DENSO Crafting the Core

March 6, 2020

Via Email
Via Docket Management

Mr. Garrick Forkenbrock
Research Engineer, Vehicle Research and Test Center
National Highway Traffic Safety Administration
10820 SR 347, Bldg. 60,
East Liberty, OH 43319

RE: Advanced Driver Assistance Systems Draft Research Test Procedures
Docket No. NHTSA-2019-0102

Dear Mr. Forkenbrock:

On behalf of DENSO CORPORATION ("DENSO"), DENSO International America, Inc. submits the following comments for NHTSA's November 21, 2019, Request for Comment (RFC) regarding Advanced Driver Assistance Systems (ADAS) Draft Research Test Procedures (Docket No. NHTSA-2019-0102).

DENSO, a leading mobility supplier, develops advanced automotive technology for all major global vehicle manufacturers, and operates in 35 countries and regions with approximately 170,000 employees worldwide. We have been in the U.S. for over 50 years. In that time, our local operations have been dedicated suppliers of world-class automotive systems and components that protect lives and preserve the planet. Our 17,000 U.S. employees, and more than $4.5 billion of U.S. capital investment in 41 facilities across 14 states, demonstrate our commitment to creating a bright future for generations to come. In the U.S., DENSO employs people in Alabama, Arkansas, California, Indiana, Iowa, Georgia, Kentucky, Michigan, North Carolina, Ohio, Pennsylvania, Tennessee, Texas and Washington.

In addition to contributing to cleaner and more efficient transportation, our corporate focus is to develop best-in-class products that help reduce and avoid car crashes. This focus is intensifying as we see increases in fatal crashes globally. In fact, the U.S. Department of Transportation (DOT) records show fatalities increasing over the past year, after a longtime trend of decreasing in previous years. There is also an increasing trend in vulnerable road user incidents. We believe that ADAS could be able to help stop this trend and further reduce accidents.

DENSO appreciates the opportunity to share our perspective on NHTSA's ADAS draft research test procedures. We support NHTSA's activities in this area since it encourages the development and application of new technologies to reduce traffic crashes.

Sincerely,

Pat Bassett
Senior Vice President, Engineering

Summary

DENSO understands that some of these draft test procedures are in the early stages of development, while others are closer to being fully developed. As NHTSA continues to refine these test procedures, we would welcome the opportunity to continue to provide comments as they are updated.

We support NHTSA's effort to harmonize its test procedures, test devices and criteria with ISO or regulations or NCAP programs in other regions. We believe that harmonization will improve cost efficiency within the industry.

There may also be opportunities to consolidate conditions across the test procedures. For example, regarding test conditions, ambient temperature and wind speed conditions differ for each test. Further, for the illuminance condition, only "daytime" is described except for the rear automatic brake, and thus no specific value is described. If there is no special reason, we propose to consolidate the conditions and specify the conditions. In addition, we ask NHTSA to consider the impact on stability of the dummy and sensing when determining test conditions.

Technology Specific Comments

Attached below are DENSO comments on the specific test procedures.

(1) Active Parking Assist (APA)

(i) 4.3.1 Perpendicular Parking Test Layout

In the Draft, the longitudinal position of the parked vehicle (PV) is described as the distance between the front end of the vehicle and the perpendicular edge line.

- Since the important point in parking assist is the distance between the subject vehicle (SV) and the rear end of the PV, we propose to describe the vehicle length of PV or the longitudinal position of the PV by the distance between the parking space boundary (18 feet long from inside of the front edge line to the end of the perpendicular edge lines) and the rear end of the PV.

(ii) 5.4.3 Stage 3: Automated Parking Execution

If it takes more than 60 seconds with Lv1 support and more than 45 seconds with Lv2 support to complete the parking maneuver, this test trial is terminated.

- We propose extending the time allowed because it is too short and severe.
- For example, ISO 20900 (Partially Automated Parking Systems) requires 180 seconds or less.

(iii) 5.4.4 Stage 4: Automated Parking Completion

Our understanding of the desired parking completion status of SV from the draft as follows;

(a) Park the rear end of SV and perpendicular edge lines to 1feet (0.3m) or less, and not cross with the perpendicular edge lines.

(b) Park to ensure a distance of 1 feet (0.3m) or more for PV on both sides.

If our understanding is correct, we have the following feedback:

- Regarding (iii) 5.4.4 Stage 4 (a): In the Figure.1 layout, since the PV2 and PV3 are parked in the position of 1feet (0.3m) from the perpendicular edge lines, the requirements can be achieved if these PVs are used as the target to park, but in the real traffic situation the parking position of the PV is various. There is a problem in determining the rear end according to the PV2 and/or PV3.

- Regarding (iii) 5.4.4 Stage 4 (b): In a real traffic situation, the parking position of the PV is various. Therefore if we decide the parking lateral position based on the PV2 and/or PV3, it may deviate from the desired parking space.

NHTSA might consider harmonization with ISO 20900 (Partially Automated Parking Systems)[1] requirements, which parks the vehicle with the available clearance from the three lines of the desired parking space.

As the requirements for parking completion are difficult to understand only in the text, in the future NHTSA might consider clarifying the desired parking completion status of SV with a picture.

(iv) 5.6 System Override Assessment
In Figure 7, Active Park Assist system override sequence, SV stops automatically when any kind of manual override is initiated. We propose to change the requirement because it is inconvenient to use. Since ISO 20900 (Partially Automated Parking Systems) specifies the vehicle behavior according to the driver's intervention pattern, we propose to refer to ISO. For example, in ISO, if the driver controls the accelerator pedal, it is ignored, and if the driver controls the brake pedal, the system continue the assist operation with the deceleration, etc.

- We understand in 5.6.1 that the steering torque lower limit can be set at 27 Nm or less for system cancellation by override. In this case, we propose the following;
  "The steering wheel torque required to manually override system operation, at any time during the automated parking maneuver, shall not exceed 20 ft·lbf (27N·m)."

(V) 5.6.3.2 Manual Timeout Assessment
The test procedure describe the following:
"Once the SV has remained stopped for > 5 seconds, the SV must automatically terminate the active park assist maneuver and restore full manual control of the vehicle to the SV driver."

- We request clarification to understand if it means: a) the system shall be automatically terminated at the latest 5 seconds after the SV has remained stopped, or b) the system shall be automatically terminated after 5 seconds or more after the SV has remained stopped.

(2) Intersection Safety Assist (ISA)
(i) Intersection Geometry
When the left turning radius of the POV is 8.58m and the evaluation speed is 24km/h, the lateral acceleration is 5.5m / s2, which is considered to be too high from the design of the intersection. In the normal intersection geometry design, it is considered that the lateral acceleration is designed to be 2-3m / s2 or less for safety in rainy weather etc.

For this test procedure, NHTSA might consider to review the intersection geometry in Euro NCAP, the left turning radius is 15m when evaluating at 20km/h. In addition, GVT (3D vehicle dummy) slips in the

[1] ISO 20900:2019: Intelligent transport systems — Partially automated parking systems (PAPS) — Performance requirements and test procedures. (https://www.iso.org/standard/69405.html)

lateral direction at 5.5m/s2 of lateral acceleration, and there is a problem such as unstable vehicle behavior in S2 scenario.

If appropriate, we suggest NHTSA to review this four way intersection geometry with reference to Euro NCAP. However, this example may not apply if the four-way intersection used for ISA evaluations is considered the typical layout for U.S. intersections with many accidents.
https://cdn.euroncap.com/media/56143/euro-ncap-aeb-c2c-test-protocol-v302.pdf (see 7.1.4)

(ii) 5.3.8 ISA Scenario 3: SV Left Turn Across POV Path
We propose that the SV driver activate the left turn signal indicator before start turning.

(3) Pedestrian Automatic Emergency Braking (PAEB)
(i) 4.3.2 Pedestrian Test Mannequin
We suggest NHTSA consider the use of an articulated dummy target that more closely resembles the behavior of a pedestrian.

(ii) Test condition tolerance
Regarding PTM speed, we are interested to understand why the tolerance is different even when using the same 4activePS dummy as Euro NCAP.

Euro NCAP: 5km/h ± 0.2km/h
NHTSA (Draft): 5km/h ± 0.4km/h

Regarding PTM acceleration distance, Euro NCAP originally considered 0.5m, but it was revised as follows due to unstable walking speed and movement of the dummy.

Walking condition (PTM speed = 5km/h)
Euro NCAP: 1.0m
NHTSA (Draft): 0.5m

Running condition (PTM speed = 8km/h)
Euro NCAP: 1.5m
NHTSA (Draft): 1.0m

NHTSA might consider to review the setup of the Euro NCAP protocol [https://cdn.euroncap.com/media/53153/euro-ncap-aeb-vru-test-protocol-v302.pdf].

(7) Rear Automatic Braking
(i) 2.4 Test Object
We understand that the 4active Systems Euro NCAP pedestrian child posable mannequin is tuned for RADAR, IR (Infrared), and optical features in the proposed test procedure.

- We ask NHTSA to consider alternative test measures so that manufacturers can use other types of sensor systems not listed above, such as ultrasonic sonar system.

(ii) Visibility

- We request NHTSA clarify the visibility conditions when determined in order to assess the system performance accurately.

(a) Surroundings

- We request NHTSA clearly state that there are no objects that may give rise to abnormal sensor measurements in the surrounding environment behind the vehicle.

(b) Illuminance Conditions

We understand that the illuminance conditions in Appendix A original draft (the rear automatic braking system should be active for all lighting conditions except less than 16 lux) are valid.

- We agree with NHTSA that the test should be conducted in only daytime condition initially. If NHTSA considers introducing the test in an obscure lighting condition, it should be next step after the test in daytime condition.

When testing in obscure lighting conditions is necessary, we believe the average illumination condition should be defined based on crash data analysis of illumination conditions or time periods when back-over crashes most frequently occur.

In addition, we recommend the illumination condition be defined over the head of the child posable mannequin, instead of the center of the vehicle roof rearmost exterior surface.

(iii) Test Execution

This test procedure requires the brake pedal to fully release and allow the vehicle to coast backward. This coasting speed of the three test vehicles do note differ significantly, but we would like to you're your attention to the fact that Euro NCAP has confirmed that it varied from 4 km/h to 8 km/h depending on the vehicle.

In addition, it is necessary to avoid the control to increase engine speed like idle up, which suggests an evaluation is necessary at constant speed for two levels. For example, Euro NCAP evaluates at 4 km/h and 8 km/h.

- We recommend that NHTSA analyze back-over crash data to determine a specific vehicle speed and acceleration until the vehicle reaches coasting.