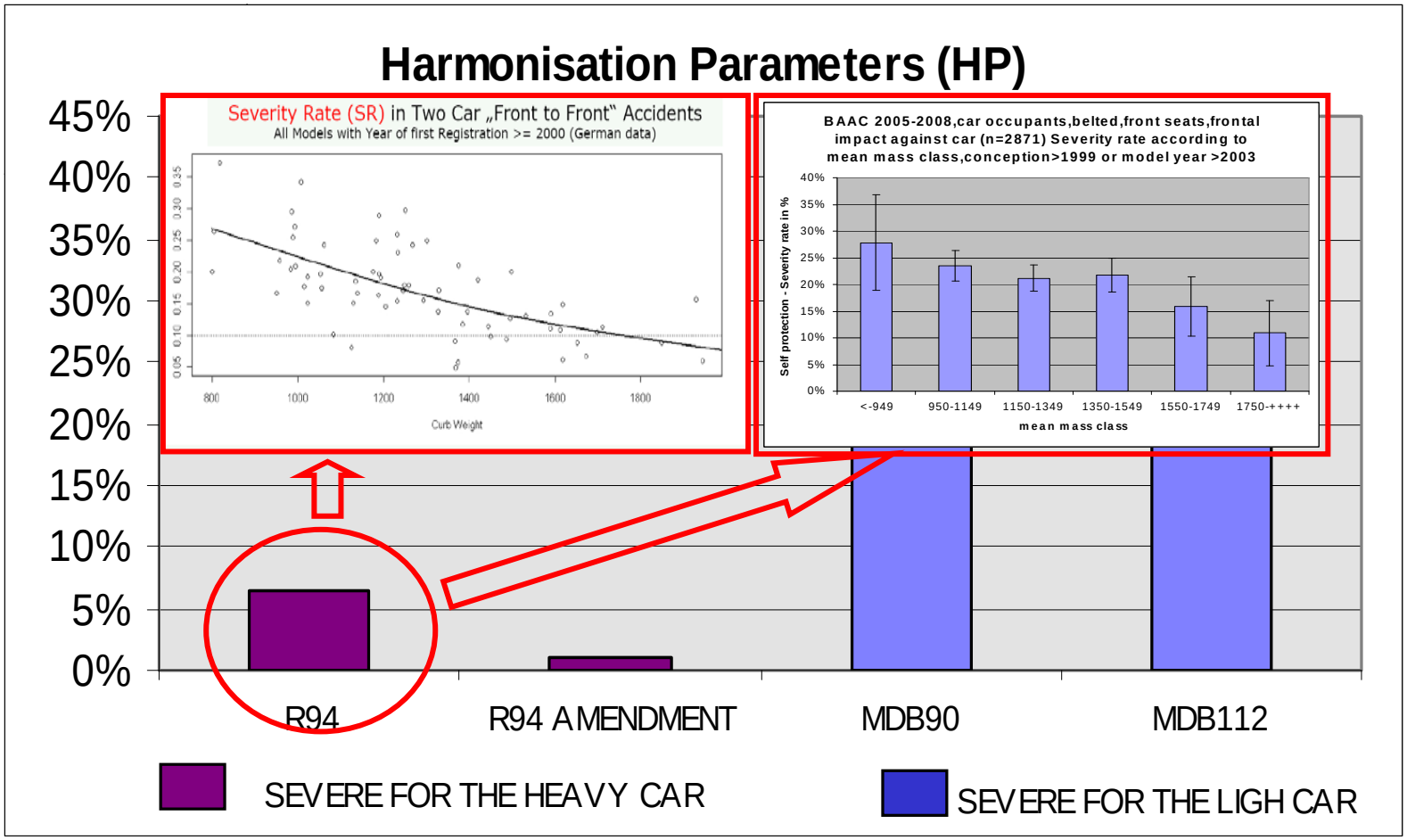
HP = (SP light car – SP heavy car) / SP mini



- R94 amendment severe for light and heavy cars
- MDB@90 less severe for heavy cars / R94
- MDB@112 very severe for light cars / R94



- Test severity harmonization:
  - close to 0 with R94 amendment
  - important difference in MDB Test



Remark and reminder:

HP of 7% today is responsible for a part of the compatibility problem showed by German and French data.

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		Test Severity / R94		Test Severity Harmonisation Light / Heavy
		Light car	Heavy car	
R94 amendment	Delta V	↗	↗	😐
	EES	↗	=	☺
MDB @ 90	Delta V	↘	↘ ↘	☹
	EES	↗	↘ ↘	☹
MDB @ 112	Delta V	↗ ↗	↘	☹
	EES	↗ ↗ ↗	↗ ↗	☹

- **Inhomogeneous severities are observed**

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- **MDB test is supposed to reflect car to car accident, however, it is not obvious after considering physics and energetical effects**
- **For a large range of mass ratio, MDB is less severe than fixed barrier**
- **MDB increases the severity difference between light and heavy cars**
- **MDB generates numerous problems, some of them without solution**
- **Before finding a solution that could allow us to introduce MDB, fixed barrier remains a simple and reliable solution to answer most of the compatibility problems.**

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THANK YOU FOR YOUR ATTENTION

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