

# Study of AEBS False Reaction scenarios for passenger cars

Toru Kojima, Koji Urate

National Traffic Safety and Environment Laboratory

# 1. Back ground and Purpose

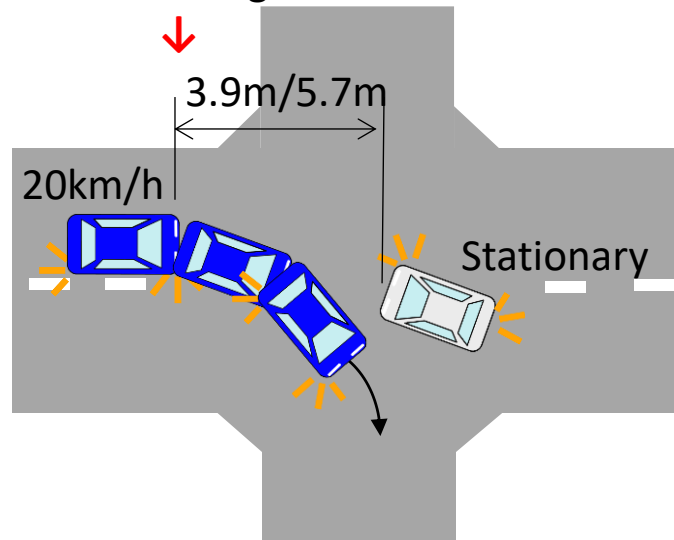
- Current False Reaction scenarios in Annex3(CEL) Appendix 2 of UN-R152 were established by being referred to R131, and they are being applied to UN-R152 without any validation to confirm whether they are appropriate to AEBS for passenger cars.
- In the current UN-R152, false reaction is defined as activation of AEBS (collision warning or advanced emergency braking) while there is no possibility of collision physically. However, in some cases, even there is no possibility of collision, collision warning is likely to make the driver drive more safely. Therefore, it is essential to research the relation between activation of AEBS (system behavior) and human driver in each situation.
- In this research, plural draft scenarios for the test of system behavior were studied, in a wider view point.
- This document is intended to report progress of study regarding the scenarios and the result of the test by using several passenger cars. Regarding driving behavior of normal drivers in the situations of the draft scenarios will be investigated in the next step.
- If activation of AEBS is confirmed in some scenarios, the manufacturer should explain the design philosophy to the Technical Service according to Annex3(CEL).

## 2. Draft scenarios

- In this research, 8 draft scenarios were studied, and each scenario was confirmed by using several passenger cars.
- Basically the draft scenarios were made by being referred to owner's manuals on each car manufacturers and some other information.

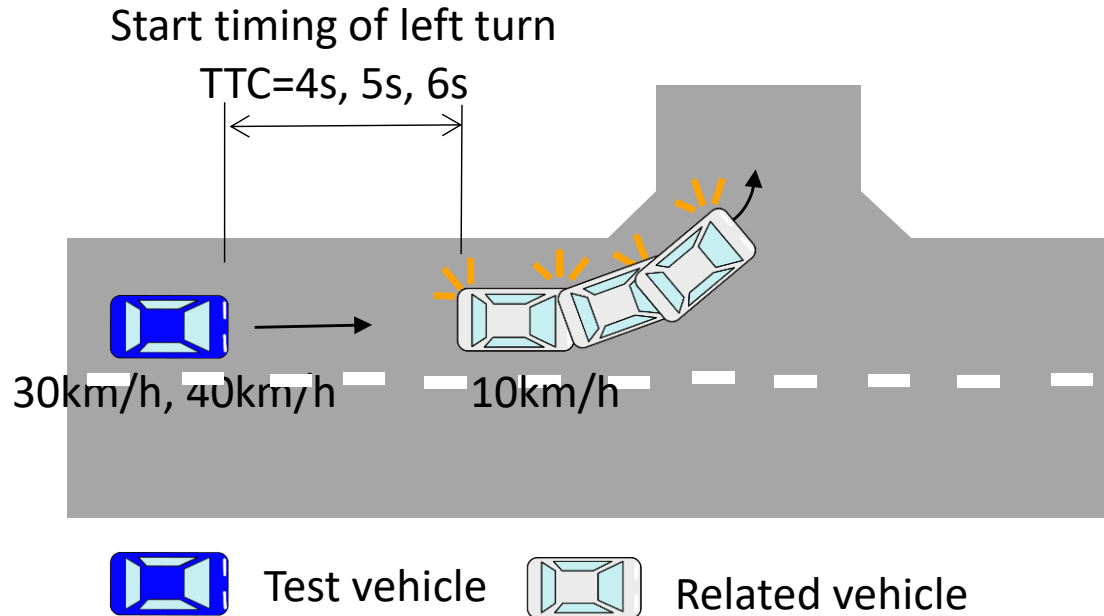
### Draft Scenario 1

Start point of steering input  
for right turn



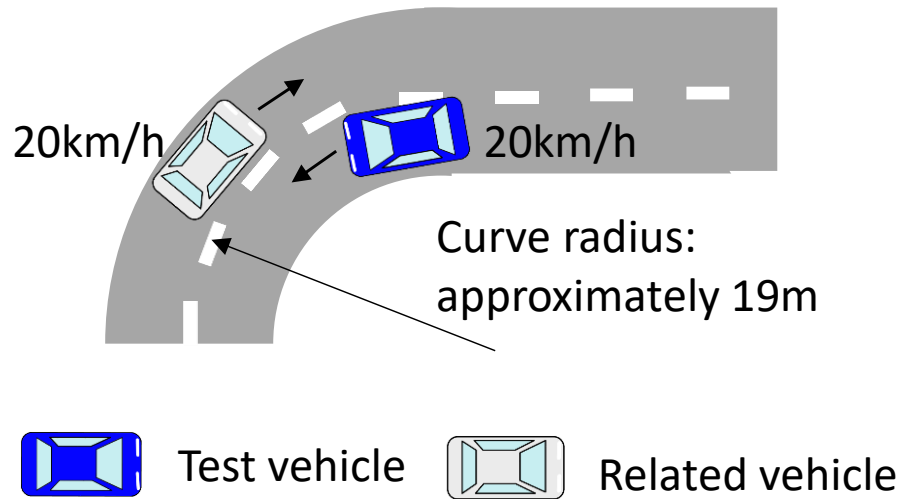
- The test vehicle turns right in the intersection
- The related vehicle is waiting in the opposite side of the intersection to turn right.
- The speed of the test vehicle is 20km/h (one condition), and the start points of right turn (steering right) are 3.9m and 5.9m (two conditions).

## Draft Scenario 2



- The test vehicle (going straight) approaches the related vehicle which is running at 10km/h.
- The related vehicle turns left when the value of TTC between the test vehicle and the related vehicle becomes the specified value.
- The speeds of the test vehicle are 30km/h and 40km/h (two conditions), and the specified values of TTC are 4s, 5s and 6s (three conditions).

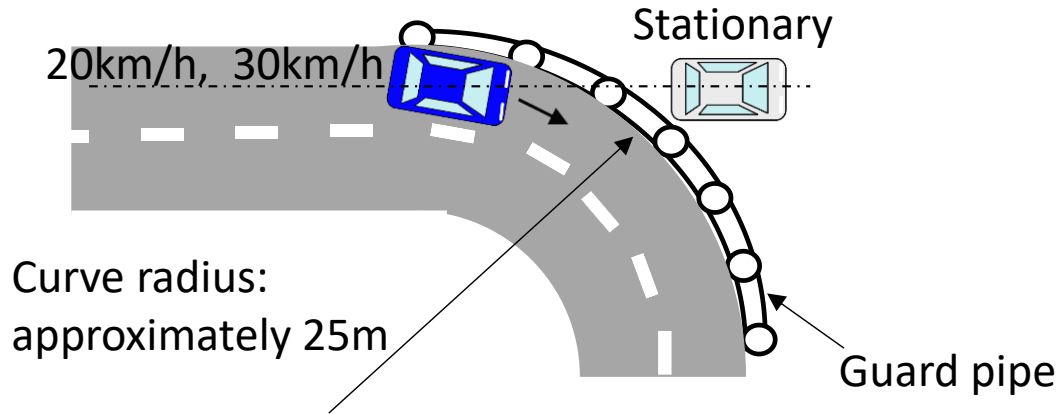
## Draft Scenario 3



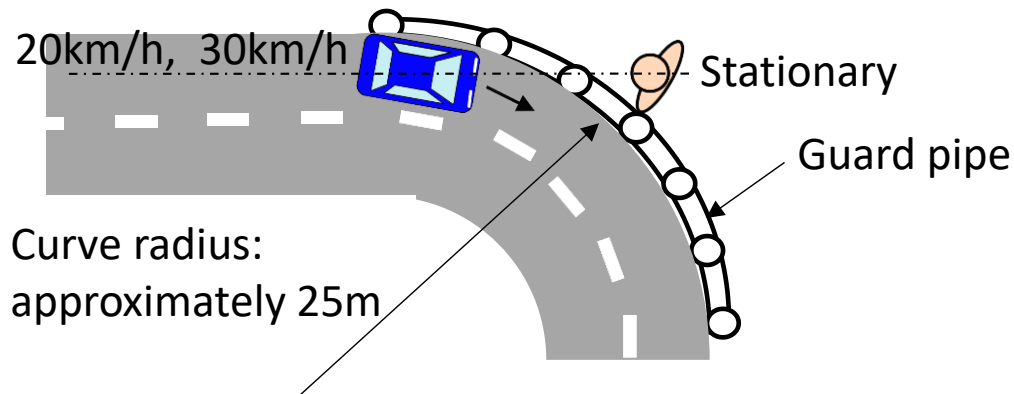
- The test vehicle and the related vehicle pass the small radius curve each other.
- The test vehicle turns left, and the related vehicle turns right. The two vehicles approach in the middle of the curve.
- The speeds of both the test vehicle and the related vehicle are 20km/h (one condition).

## Draft Scenario 4

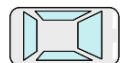
### Car to Car



### Car to Pedestrian



Test vehicle



Related vehicle

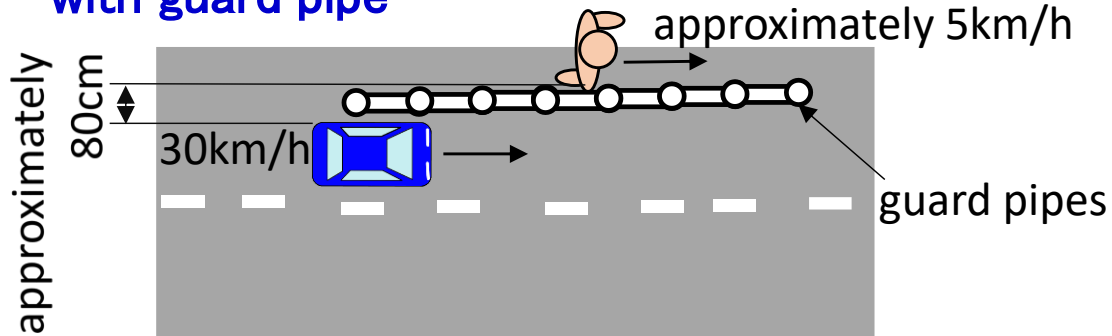


Pedestrian target

- In the small radius curved road in which the guard pipes are established at the roadside, the related vehicle or the pedestrian target is located just outside of the guard pipes.
- The speeds of the test vehicle are 20km/h and 30km/h (two conditions).

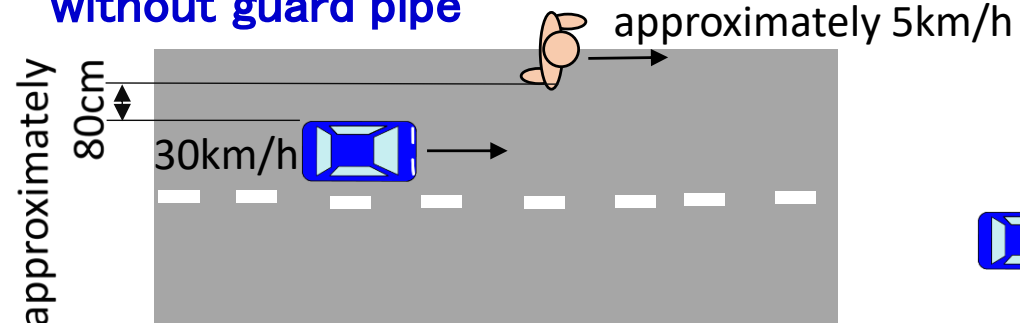
## Draft Scenario 5

### with guard pipe



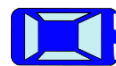
- Distance between the left side of the test vehicle and the guard pipes is approximately 50 cm.
- The pedestrian walks along the guard pipes. The distance between the left side of the test vehicle and pedestrian is approximately 80 cm.

### without guard pipe



- The distance between the left side of the test vehicle and pedestrian is approximately 80 cm (same as "with guard pipe" condition).

- The test vehicle (going straight) passes the pedestrian which is walking left side of the test vehicle.
- The directions of walking of the pedestrian are the same direction as the test vehicle and opposite direction as the test vehicle (two conditions)
- The speed of the test vehicle is 30km/h (one condition)

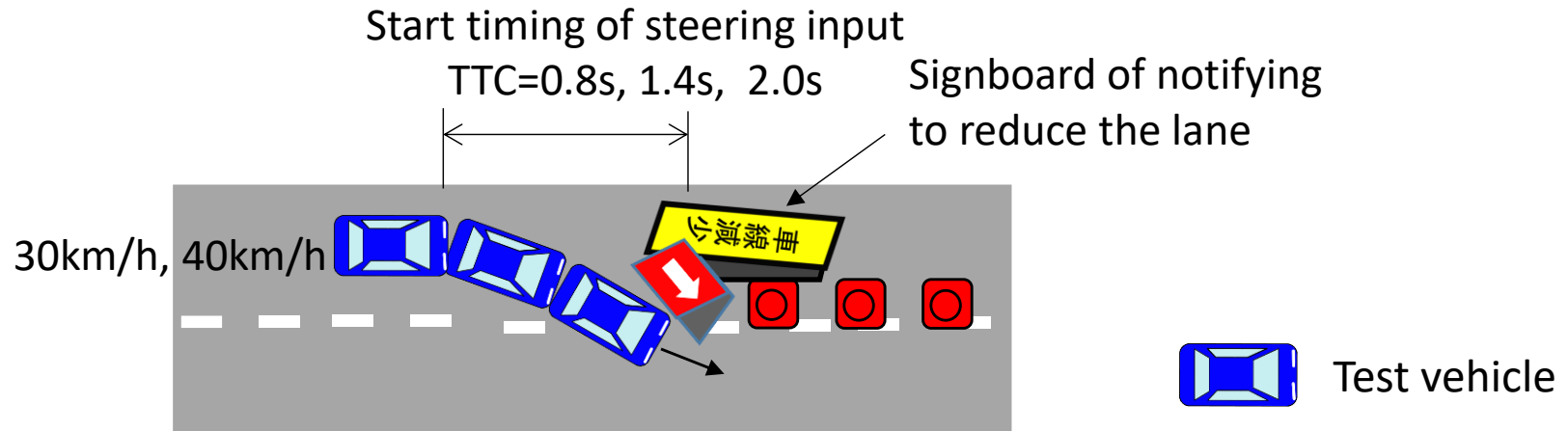


Test vehicle



Real pedestrian

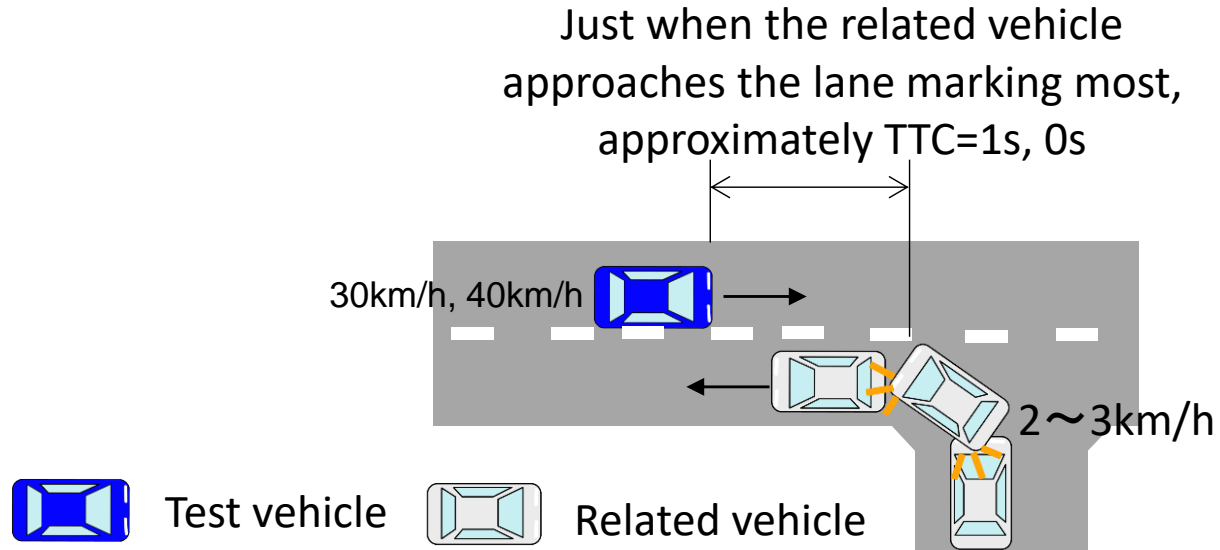
## Draft Scenario 6



- The signboard which notifies reducing the lane is located forward of the test vehicle (going straight), and the test vehicle approaches the signboard.
- The test vehicle starts the steering input to the right side just when TTC between the test vehicle and the signboard becomes the specified value.
- The specified values of TTC are 2.0s, 1.4s, 0.8s (three conditions), and the speeds of the test vehicle are 30km/h and 40km/h (two conditions).



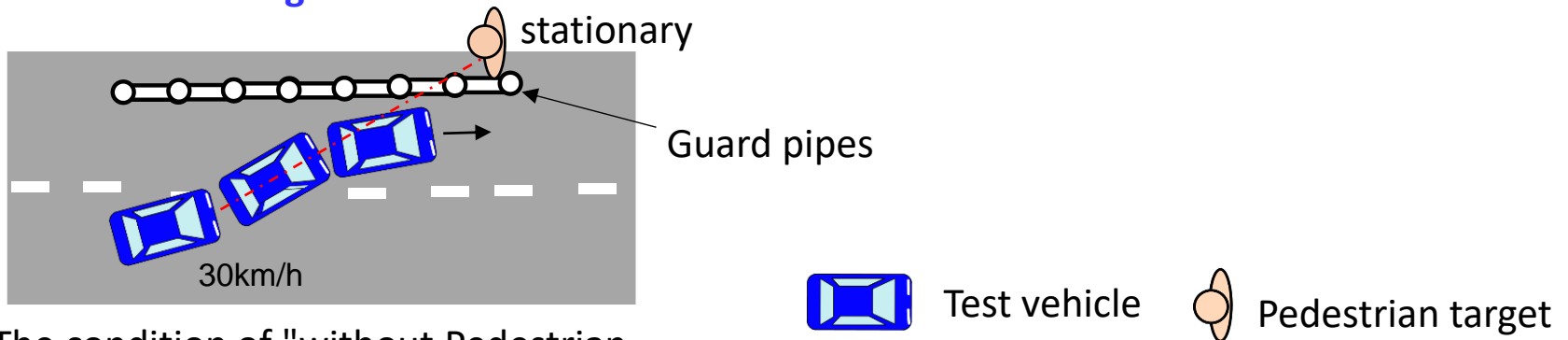
## Draft Scenario 7



- The test vehicle runs straight, and the related vehicle turns left and comes into the opposite lane.
- During the left turn of the related vehicle, the corner of the vehicle slightly touches the lane marking, but it doesn't cross the lane marking.
- Regarding the condition of TTC between the test vehicle and the related vehicle just when the related vehicle approaches the lane marking most, it is approximately 1s and 0s (two conditions).
- The speeds of the test vehicle are 30km/h and 40km/h (two conditions).

## Draft Scenario 8

with Pedestrian target\*



\*The condition of "without Pedestrian target" is also carried out.

- The test vehicle changes the lane from the right side to the left side.
- The guard pipes are located at the roadside of the left lane.
- In the condition of "with pedestrian target", the pedestrian target is located in front of the center line of the test vehicle just when changing the lane.
- The speed of the test vehicle is 30km/h (one condition).
- Regarding the condition of steering input, normal steering input and slightly rapid steering input are carried out (two conditions).

### 3. Test vehicles and the field of the test

Three passenger cars made by Japanese manufacturers were used.

<b>Test vehicle</b>	<b>Types of body</b>	<b>Registration year, month</b>
A	Mini Van (7 seats)	February 2018
B	Sedan (5 seats)	March 2018
C	Station Wagon (5 seats)	January 2018

The test was carried out in the second district of Automobile Proving Ground of National Traffic Safety and Environment Laboratory

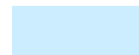
## 4. Result of the test

### Overview of the test (from scenario 1 to scenario 4)

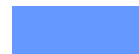
- Both Collision Warning and Emergency Braking were not confirmed.
- Collision Warning was confirmed, Emergency Braking was not confirmed.
- Collision warning and Emergency Braking were confirmed.

Draft Scenario	Test conditions		Test results									
			Test vehicle A			Test vehicle B			Test vehicle C			
			1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
1	Test vehicle 20km/h	Start point of steering input : 5.7 m										
		Start point of steering input : 3.9 m										
2	Test vehicle 30km/h Related vehicle 10km/h	Start timing of steering input : TTC= 4s										
		Start timing of steering input : TTC= 5s										
		Start timing of steering input : TTC= 6s										
	Test vehicle 40km/h Related vehicle 10km/h	Start timing of steering input : TTC= 4s										
		Start timing of steering input : TTC= 5s										
		Start timing of steering input : TTC= 6s										
3	Test vehicle 20km/h, Related vehicle 20 km/h											
4	Test vehicle 20km/h	Stationary related vehicle										
	Test vehicle 30km/h	Stationary related vehicle										
	Test vehicle 20km/h	Stationary pedestrian target										
	Test vehicle 30km/h	Stationary pedestrian target										

# Overview of the test (from scenario 5 to scenario 8)



Both Collision Warning and Emergency Braking were not confirmed.



Collision Warning was confirmed, Emergency Braking was not confirmed.



Collision warning and Emergency Braking were confirmed.

Draft Scenario	Test conditions			Test results									
				Test vehicle A			Test vehicle B			Test vehicle C			
				1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
5	Test vehicle 30km/h	With guard pipes	Same direction										
		With guard pipes	Opposite direction										
	Test vehicle 30km/h	Without guard pipes	Same direction										
		Without guard pipes	Opposite direction										
6	Test vehicle 30km/h	Start timing of steering input : TTC= 2s											
		Start timing of steering input : TTC= 1.4s											
		Start timing of steering input : TTC= 0.8s											
	Test vehicle 40km/h	Start timing of steering input : TTC= 2s											
		Start timing of steering input : TTC= 1.4s											
		Start timing of steering input : TTC= 0.8s											
7	Test vehicle 30km/h	Approaching lane marking most : TTC=1s											
		Approaching lane marking most : TTC=0s											
	Test vehicle 40km/h	Approaching lane marking most : TTC=1s											
		Approaching lane marking most : TTC=0s											
8	Test vehicle 30km/h	without pedestrian target	Normal steering input										
		without pedestrian target	Rapid steering input										
		with pedestrian target	Normal steering input										
		with pedestrian target	Rapid steering input										

## 5. Summary

- According to the result of the test, in the draft scenario 1, 2, 4 and 6, collision warning or emergency braking were confirmed.
- Regarding the several draft scenarios in which collision warning or emergency braking were confirmed, further study in order to investigate driving behavior of normal drivers (ex. speed, approaching to the objects) in each scenarios will be done until March of 2020.
- Based on the whole of the study, the material as the technical background of draft proposal to amend the current false reaction scenario will be prepared.