

AEBS-14 /GRVA-07
Justification for 2 Step Approach for
AEBS Car to Bicycle

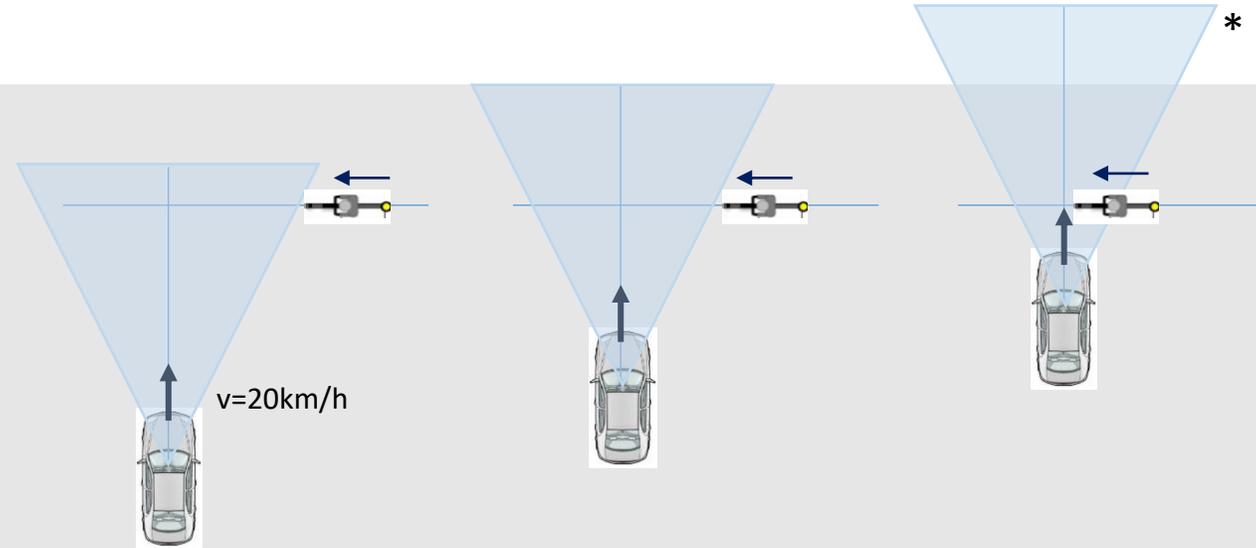
- The IWG on UN-R 152 (AEBS M1/N1) aims to establish performance requirements for AEBS in a scenario with a bicycle that is crossing the road at 15km/h.
- The performance of the AEBS in a scenario with a crossing bicycle depends on the system's field of view, which will determine whether the bicycle can be detected in time in order to initiate an Emergency Braking.
- Recent EURO NCAP results (AEBS-10-04) show that ca. 70% of all vehicles equipped with a Car2Bicycle AEB today are unable to avoid a collision with a crossing bicycle at vehicle speeds below 30km/h.
- In order not to punish these front-runners, who introduced AEBS Car2Bicycle to their vehicles when it wasn't even regulated yet, by now requiring extensive re-design to meet these new performance requirements below 30km/h, CLEPA/OICA propose a 2-Step Approach for Car2Bicycle provisions.

AEBS Car to Bicycle scenario

What is the challenge avoiding a collision when travelling below 30km/h?

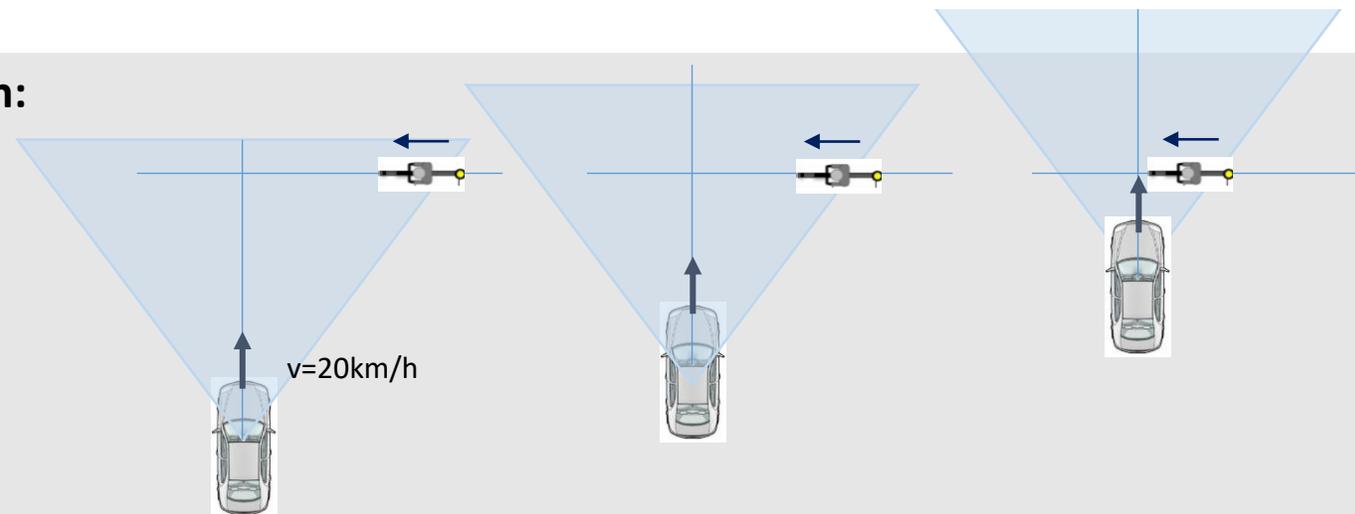
Field of view needed to avoid a collision at 30km/h:

When travelling at 20km/h, a bicycle travelling at 15km/h will be outside the field of view almost up to the collision.
Performance of ca. 70% of AEB Car2Bicycle systems tested in EURO NCAP in 2018/19. (see slide 5)



Field of view needed to avoid a collision at 20km/h:

Field of view needed to avoid a collision at 20km/h.
Performance of ca. 30% of AEB Car2Bicycle systems tested in EURO NCAP in 2018/19. (see slide 5)



*Illustration of principle geometric relations, in reality an even larger field of view is required for robust performance (e.g. due to computing time, object classification)

AEBS Car to Bicycle scenario

Why should this be regulated in a 2-Step Approach?

What is the difference between the 1-Step and the 2-Step Approach?

Collision avoidance required for vehicle speed of **XX** km/h; Collision mitigation required for a vehicle speed of **YY** km/h

	1-Step approach	=	2-Step approach
	20		20
	25		25
	30		30
	35		35
	40		40
	45		45
	50		50
	55		55
	60		60

Car2Bicycle first approved after 07/2024

	1-Step approach	2-Step approach	
		until 09/2028	after 09/2028
	20		20
	25		25
	30	30	30
	35	35	35
	40	40	40
	45	45	45
	50	50	50
	55	55	55
	60	60	60

Car2Bicycle approved before 07/2024

- The 1-Step and 2-Step approach **will establish the same level of safety of new type approvals** after 07/2024.
- The **1-Step approach would punish manufacturers who offered Car2Bicycle capabilities early**, by forcing them to re-design their systems based on new performance thresholds that were unknown at the time of system development.

AEBS Car to Bicycle scenario

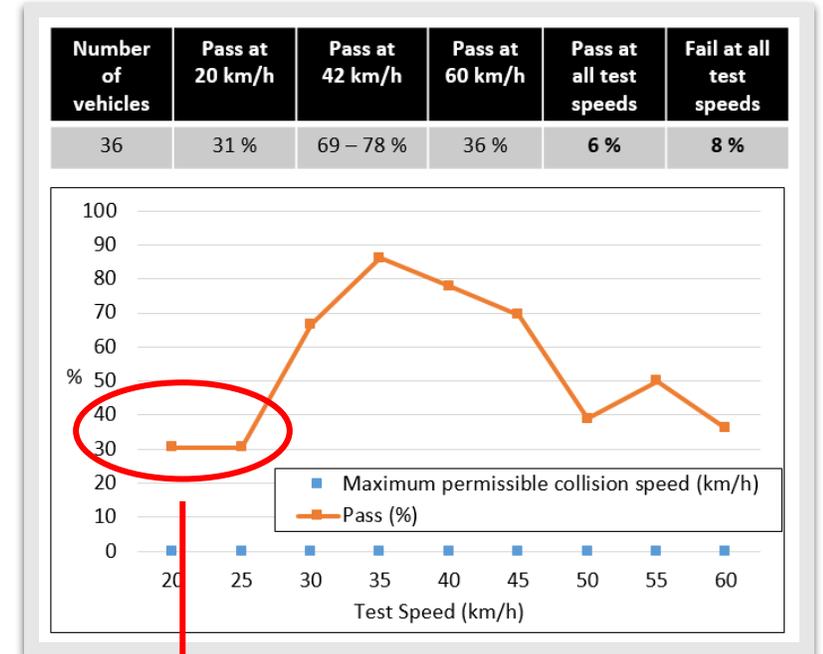
Why should this be regulated in a 2-Step Approach?

Why is this 2-Step Approach necessary and reasonable?

- The issue comes with the required **collision avoidance at low vehicle speeds**.
- Whether the AEBS will be able to avoid a collision when travelling at a speed lower or close to that of the target **depends the field of view of its sensors**.
- If the bicycle travels **outside of the field of view of the AEB sensors, the system cannot react to it**.
- In **today's EURO NCAP results, only ca. 30% of vehicles tested in the Car2Bicycle scenario are capable of avoiding a collision below 30km/h** – and this doesn't take into account the number of vehicles not even fitted with Car2Bicycle yet.
- The **field of view cannot be changed through software, it requires new sensors fitted to these vehicles**, which usually requires a re-design of the vehicle architecture (e.g. in the form of hardware, communication, software).
- These changes require **extensive validation testing** of all features based on the new sensor input or related to the change in vehicle architecture.

	20
	25
30	30
35	35
40	40
45	45
50	50
55	55
60	60

EURO NCAP C2B test results (AEBS-10-04)



Only 30% of vehicles with AEBS C2B tested achieve avoidance at 20km/h, compared to almost 70% at 30km/h.

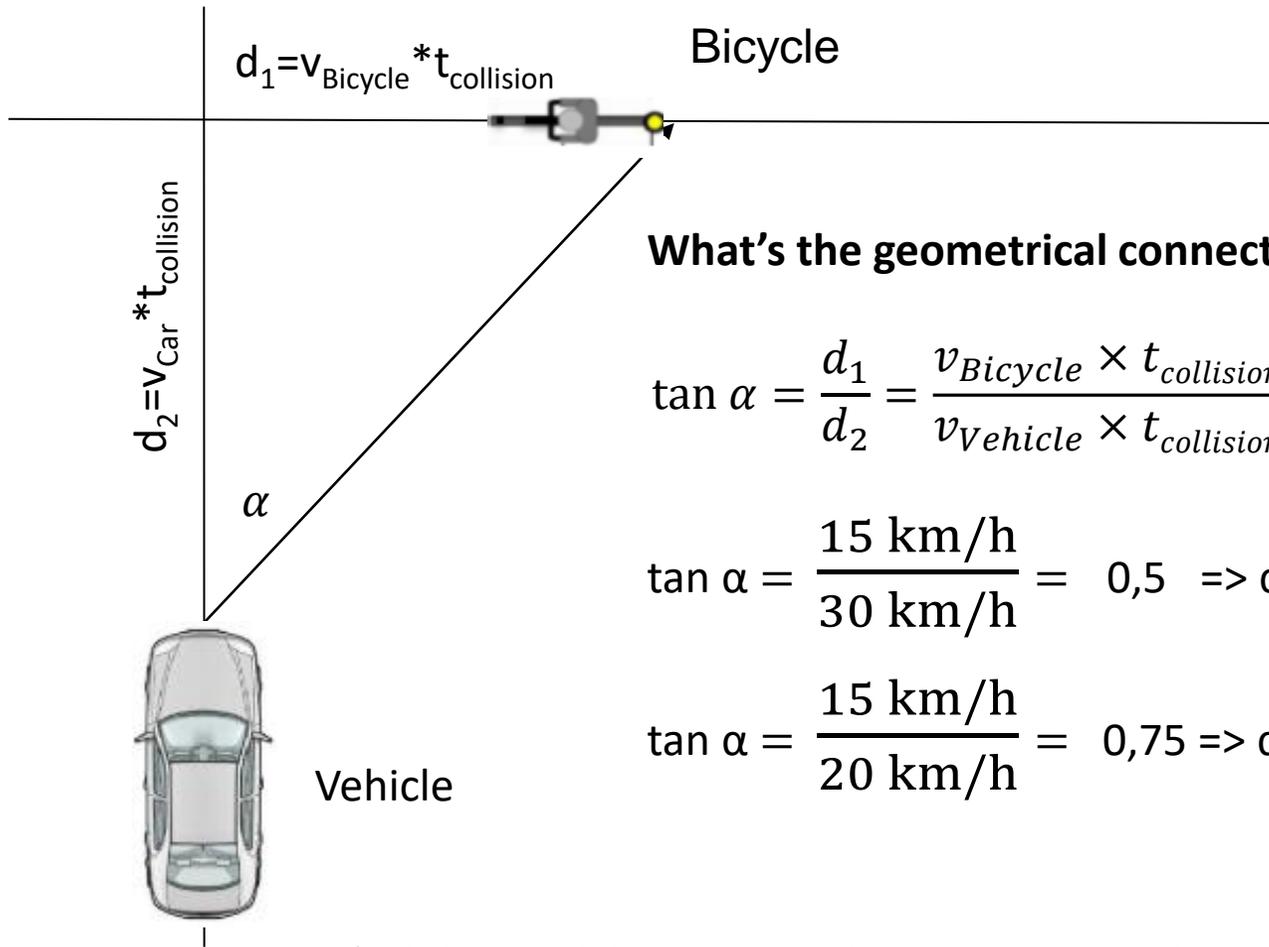
- The proposed 2-Step Approach will establish the same high performance requirements for vehicles whose AEBS Car2Bicycle is type approved after 07/2024.
- While the 1-Step Approach would unnecessarily bind resources and finance for re-design for existing systems, and thereby prevent future safety innovations with additional benefits to road safety,
- the 2-Step Approach will ensure that vehicles that were already early on equipped with AEBS Car2Bicycle will not have to be redesigned towards the end of their lifecycle.



Backup

AEBS Car to Bicycle scenario

Geometry of the required opening angle



What's the geometrical connection between vehicle speed and bicycle speed?

$$\tan \alpha = \frac{d_1}{d_2} = \frac{v_{Bicycle} \times t_{collision}}{v_{Vehicle} \times t_{collision}} = \frac{v_{Bicycle}}{v_{Vehicle}}$$

$$\tan \alpha = \frac{15 \text{ km/h}}{30 \text{ km/h}} = 0,5 \Rightarrow \alpha \approx 27^\circ \text{ required* opening angle for performance at 30km/h}$$

$$\tan \alpha = \frac{15 \text{ km/h}}{20 \text{ km/h}} = 0,75 \Rightarrow \alpha \approx 37^\circ \text{ required* opening angle for performance at 20km/h}$$

*this is the minimum theoretical value. At anything less the AEBS will physically not be capable of avoiding a collision. In order to achieve robust behavior an additional 5-10° are needed.