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Ministerie van Infrastructuur en Milieu

REPORT

AEBS and Traffic Control Measures

Field Test to the visibility of traffic control measures for Autonomous Emergency Braking Systems

Client: Rijkswaterstaat (National Dutch Highway Authority)

Reference: T&PBF7439R001F01

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Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

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1 Introduction

An Advanced Emergency Braking System (AEBS) is to be phased in for new trucks (Category M2, M3, N2 and N3 motorised vehicles)[1]. This system must prevent trucks from rear-ending a traffic jam and/or significantly reduce the severity of an incident. The system must also be capable of detecting a traffic jam with stationary passenger vehicles on a timely basis.
Similar systems are available for passenger vehicles. These are available under various names including City Advanced Emergency Braking (C-AEBS) for low speeds and Urban AEBS for high speeds.

Manufacturers are using different methods to detect traffic jams. Generally, these are radar-based and may or may not be combined with a camera. When an object with which a collision is probable is detected, the driver receives a warning signal. This signal may be visual, acoustic or a combination of the two. This warning system is called Forward Collision Warning (FCW). If the situation persists and the driver fails to intervene, the system must intervene. In a number of systems used, the system first brakes the vehicle lightly (approx. 3 m/s^2) to attract the driver's attention. After this, the system intervenes within 1.4 seconds through means of an emergency stop. An emergency stop by the system (> 5 m/s^2) must reduce the speed by at least 20 km/h in order to as much as possible reduce the impact of a potential collision. This braking system actually is the AEBS. In other words, AEBS is always implemented in combination with FWC, whereby FWC warns and AEBS brakes.

Rijkswaterstaat wants to know whether the introduction of these systems in the vehicle fleet will result in safety gains in relation to the different traffic control measures used during road construction work and in relation to incident management. For this to be the case, the vehicle systems must detect the objects that make up the traffic control measure on time.

The objective of this test is to assess in actual practice under which conditions the traffic control measures are detected by the FWC/AEBS currently in common use.

Rijkswaterstaat has commissioned Royal HaskoningDHV to orchestrate this test, and to analyse and report on the results. This report covers the design of the study (Chapter 2) and the test results (Chapter 3), while Chapter 4 sets out the conclusions and recommendations.

[1] Effective from 01-10-2016 AEBS Level 01 must be present in all new type approvals. The existing type approvals will expire on 01-10-2018. Effective dates are extracted from Regulation 347/2012, associated performance levels are listed in Regulation 2015/562 - Source: National Vehicle and Driving Licence Registration Authority (RDW).

2 Study Design

To answer the study's basic question, we had test vehicles drive towards various traffic control measures under controlled conditions. Next, we determined to what extent the driver received a timely warning from the Forward Collision Warning System and was able to safely avoid the traffic control measure. We did not test the actual intervention of the vehicle – the Autonomous Emergency Braking System – for safety reasons.

2.1 Traffic Control Measures to be Tested

Figure 1 Traffic control measures tested: traffic arrow trailer, WIS car fend-off, WIS jacket, WIS motorcycle.

Rijkswaterstaat institutes traffic control measures for road construction work and incidents to prevent vehicles from entering the working area or the incident site. Different traffic control measures are deployed for this purpose. The following nine traffic control measures were tested:

1. Collision absorber
2. Traffic arrow trailer
3. WIS[2] car straight (with extended and activated DRIP[3])
4. WIS car fend-off (with extended and activated DRIP)
5. WIS motorcycle
6. WIS jacket on PVC support
7. 50-cm pylons with WIS car in accordance with guideline (as indicated in Figure 2 with collapsed DRIP) – this situation simulates an ANWB car on the hard shoulder.
8. 75-cm pylons with WIS car in accordance with guideline (as indicated in Figure 2 with extended DRIP) – this situation simulates a WIS car on the hard shoulder.
9. Beacons - 10 units diagonally positioned across a 50 m length – this situation simulates a lane reduction.

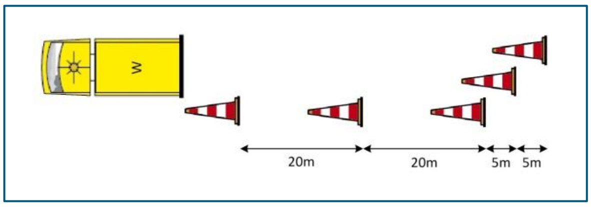

Figure 2 - WIS car set-up with 50/75 cm pylons.

To check whether the AEBS systems actually function, a reference test (see Section 3.1) was performed using three different passenger cars (Volkswagen Touran, Volkswagen Transporter and Renault Megane).

[2] *WIS: Rijkswaterstaat Road Inspector.*
[3] *DRIP: Dynamic Route Information Panel: information panel mounted on an extendible column on the vehicle.*

2.2 Test Vehicles

Six different vehicles equipped with AEBS were used to test the traffic control measures: 4 trucks and 2 passenger cars.

- Trucks
    - DAF
    - Scania R410 (2013)
    - MAN TGX (2009)
    - Mercedes Benz Actros (2017)
- Passenger cars
    - Tesla Model S (2016)
    - Volvo V40 (2014)

The goal of this study is not to test different truck brands, but to get an overall picture of the performance of AEBS. That is why the trucks are randomly numbered in the results section of the report. The results can’t be traced back to individual brands.

Figure 3 – All test vehicles.

2.3 Test Site and Date

The tests were carried out on the Police Academy's test track in Lelystad, the Netherlands. The test track includes a straight section approx. 700 m in length along which various traffic control measures were placed.
The tests took place on Friday 27 January 2017. This was a clear and cold day with an average temperature of 1°C, 10 km visibility and an average wind speed of 2 BFT from the southeast (source: historical data Royal Netherlands Meteorological Institute (KNMI)).

Figure 4 – Weather conditions on the 27 January test day

The swerving distance (see Section 2.4) was determined on the day prior to this, on Thursday, 26 January at the end of the afternoon. The weather conditions that day were the same as they were on Friday.

A plenary briefing was held with all participants prior to conducting the test. The results were discussed with all participants at the end of the test.

Figure 5 – Plenary briefing prior to the test.

2.4 Test Preparation: Determining the Swerving Distance

This test determined whether the driver received a timely warning from the AEBS system and thus was able to avoid the traffic control measure independently. To avoid the probability of a collision, we determined the critical swerving distance in advance. The swerving distance is the minimum distance a driver requires to be able to safely swerve. The swerving distance is determined as follows:

- Pylons are placed at 10 m intervals;
- A truck approaches at 80 km/h and initiates a swerving manoeuvre when it reaches the first pylon;
- A readout is then taken to determine the number of metres required for the truck to have swerved into the adjacent lane.

This manoeuvre was carried out five times. Each time, the truck required approximately 40 m to change lanes. This distance plus a safety margin of 10 m was maintained as the space between the spot where the truck was to commence swerving and the traffic control measure. The swerving distance was therefore set at 50 m.

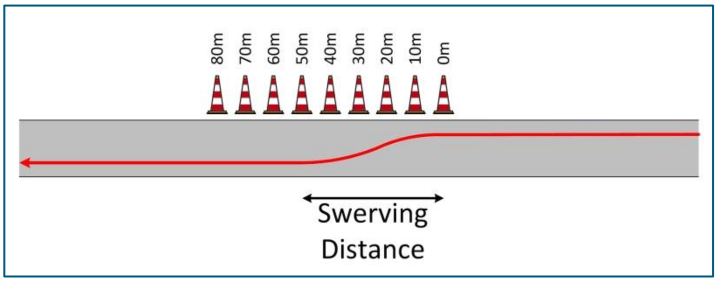

Figure 6 – Determining the swerving distance.

2.5 Test Method

Three traffic control measures were placed in three series on the test track each time. The test vehicles each drove at least 5 rounds.

- At least 3 rounds were driven 'solo' by the vehicles;
- At least one round, whereby two test vehicles drove one behind the other at a distance of approximately 50 m, was completed to simulate a 'regular traffic flow';
- At least one round, whereby the traffic control measure was fitted up with an aluminium prism to determine whether the traffic control measure would be better/earlier detected by the AEBS system, was completed.

Aside from the driver, each vehicle included a co-driver to record information. The co-driver recorded the following information for each traffic control measure:

- Was the ride a steady 80 km/h;
- Did the driver receive a warning signal (Y/N);
- If so, at what distance from the traffic control measure.

The results were recorded in a log (see Appendix 3 for this log).

2.5.1 Test Set-up

Figure 7 depicts the test set-up. The test vehicles were set up at Position 1. The test vehicles completed the blue circuit at least five times. The circuit time was approximately 2:30 minutes.

Observers were located on the hill, designated in purple, from which the three test sites were clearly observable. The traffic control measures that were not tested in the relevant series were placed far from the moving vehicles in the areas circled in black.

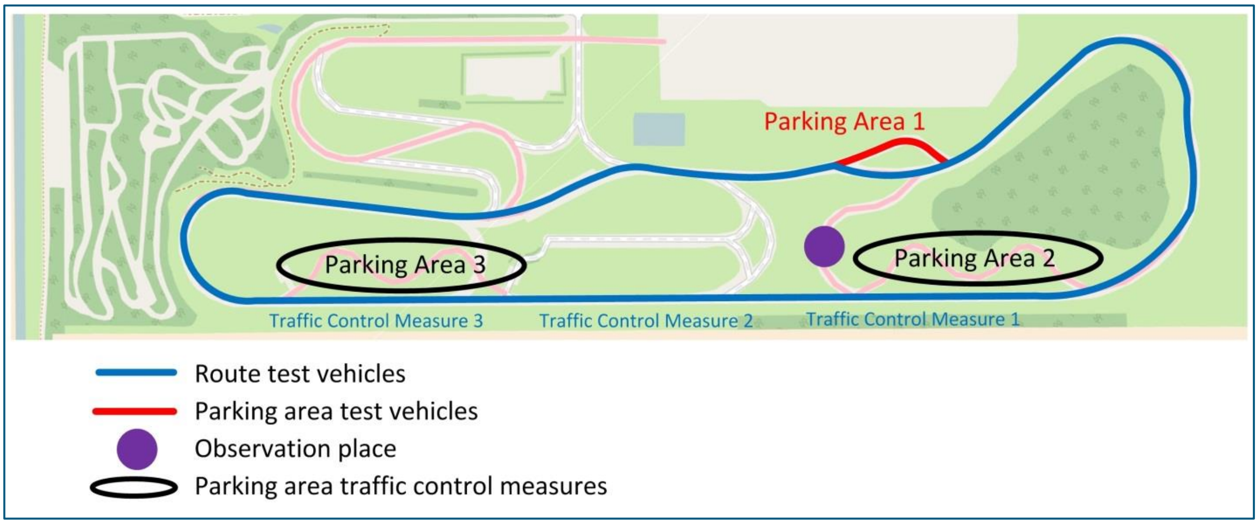

Figure 7 – Set up of traffic control measures, test vehicles and observers.

2.5.2 Determining the Visibility of Traffic Control Measures

With the help of the set-up below, tests were conducted to determine whether, and if so, when, the test vehicles reacted to the approaching traffic control measure.

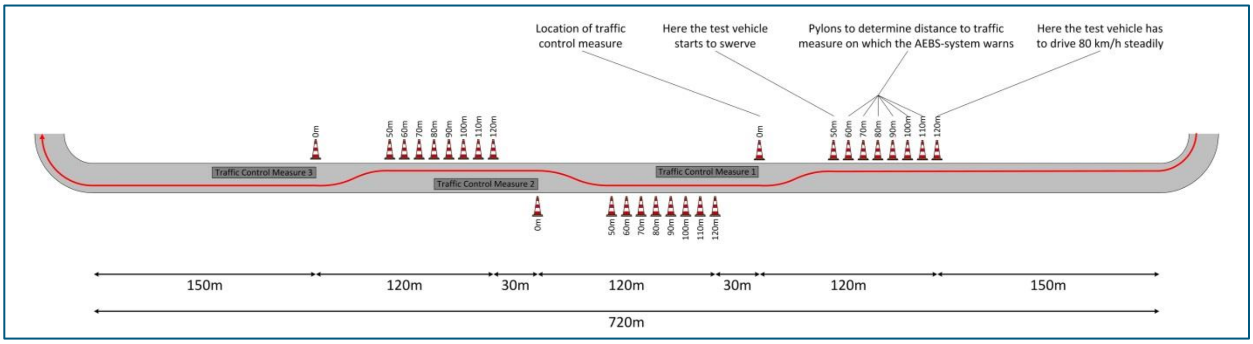

Figure 8 – Test set-up

For an acceptable test, the test vehicle was required to be driving at a steady speed of 80 km/h at a distance of 120 m from the traffic control measure. The co-driver checked this. When this was not the case, the test was rejected. The driver continued driving up to the last pylon positioned at the swerving distance (50 m) from the traffic control measure and then swerved to the other side of the lane. The co-driver recorded whether, and if so, where, the driver received a warning signal.

The truck continued driving up to the pylon located 120 m from the second traffic control measure and the process was then repeated. Ditto for traffic control measure 3. At the end, the driver had a 150 m distance available for braking and safely steering into the bend. No unsafe situations occurred during the tests.

2.5.3 Testing the Addition of Prisms to Improve the Visibility of Traffic Control Measures

To determine to what extent the detection of the nine traffic control measures could be improved, a number of test rounds were driven with traffic control measures fitted up with an aluminium prism[4]. The prism's dimension was 215x215x300 mm and its reflective capacity was equivalent to that of a 3 m^2 surface.

Figure 9 – Reflector attached to traffic arrow trailer (left) and to a 75 cm pylon (right).

[4] http://www.123watersport.nl/radarreflector-achtvlakkig.html?id=40281674&quantity=1

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3 Test Results

This chapter describes the test results of the reference test and the different traffic control measures. There are three situations for each test vehicle:

- Traffic control measure without prism and without vehicle in front
- Traffic control measure without prism and with vehicle in front
- Traffic control measure with prism and without vehicle in front

The following information was recorded for each situation:

- Number of tests
- Number of times that the traffic control measure was detected by the FCW/AEBS
- Average distance at which the detected traffic control measure was detected

3.1 Reference Test Using Stationary Passenger Cars

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	6	6	50	3	2	50
Truck 2	6	5	50	1	1	50
Truck 3	5	5	48	3	0	-
Truck 4	6	3	50	3	0	-
Car 1	6	6	85	3	3	50
Car 2	6	1	30	3	0	-
Average	**35**	**74%**	**52**	**16**	**38%**	**50**

Table 1 – Reference test using stationary passenger cars

Table 1 shows that the AEBS systems on trucks score 82% (19 out of 23) and detect the stationary vehicles at an average distance of 50 m. The second passenger car scores less, possibly because it uses older technology. With a vehicle in front, the vehicles score significantly lower.

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3.2 Visibility of Collision Absorber

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	5	0	-	0	0	-	1	0	-
Truck 2	4	0	-	1	0	-	1	0	-
Truck 3	5	0	-	0	0	-	1	0	-
Truck 4	3	0	-	1	0	-	1	0	-
Car 1	3	1	50	1	0	-	1	1	50
Car 2	3	0	-	0	0	-	1	0	-
Average	**23**	**4%**	**50**	**3**	**0%**	**-**	**6**	**17%**	**50**

Table 2 – Visibility of collision absorber

The visibility of the often used collision absorber traffic control measure is poor. The test with a vehicle in front or the addition of a prism does not result in any improvement.

3.3 Visibility of Traffic Arrow Trailer

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	4	1	60	2	0	-	2	1	60
Truck 2	3	0	-	2	2	65	3	0	-
Truck 3	3	1	50	0	0	-	2	1	60
Truck 4	3	1	50	0	0	-	2	0	-
Car 1	4	1	40	2	2	40	2	2	45
Car 2	5	0	-	1	0	-	2	0	-
Average	**22**	**18%**	**50**	**7**	**57%**	**53**	**13**	**31%**	**55**

Table 3 – Visibility of traffic arrow trailer

The traffic arrow trailer is also poorly detected. With a vehicle in front, the score (for a limited number of observations) is somewhat higher. Even with a prism, the score stays low at 31%.

3.4 Visibility of WIS Car Straight with Active DRIP

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	5	2	60	0	0	-	1	1	60
Truck 2	4	0	-	1	1	70	1	0	-
Truck 3	5	0	-	0	0	-	1	0	-
Truck 4	3	0	-	1	0	-	1	0	-
Car 1	3	3	75	1	1	45	1	1	70
Car 2	3	3	73	0	0	-	1	1	70
Average	**23**	**35%**	**69**	**3**	**67%**	**58**	**6**	**50%**	**67**

Table 4 – Visibility of WIS car straight

The WIS car in the straight position (parallel to the direction of travel) is well-detected by the passenger cars (at a good distance), but poorly by the trucks. This also applies to the prism situation.

3.5 Visibility of WIS Car with Active DRIP in Fend-off

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	4	0	-	2	0	-	2	0	-
Truck 2	3	0	-	2	2	60	3	0	-
Truck 3	3	1	60	0	0	-	2	1	50
Truck 4	3	0	-	0	0	-	2	0	-
Car 1	4	3	50	2	2	40	2	0	-
Car 2	5	0	-	1	0	-	2	0	-
Average	**22**	**18%**	**55**	**7**	**57%**	**50**	**13**	**8%**	**50**

Table 5 – Visibility of WIS car in fend-off position

When the WIS car is placed in a fend-off position, the result declines. The prism does not produce any improvement.

3.6 Visibility of WIS Motorcycle

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	5	0	-	1	0	-	2	0	-
Truck 2	4	1	40	3	1	70	2	0	-
Truck 3	4	0	-	1	0	-	2	0	-
Truck 4	4	0	-	1	0	-	2	0	-
Car 1	4	0	-	3	0	-	2	0	-
Car 2	4	0	-	3	0	-	2	0	-
Average	**25**	**4%**	**40**	**12**	**8%**	**70**	**12**	**0%**	**-**

Table 6 – Visibility of WIS motorcycle

The visibility of the WIS motorcycle is poor in all cases.

3.7 Visibility of WIS Jacket

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	5	2	55	1	0	-	2	1	60
Truck 2	4	0	-	3	2	60	2	0	-
Truck 3	4	2	50	1	0	-	2	0	-
Truck 4	4	0	-	1	0	-	2	0	-
Car 1	4	0	-	3	0	-	2	0	-
Car 2	4	0	-	3	0	-	2	0	-
Average	**25**	**16%**	**53**	**12**	**17%**	**60**	**12**	**8%**	**60**

Table 7 – Visibility of WIS jacket

The visibility of the WIS jacket is also poor in all cases, although surprisingly it is not nil.

3.8 Visibility of 50 cm Pylons

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	5	0	-	1	0	-	2	1	50
Truck 2	4	0	-	3	1	70	2	0	-
Truck 3	4	0	-	1	0	-	2	0	-
Truck 4	4	0	-	1	0	-	2	0	-
Car 1	4	4	38	3	3	37	2	2	40
Car 2	4	0	-	3	1	50	2	0	-
Average	**25**	**16%**	**38**	**12**	**42%**	**52**	**12**	**25%**	**45**

Table 8 – Visibility of 50 cm pylons with a WIS car straight parked beyond the pylons

The visibility of the pylons (50 cm) is poor. Where there is any detection, it probably concerns the WIS car, which in this configuration (in accordance with the guideline) is parked beyond the pylons.

3.9 Visibility of 75 cm Pylons

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	4	0	-	2	0	-	2	1	50
Truck 2	3	0	-	2	1	60	3	0	-
Truck 3	3	0	-	0	0	-	2	1	50
Truck 4	3	0	-	0	0	-	2	0	-
Car 1	4	3	43	2	0	-	2	2	40
Car 2	5	0	-	1	0	-	2	0	-
Average	**22**	**14%**	**43**	**7**	**14%**	**60**	**13**	**31%**	**47**

Table 9 – Visibility of 75 cm pylons with a WIS car straight with collapsed DRIP parked beyond the pylons

When the test was repeated with the larger 75 cm pylons, they were also poorly detected.

3.10 Visibility of Beacons

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance	Total Number of Tests	Number of Times Detected	Average Distance
Truck 1	5	0	-	0	0	-	1	0	-
Truck 2	4	0	-	1	0	-	1	0	-
Truck 3	5	0	-	0	0	-	1	0	-
Truck 4	3	0	-	1	0	-	1	0	-
Car 1	3	0	-	1	0	-	1	0	-
Car 2	3	0	-	0	0	-	1	0	-
Average	**23**	**0%**	**-**	**3**	**0%**	**-**	**6**	**0%**	**-**

Table 10 – Visibility of beacons

It is clear that the AEBS systems do not detect the beacons.

4 Conclusions and Recommendations

4.1 Traffic Control Measures – Conclusions

The reference test showed that the AEBS systems in the trucks in 19 out of 23 cases (82%) on average issued a warning 50 metres ahead of the passenger cars placed on the road. Of the systems in the passenger cars, car 1 issued a warning in all six cases, while the somewhat older car 2 only detected 1 in 6 cars.

The tested traffic control measures show a very different picture, however. The table below displays the totals of the various tests by traffic control measure.

	No Prism, No Vehicle in Front			No Prism, Vehicle in Front			Prism, No Vehicle in Front		
	Number of Tests	Detected	Average Distance	Number of Tests	Detected	Average Distance	Number of Tests	Detected	Average Distance
Collision absorber	23	4%	50	3	0%	-	6	17%	50
Traffic arrow trailer	22	18%	50	7	57%	53	13	31%	55
WIS car straight	23	35%	69	3	67%	58	6	50%	67
WIS car fend-off	22	18%	55	7	57%	50	13	8%	50
WIS motorcycle	25	4%	40	12	8%	70	12	0%	-
WIS jacket	25	16%	53	12	17%	60	12	8%	60
Pylons – 50 cm[5]	25	16%	38	12	42%	52	12	25%	45
Pylons – 75 cm2	22	14%	43	7	14%	60	13	31%	47
Beacons	23	0%	-	3	0%	-	6	0%	-
Reference test: passenger cars	35	74%	52	16	38%	50	0	-	-

Table 11 – Totals of all detected traffic control measures in the three situations

4.1.1 Segmented Conclusions

Tests with Solo Vehicles

The AEBS systems in the trucks did not detect the collision absorber within the safe swerving distance in any of the tests. The other traffic control measures, including the traffic arrow trailer, WIS car straight, WIS car fend-off, WIS motorcycle, WIS jacket, pylons and beacons, were only rarely detected or not at all.

The key conclusion is that the AEBS systems in trucks do not reliably detect the traffic control measures. Even the WIS vehicle with extended DRIP was only detected in 2 of the 17 tests.

[5] The pylons were detected in a number of instances, but most probably it was the WIS car parked past the pylons that was in fact detected in these instances.

The results for the passenger cars, to which the AEBS specifications for the truck type approval do not apply, were not all that much better. Of the passenger cars, car 1 was the only one to detect the collision absorber once in three attempts.
The beacons were not detected in any of the tests by any of the participating vehicles.

Tests with a Vehicle in Front
For the test with a vehicle in front that swerves for a stationary passenger vehicle, the number of timely warnings decreases by half. Swerving at the last moment hampers detection by the vehicle coming after it.

Addition of Prism
The addition of a aluminium prism to the traffic control measure does not appear to have any effect.

4.1.2 Final Conclusion Relating to the FWC and EABS Systems Used

The FWC and AEBS systems in trucks do not warn the driver within the safe swerving distance used for the applicable traffic control measures in the tests. This distance was used to prevent vehicles from colliding with the placed object. In principle, it is possible that the vehicles that did not issue a warning within the applicable 50 metre swerving distance, would nevertheless have activated an emergency stop. However, it is unlikely that at this speed the emergency stop would have fully avoided a collision. The type approvals are focused on limiting or avoiding having trucks drive into passenger cars[6].

In assessing the performance of AEBS and emergency braking systems, due consideration must be provided to the fact that an unjustified emergency intervention can also result in severe accidents due to the traffic coming from behind. Manufacturers are calibrating existing systems to detect a stationary or moving sedan model passenger vehicle.

4.1.3 Final Conclusion for Road Authority

The currently tested traffic control measures are not or only incidentally detected at a sufficiently safe distance by AEBS systems. As such, the implementation of these systems do not yield any immediate safety gains for the road authority and for other persons working on the road. If this causes the users of these systems to pay less attention to the road themselves, this can even have a negative effect in the presence of traffic control measures.

4.1.4 Final Conclusion Passenger Car Systems

Neither test passenger vehicle detected the traffic control measures. Only the WIS car was detected on several occasions. This means that the driver him/herself must always be alert to the presence of traffic control measures. In actual practice, blind reliance on installed systems can result in serious collisions.

[6] *R131.00 and 01 in: https://www.unece.org/trans/main/wp29/wp29regs121-140.html. Also see EuroNCAP AEB Systems Test Protocol v1.1 June 2015.*

4.2 Recommendations

Action is required to improve the safety of traffic control measures.

1. Existing safety procedures must be adhered to for all road work. Furthermore, these procedures must include additional devices for warning drivers.
2. The motor vehicle industry must be stimulated to further develop FCW and AEBS systems to be able to detect traffic control measures and to keep the road user's attention focused on the road.
3. Users of these systems must know that a traffic control measure potentially will not be detected and must be aware of the additional danger of distraction.

Appendices

A1 Script for 27 January Test Day

A2 Log for Recording Test Results


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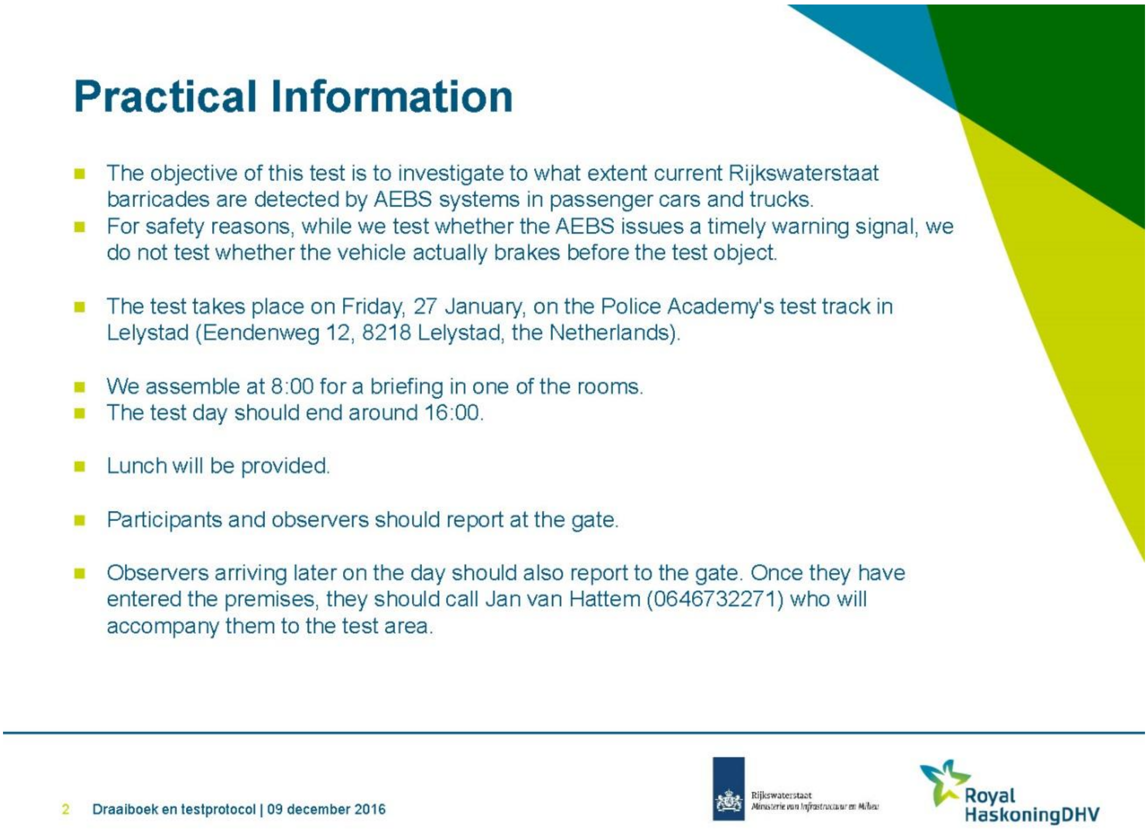
POLITIE
Politieacademie
PRODRIVE TRAINING
SAFE & ECO DRIVING
Script
AEBS and Traffic Control Measures Test
27 January 2017
Police Academy Test Track,
Lelystad


Practical Information
The objective of this test is to investigate to what extent current Rijkswaterstaat barricades are detected by AEBS systems in passenger cars and trucks.
For safety reasons, while we test whether the AEBS issues a timely warning signal, we do not test whether the vehicle actually brakes before the test object.
The test takes place on Friday, 27 January, on the Police Academy's test track in Lelystad (Eendenweg 12, 8218 Lelystad, the Netherlands).
We assemble at 8:00 for a briefing in one of the rooms.
The test day should end around 16:00.
Lunch will be provided.
Participants and observers should report at the gate.
Observers arriving later on the day should also report to the gate. Once they have entered the premises, they should call Jan van Hattem (0646732271) who will accompany them to the test area.
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Programme

Time	Activity
08:00	Start of briefing by Evert and Mark
09:00	Vehicles to set-up area on test track
09:30	First test (see schedule on next slide)
10:30	Change test objects for Round 2
11:00	Second test (see schedule on next slide)
12:00	Change test objects for Round 3
12:30	Lunch
13:30	Third test (see schedule on next slide)
14:30	Complete and dismantle
15:00	Share experiences, post-test discussion
16:00	End of session

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Test Schedule

Test Session	Test Object 1	Test Object 2	Test Object 3	Test Number	Vehicle 1 (Co-driver Floris de Vos)	Vehicle 2 (Co-driver Mathijs Huisman)
Session 1 (9:30 - 10:30)	Collision absorber	WIS car straight	Beacons	1.1	DAF	Scania
				1.2	Mercedes	MAN
				1.3	Tesla	Volvo
Session 2 (11:00 - 12:00)	Traffic arrow trailer	WIS car fend-off	Pylons – 75 cm	2.1	DAF	Scania
				2.2	Mercedes	MAN
				2.3	Tesla	Volvo
Session 3 (13:30 - 14:30)	WIS motorcycle	WIS jacket	Pylons – 50 cm	3.1	DAF	Scania
				3.2	Mercedes	MAN
				3.3	Tesla	Volvo

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Test Schedule

- A test comprises the following components:
  - 3 rounds during which the two vehicles drive far apart.
  - 1 round during which the two vehicles drive close together (spacing of about 50 m as per driver's judgement).
  - *Vehicles stop on the track and the reflective objects are attached to the test objects.*
  - 1 round during which the two vehicles drive far apart.
  - *Vehicles are parked on the set-up site and the next vehicles depart. The test is repeated with other vehicles.*
- The test vehicle drives at a steady 80 km/h speed towards the test object and continues driving up to the last pylon before the test object. Here, the driver safely steers the vehicle past the test object. This is repeated three times for each round after which the vehicle brakes before the bend.
- The co-driver records whether the vehicle drove at a steady 80 km/h and whether the AEBS issued a warning signal before the vehicle changed lanes. If yes, the distance to the test object is recorded.

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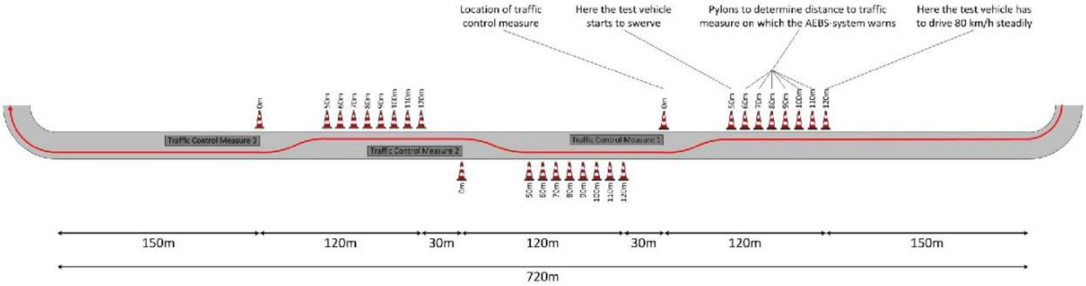
Test Set-up – Tests

Set up as shown in diagram below:

- After the test vehicle emerges from the bend, it has 150 m to reach a steady speed of 80 km/h. At the level of the '120 m' pylon, the test vehicle must therefore be driving 80 km/h. The observer checks this. The test is rejected otherwise.
- The driver continues driving to the last pylon before the test object. He then swerves to the other side of the lane.
- The co-driver records whether, and if so, where, the AEBS issues a warning signal.
- The truck continues driving up to the pylon located 120 m from the second test object and the process is then repeated. Ditto for test set-up 3.
- The driver now has a 150 m distance for braking and safely steering into the bend.



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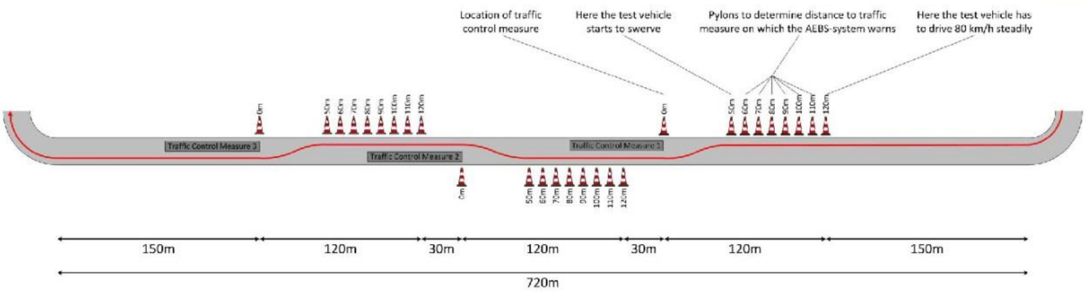
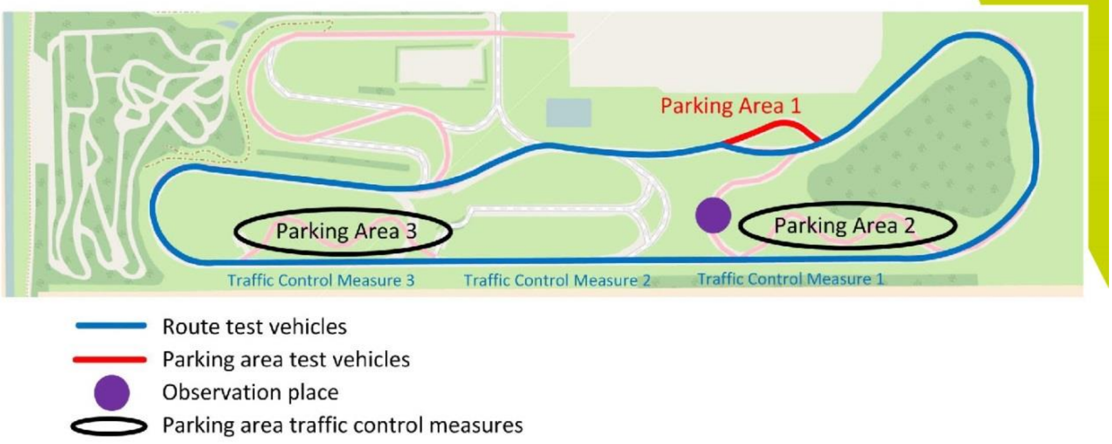
Test Set-up – Tests (cont'd)

- For each test, there are two vehicles on the track that depart one minute apart. This way, they drive with a safe distance between them.
- All vehicles drive five rounds.
- After five rounds, the vehicles are changed. The observers get into the next vehicle.
- After all vehicles have taken their turn, the test objects are changed.



Test Set-up – Top View

- Vehicles are positioned in the red area.
- Test vehicles drive the blue circuit five times. The circuit time is approximately 2:30 minutes.
- Observers are located on the hill, designated in purple.
- Test objects that are not being tested are placed in the areas circled in black.



Safety

- Evert Klem is the Test Manager.
- The Test Manager has a view of the test set-ups and the set-up sites from the hill.
- Each vehicle has a walkie-talkie, as do the people managing the test set-up.
- Every person present wears a reflective jacket/vest, which can be obtained from Jan van Hattem.
- When tests are underway, everyone who is not in a vehicle, must assemble on the observation hill, at the set-up area or at a safe distance from the circuit.
- Evert will check to confirm that the track is clear before the vehicles enter the circuit.
- Every vehicle is driven by a driver whose only task is to drive towards the test objects and to swerve at the level of the swerving pylon. Logging whether the AEBS works is done by a co-driver who also looks after the walkie-talkie traffic. As a back-up and for post-review, each vehicle is equipped with a GoPro camera.
- First Aid officers and Company Emergency Response Team members are present at the track. Any incident or emergency is reported to the Test Manager, Evert.

Roles and Key Telephone Numbers

Who	Role	Location	Telephone Number
Evert Klem	Test Manager	Hill	0652018713
Jan van Hattem	Co-test Manager	Hill	0646732271
Jan Nieuwelink	Co-test Manager	Hill	0643032931
Mark Gorter	Place test objects	Test objects positions	0623688324
Maaikel Koenis	Place test objects	Test objects positions	0631781890
Heebink Employee	DAF Driver	Vehicles	
Heebink Employee	Scania Driver	Vehicles	
Berth van Veldhuizen	Mercedes Driver	Vehicles	
Gert van Deuveren	MAN Driver	Vehicles	
Chris Heiligers	Tesla Driver	Vehicles	
ProDrive Employee	Volvo Driver	Vehicles	
Mathijs Huisman	Co-driver	Vehicles	0883481519
Floris de Vos	Co-driver	Vehicles	0650419517

Logbook results test AEBS Session 1

Vehicle: ....

Observant: ....

Did AEBS work as expected? ◯ yes ◯ no

Explanation: ....

Round-number	Traffic Control Measure	Did the test vehicle drive 80 kph at the first pylon (120m)?	Did AEBS give a warning before the swerving of the test vehicle?	At what distance from the traffic control measure did AEBS give a warning?	Remarks
Round 1	Collision absorber	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	WIS-car straight	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	Beacons	◯ yes ◯ no	◯ yes ◯ no	.... meter	
Round 2	Collision absorber	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	WIS-car straight	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	Beacons	◯ yes ◯ no	◯ yes ◯ no	.... meter	
Round 3	Collision absorber	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	WIS-car straight	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	Beacons	◯ yes ◯ no	◯ yes ◯ no	.... meter	
Round 4	Collision absorber	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	WIS-car straight	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	Beacons	◯ yes ◯ no	◯ yes ◯ no	.... meter	
Round 5	Collision absorber	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	WIS-car straight	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	Beacons	◯ yes ◯ no	◯ yes ◯ no	.... meter	
Round 6	Collision absorber	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	WIS-car straight	◯ yes ◯ no	◯ yes ◯ no	.... meter	
	Beacons	◯ yes ◯ no	◯ yes ◯ no	.... meter	