AEBS-HDV IWG

LPB and LPS

AEBS-HDV-03

March 22, 23, 25 - 2021

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- LCVs – LPB vs LPS
- HCVs
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  - Avoidance strategies
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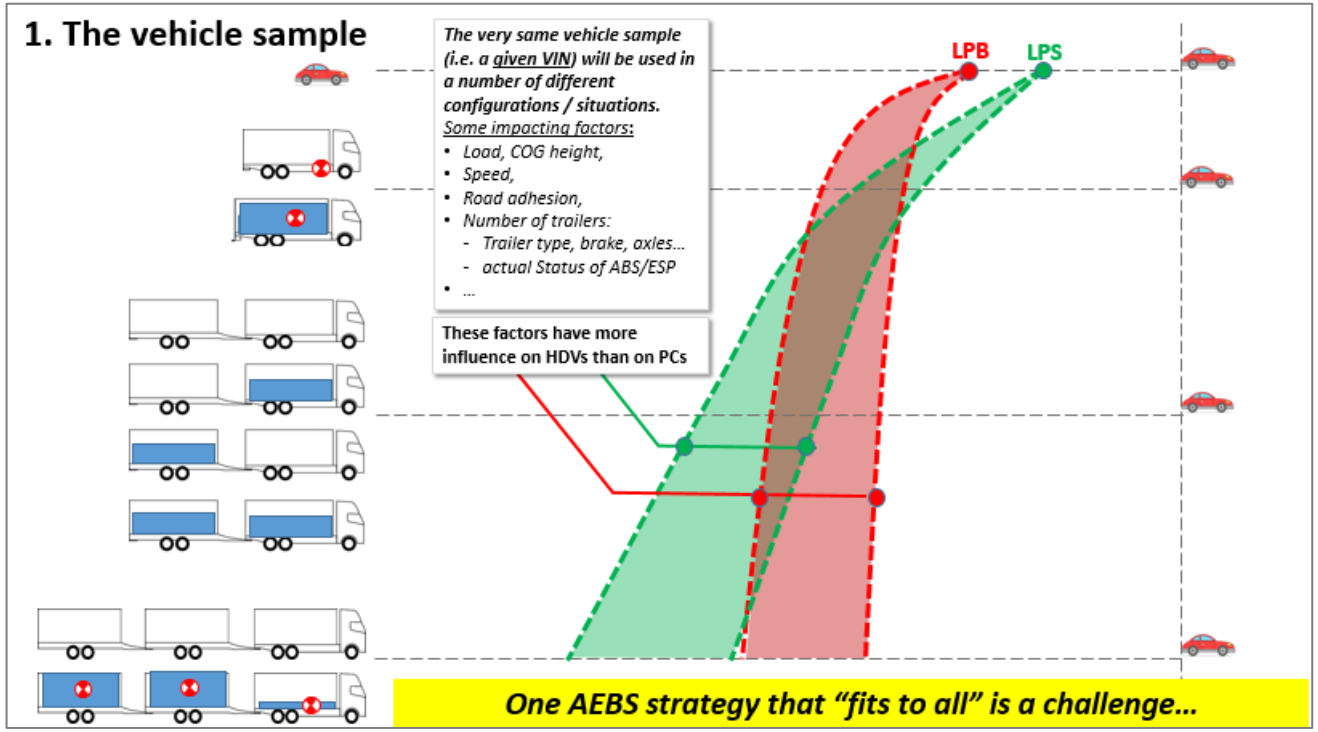
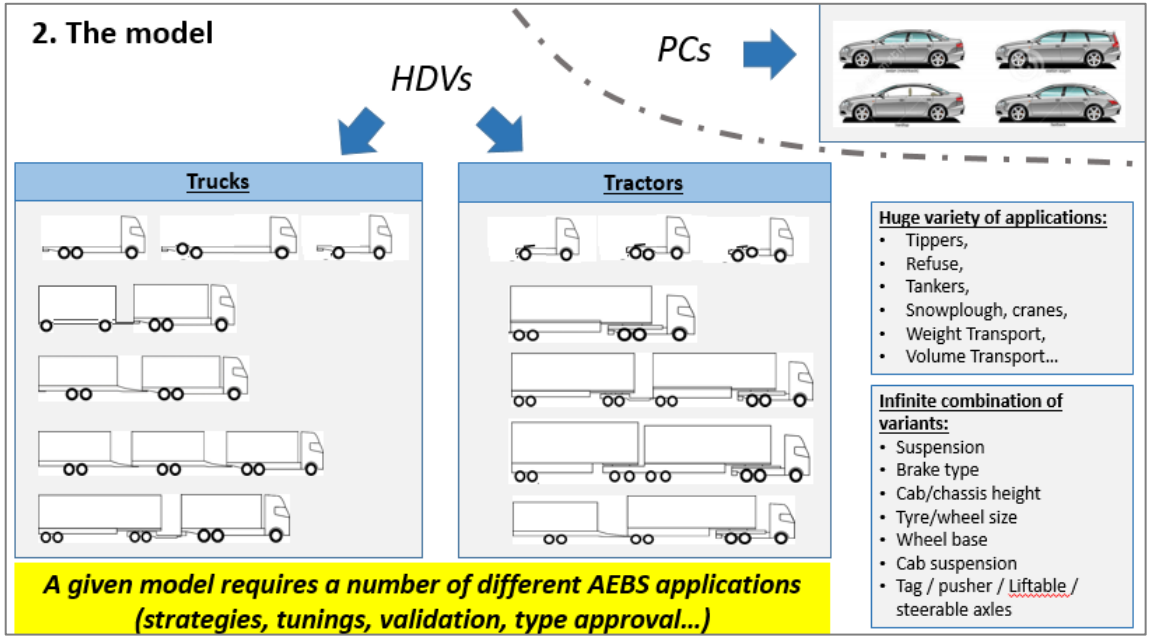
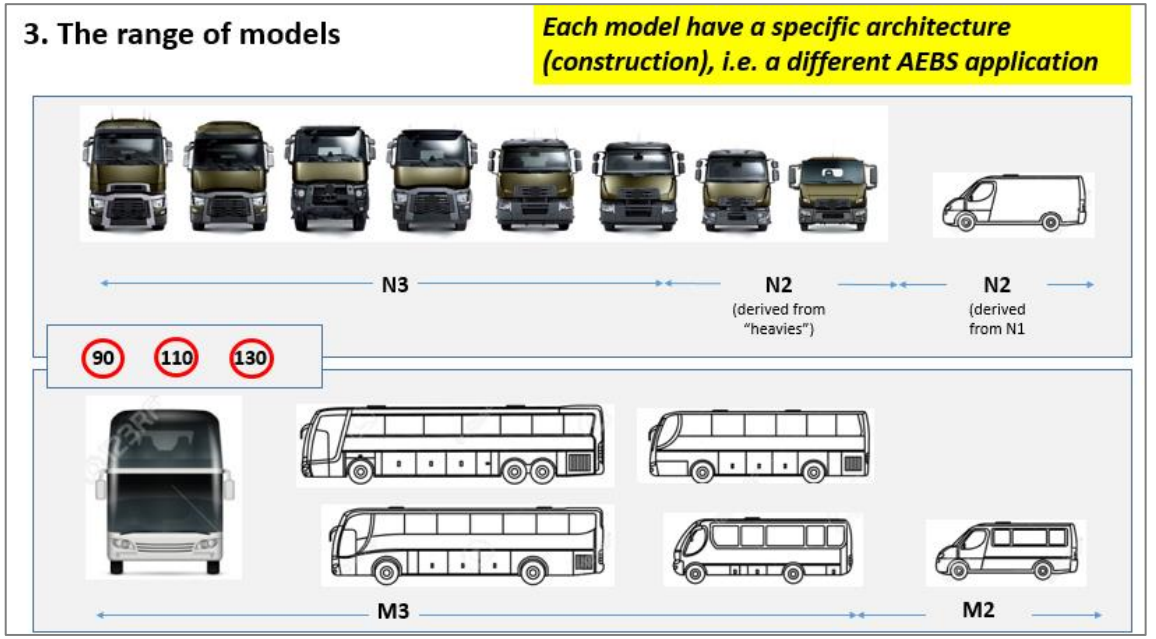
- Considerations about brake performance
- How to split performance requirements

AEBS complexity
(reminder from AEBS-HDV-SP-02-04)







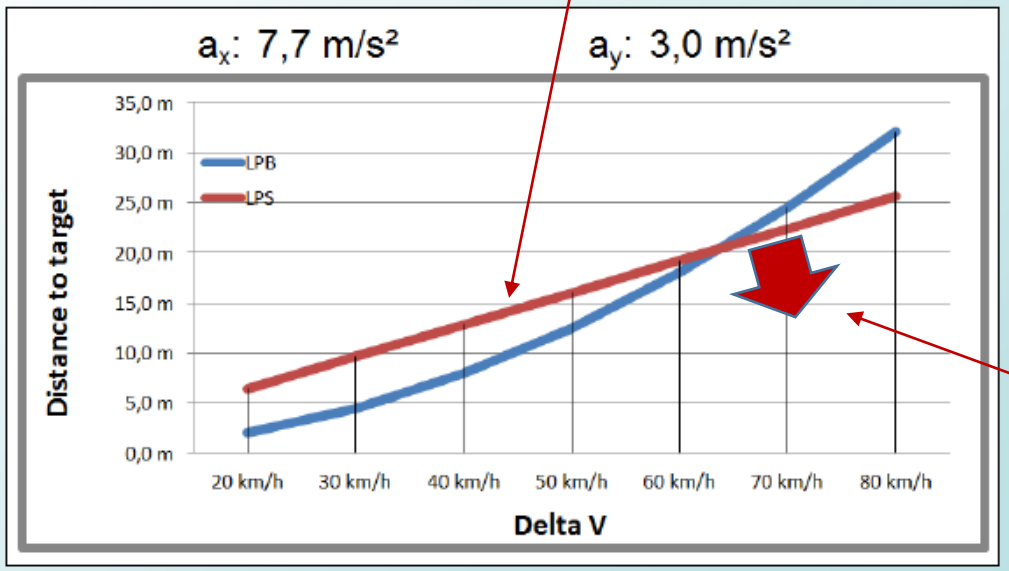
LCVs

Avoidance manoeuver w/o ESC intervention (normal evasive manoeuver)

Based on tests in Jeversen (D)
Reference: AEBS-LDWS-18-03

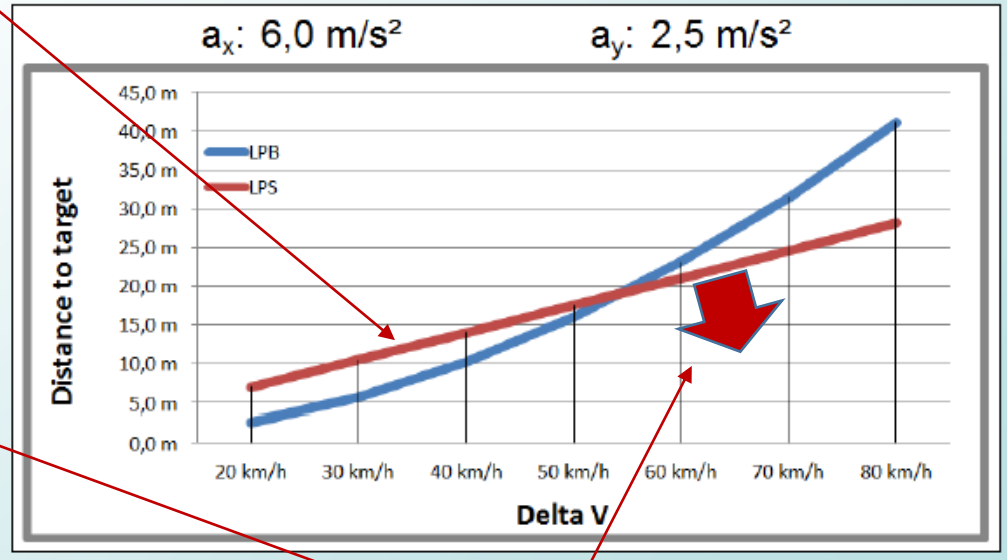
Ideal braking performance delivered by the driver

From 65 km/h on it is a better decision to steer around an obstacle and avoid an impact, than collide with only a reduced speed.



Realistic braking performance delivered by an AEBS and steering in real life conditions

At 80 km/h the LPS is 13 m later than the LPB. So if a system brakes at LPB the driver would still be able to avoid the impact by steering 0,6 s later.

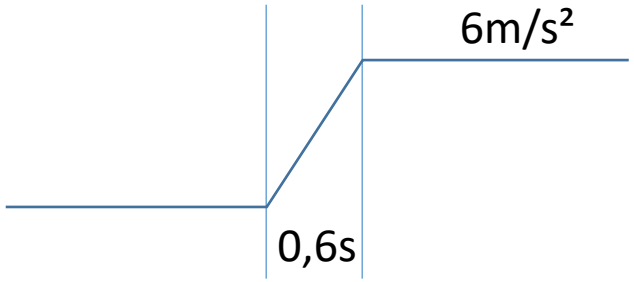


With a quicker avoidance manoeuver

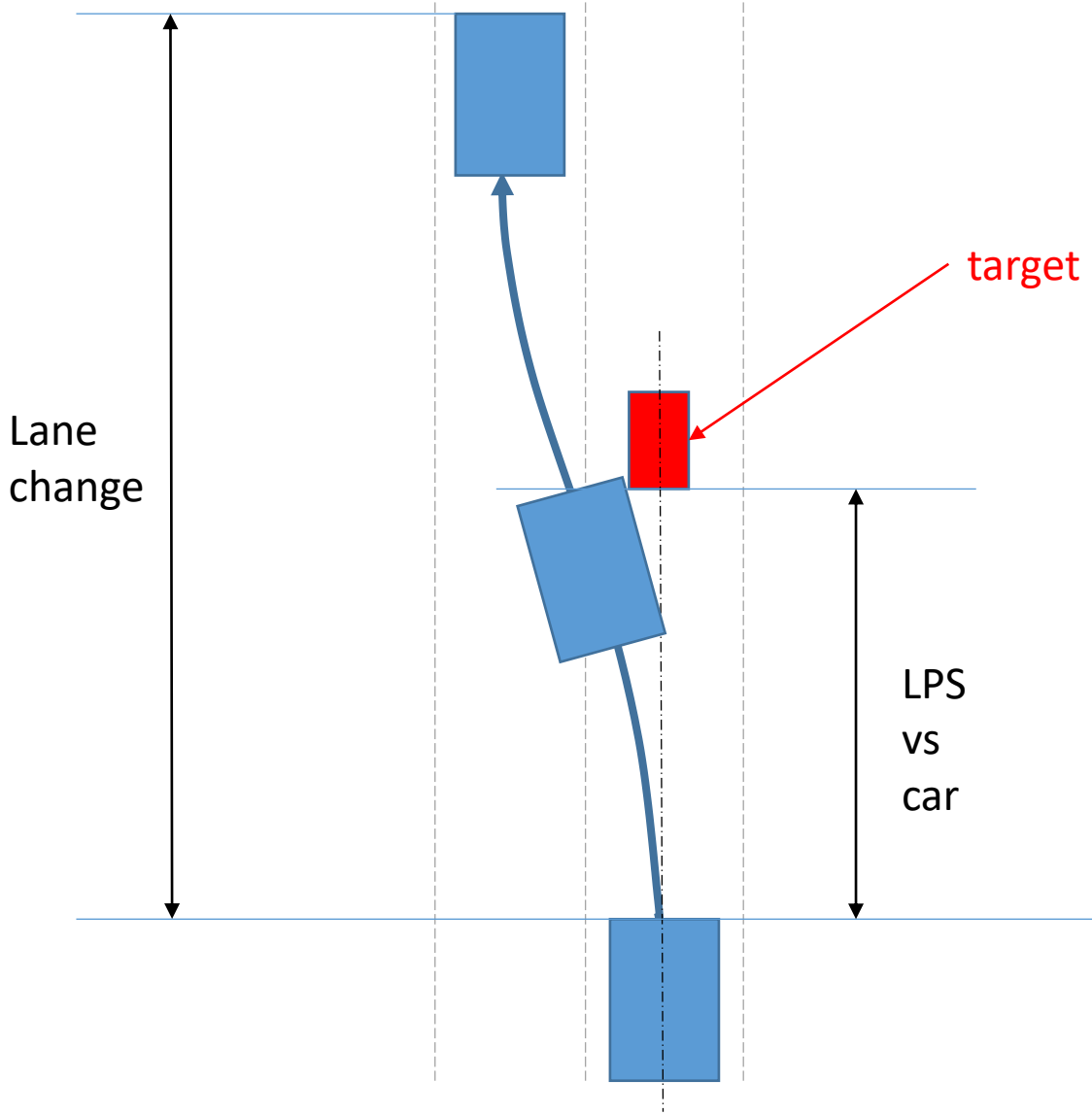
HCVs - N3

- LPS
  - Extract from SS ISO 14791: “Since the number of variants of heavy trucks (and trailers) is tremendously large, each truck combination is unique. So the measured result is valid only for the tested vehicle or combination and the transition of the results to obviously similar combinations is not possible.”
  - However, some interesting results with regard to LPS can be analysed based on this standard. See next slides.

- LPB
  - With regard to braking, a simple calculation based of deceleration and brake force build-up time can be used in first place.



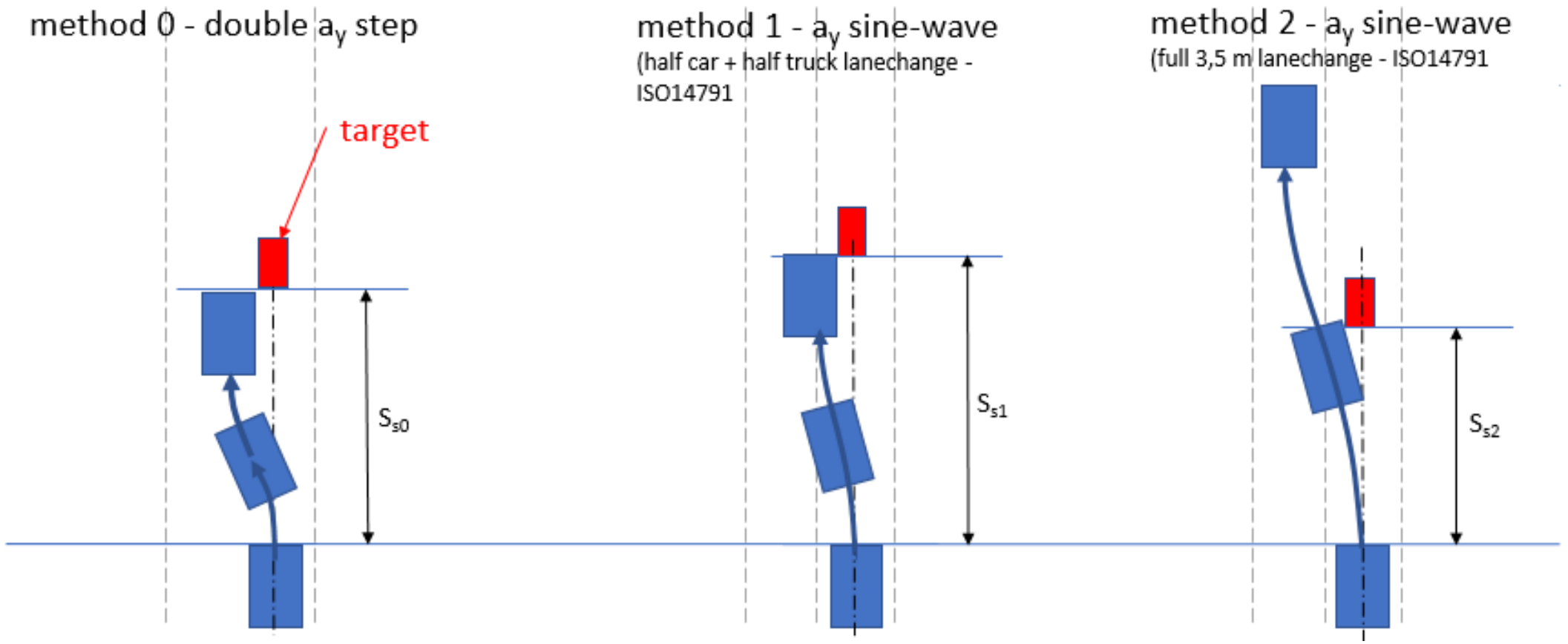
HCVs - N3 SS ISO 14791



Simulated emergency avoidance manoeuver
On the physical limits (w/o considering ESC intervention)

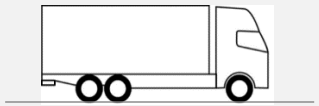
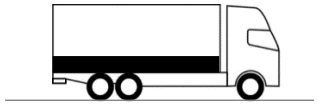
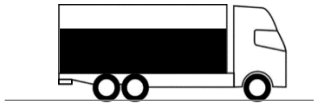
HCVs - N3 SS ISO 14791

The most efficient



3 different strategies

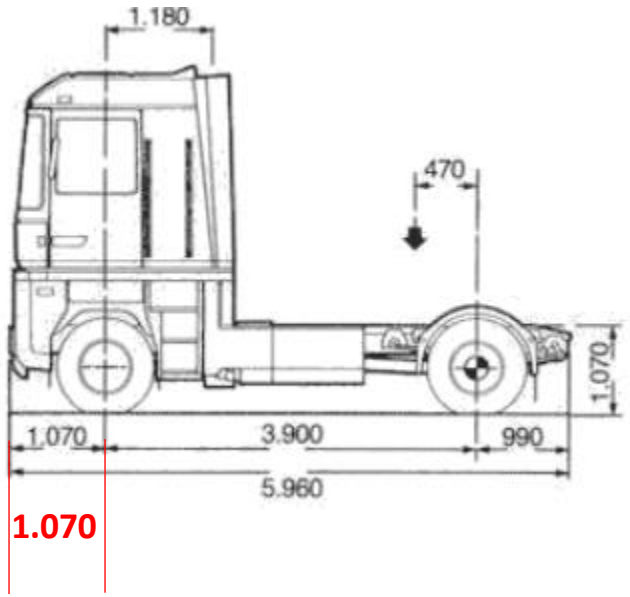
Truck

		Empty			Fully laden					
										
					Low COG			High COG		
80kph	LPS	1.2s	**26m**	*(18.6m)*	1.4s	**30.5m**	*(17.2m)*	1.6s	**34.5m**	*(17m)*
	LPB	2s	**44.6m**		2.1s	**47.7m**		2.3s	**51.5m**	
		(-6,5)			*(-6)*			*(-5.5)*		
40kph	LPS	1.2s	**13m**	*(-0,3m)*	1.3s	**14m**	*(-0,5m)*	1.4s	**15.5m**	*(-1m)*
	LPB	1.1s	**12.7m**		1.2s	**13.5m**		1.3s	**14.5m**	
		(-6,5)			*(-6)*			*(-5.5)*		

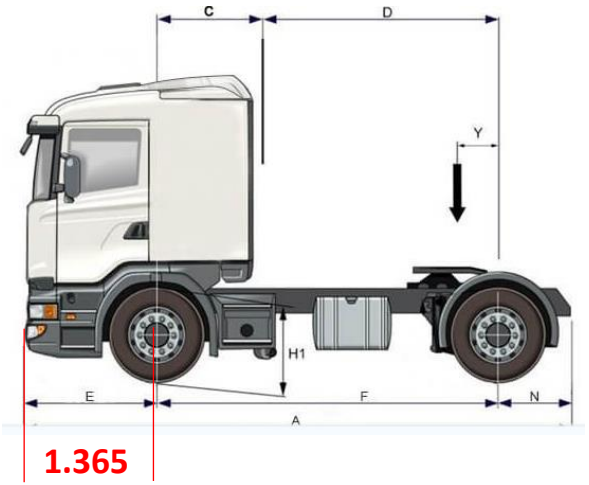
Tractor

(examples to explain the influence of the vehicle architecture on the performance, on short wheel bases)

T1

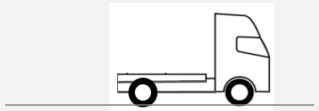


T2

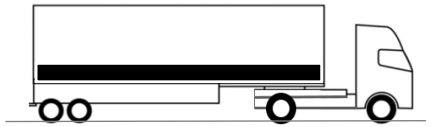


Tractor

Empty



Fully laden



			Empty	Low COG (4.5m/s²)	High COG (3.5m/s²)
80kph	LPS		1.2s **26m**	1.4s **30.5m**	1.6s **34.5m**
			(13.5m)	*(17.2m)*	*(15m)*
	LPB	**T1**	1.8s **39.5m**	2.1s **47.7m**	2.2s **49.5m**
			(-7,5)	*(-6)*	*(-5,75)*
			(23.5m)		
		T2	2,2s **49.5m**		
			(-5,75)		
40kph	LPS		1.2s **13m**	1.3s **14m**	1.4s **15.5m**
			(-1m)	*(-0,5m)*	*(-1.5m)*
	LPB		1s **11.5m**	1.2s **13.5m**	1.3s **14m**
			(-7.5)	*(-6)*	*(-5,75)*

Considerations about brake performance

- The best deceleration is obtained with 4x2 solo tractors (or chassis-cab trucks)
- This “reference” deceleration is impacted by several factors:
  - Vehicle architecture
  - More axles
  - Trailer(s)
  - Drums vs discs
  - Suspensions
  - Construction Tyres vs road tyres

- The deceleration could vary between 5.5 and 7.5 m/s^2

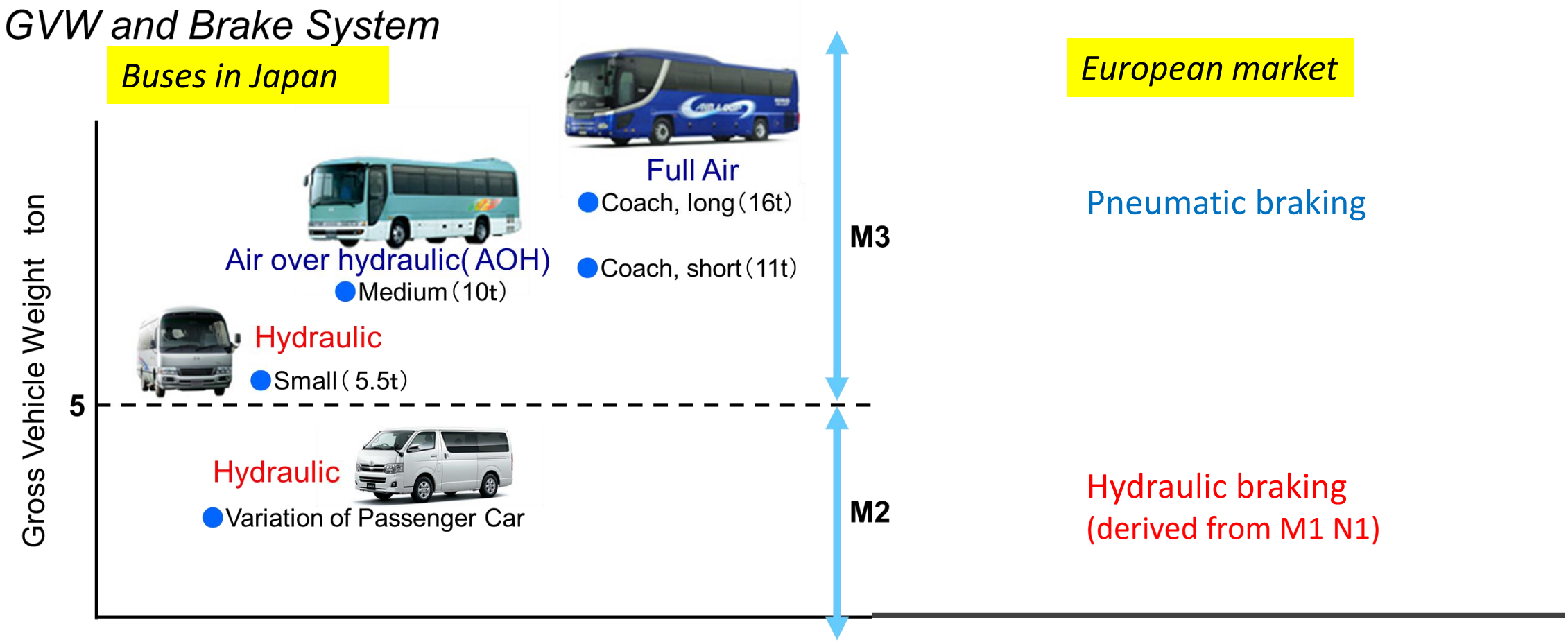
UN R131 – split of requirements

Row 1	**M3 (except hydraulic braking)** **N2 > 8 t** **N3**	**M2 and N2 ≦ 8 t with pneumatic braking**
Row 2	**M2** **N2 ≦ 8 t**	**M3 with hydraulic braking**

N2 N3

	N2 ≦ 8 t	N2 > 8 t	N3		
	LCVs	Distribution	Long Haul / Distribution		Construction
			4x2 T1 T2	6x2 / 6x4	Leaf suspension Tyre size / type High-COG
Braking	Discs……drums				
	Hydraulic B. braking	AOH (7t5 up to 20t)			
		Pneumatic braking (7t5 and above)			
Difficult to find a value that "fits to all"	7.5m/s² - 6.5 m/s²	6m/s² - 6.5m/s²	7.5m/s² - 5.5m/s²		
	Slow build-up pressure time (~2s)				
Steering (avoidance)	Agile vehicles (closer to M1N1)	LPS depends on many factors…			

M2 M3


GVW and Brake System
Buses in Japan
European market
Full Air
Coach, long（16t）
Coach, short（11t）
Air over hydraulic(AOH)
Medium（10t）
Hydraulic
Small（5.5t）
Hydraulic
Variation of Passenger Car
Gross Vehicle Weight ton
5
M3
M2
Pneumatic braking
Hydraulic braking
(derived from M1 N1)