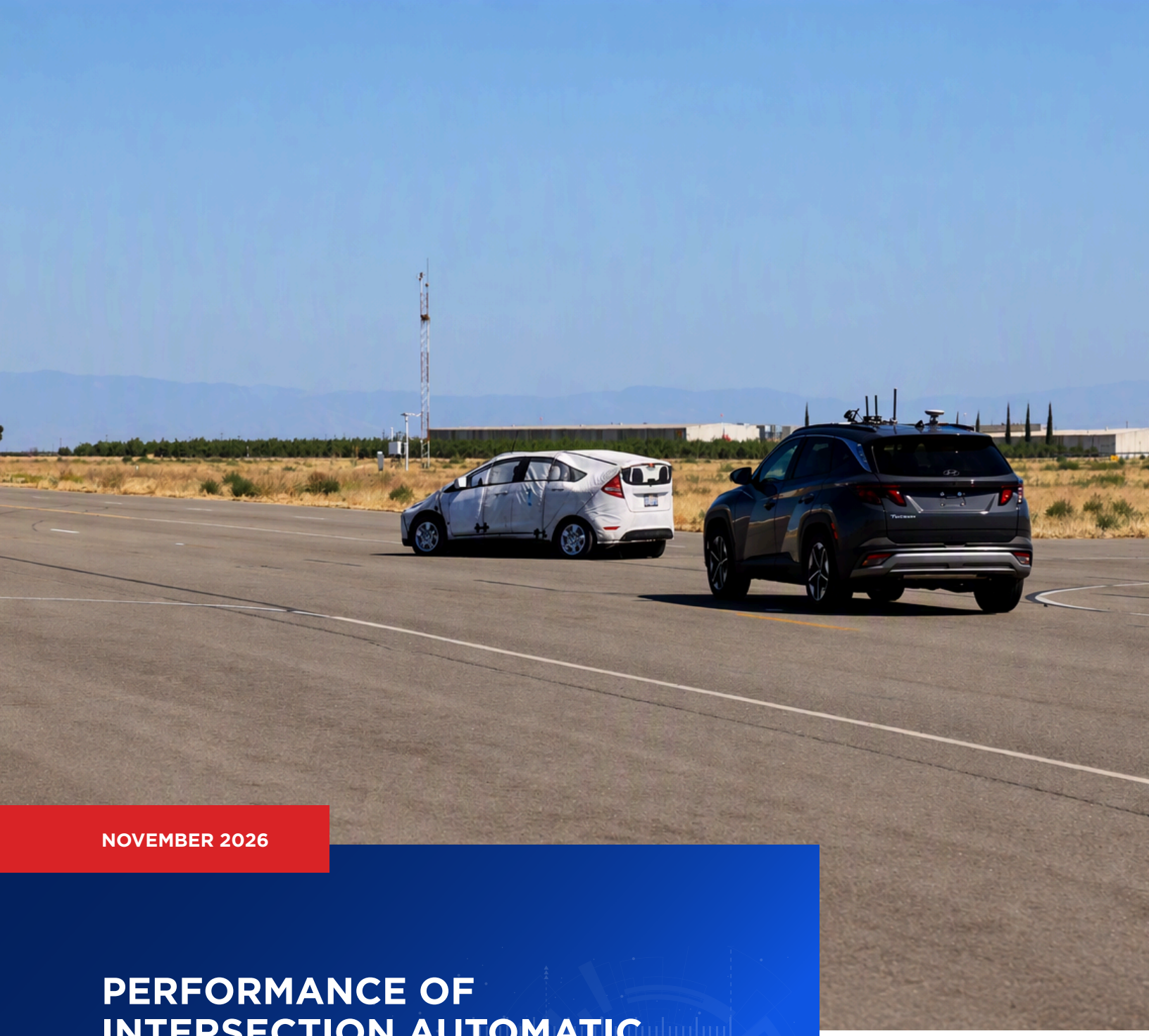


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PERFORMANCE OF INTERSECTION AUTOMATIC EMERGENCY BRAKING SYSTEMS

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ABSTRACT

Intersection automatic emergency braking (Intersection AEB) is an advanced driver assistance system (ADAS) feature that uses forward-facing sensors intended to detect a potential collision at an intersection and autonomously apply the brakes when an imminent impact is identified. While standardized AEB test procedures in the United States have historically focused primarily on rear-end collision scenarios, an analysis of 2020–2024 National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) data conducted by the AAA Foundation for Traffic Safety at AAA's request found that angle crashes, including intersection-based configurations such as turn across path, turn into path, and T-bone crashes, accounted for approximately 41% of reported two-vehicle fatalities [1]. In 2022, AAA evaluated vehicles whose standard AEB systems did not include manufacturer-identified intersection AEB functionality. Those systems did not provide alerting or braking intervention in the evaluated intersection scenarios [2].

To assess the current state of intersection AEB technology, AAA conducted primary research in a closed-course environment, evaluating four 2026 model year vehicles equipped with intersection AEB across four test scenarios. These included one turn-into-path scenario, in which a principal other vehicle (POV) executed a right-hand turn into the subject vehicle (SV) path, and three turn-across-path scenarios, in which the SV executed a left turn across the path of an oncoming POV. The turn-across-path scenarios included the European New Car Assessment Programme (Euro NCAP) car-to-car front turn-across-path (CCFtap) [3] configuration with turn signal activation and robotic steering, a no-turn-signal configuration with robotic steering, and a manual-steering configuration with turn signal. Testing was conducted at speeds where injuries commonly occur.

This research was conducted in partnership with the Automobile Club of Southern California's Automotive Research Center.

Research Questions:

1. How do evaluated intersection AEB systems perform when a POV executes a right-hand turn into the path of the SV?
2. How do evaluated intersection AEB systems perform when the SV executes a left turn across the path of an oncoming POV under the Euro NCAP CCFtap configuration?
3. Is turn-across-path performance maintained when protocol-specific conditions are relaxed, including testing without turn signal activation and use of manual steering?
4. How do the results from 2026 model year vehicles equipped with intersection AEB compare with AAA's 2022 evaluation of vehicles with standard AEB systems that did not include intersection-specific functionality?

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Key Findings:

1. The turn-into-path scenario is a major capability gap: one vehicle avoided contact in all valid runs, while the other three vehicles impacted the POV in every valid run. Of the three vehicles that impacted the POV, one provided forward collision warning (FCW) in 4 of 5 valid runs and applied AEB in 1 of 5 runs, while the other two provided neither FCW nor AEB in any valid run.
2. Under the Euro NCAP CCFtap configuration, all four vehicles avoided the POV in every valid turn-across-path run.
3. Relaxed turn-across-path conditions exposed a vehicle-specific sensitivity: testing without turn signal activation eliminated one vehicle's response. Manual steering introduced path variability but did not change the avoidance outcome for any valid run.
4. Compared with AAA's 2022 evaluation, in which vehicles with standard AEB systems that did not include manufacturer-identified intersection AEB functionality provided no FCW alerts or braking intervention in the evaluated perpendicular-crossing and left-turn-across-path scenarios, the 2026 vehicles demonstrated effective performance in turn-across-path testing. However, performance remains inconsistent across crash geometries and manufacturers.

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GLOSSARY

Advanced Driver Assistance Systems (ADAS): A suite of vehicle technologies designed to automate, adapt, or enhance vehicle systems for safety and improved driving. Common features include automatic emergency braking, lane keeping assistance, and adaptive cruise control.

Automatic Emergency Braking (AEB): A safety system that detects an impending collision and automatically applies the brakes to prevent or mitigate the impact if the driver does not respond in time.

Intersection AEB: A subset of AEB that uses forward-facing sensors and trajectory prediction to detect a potential collision with crossing or oncoming traffic at an intersection and autonomously apply braking when an imminent impact is identified.

Car-to-Car Front Turn-Across-Path (CCFtap): A Euro NCAP intersection AEB test scenario in which the SV turns across the path of an oncoming vehicle.

European New Car Assessment Programme (Euro NCAP): A European consumer vehicle safety assessment program that publishes vehicle safety ratings and test protocols, including active-safety evaluations such as AEB car-to-car scenarios.

Closed-Course Environment: A test area closed to public traffic and used to evaluate vehicle systems under controlled, repeatable test conditions.

Forward Collision Warning (FCW): A system that alerts the driver if a frontal collision with a vehicle, pedestrian, or other object is imminent.

National Highway Traffic Safety Administration (NHTSA): The U.S. federal agency responsible for vehicle safety standards, crash data, and related roadway safety research and regulation.

Global Vehicle Target (GVT): A strikable soft target conforming to International Organization for Standardization (ISO) 19206-3:2021 that replicates the visual, radar, and LiDAR attributes of a typical M1 passenger vehicle.

Guided Soft Target (GST): A satellite-guided, self-propelled, low-profile robotic platform that carries the GVT and arrives at predefined locations relative to the SV in a repeatable manner.

Mitigation: A test outcome where the system reduces the speed of impact or the severity of a collision, even if the collision is not completely avoided.

Principal Other Vehicle (POV): The simulated vehicle (GVT atop the GST platform) used to create the collision scenario with the SV.

Run-Level Results: The outcome and recorded data from a single iteration of a test scenario (i.e., one SV run against the POV under defined conditions).

Subject Vehicle (SV): The instrumented test vehicle under evaluation.

Time-to-Collision (TTC): The calculated time remaining before a collision occurs, assuming constant speeds and trajectories for both vehicle and target.

T_{steer}: The moment steering input for the turn maneuver is initiated, used as the reference for turn signal activation timing.

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I. INTRODUCTION

Intersection-based crashes remain among the most common and most harmful two-vehicle collision configurations in the United States. An analysis of 2020–2024 National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) data conducted by the AAA Foundation for Traffic Safety at AAA's request found that angle crashes, including intersection-based configurations such as turn-across-path, turn-into-path, and T-bone crashes, accounted for approximately 41% of reported two-vehicle fatalities [1].

In 2022, AAA evaluated four vehicles with standard automatic emergency braking (AEB) systems that did not include manufacturer-identified intersection AEB functionality in two common intersection collision scenarios: a perpendicular (T-bone) crossing and a left-turn-across-path configuration. In those evaluated intersection scenarios, the tested vehicle configurations did not provide alerting or braking intervention in any of the 40 test runs, and every run resulted in a collision [2].

Since that time, vehicle manufacturers have increasingly introduced intersection AEB functionality designed to address intersection crash scenarios. Standardized AEB test procedures from NHTSA and the Insurance Institute for Highway Safety (IIHS) have historically focused primarily on rear-end crash scenarios, while the European New Car Assessment Programme (Euro NCAP) includes a limited set of intersection-based tests. Intersection-based crashes nonetheless represent a critical gap in system evaluation, particularly in the U.S. market.

To assess the current state of intersection AEB technology, AAA conducted primary research in a closed-course environment, evaluating four 2026 model year vehicles equipped with intersection AEB across four test scenarios. These included one turn-into-path scenario, in which a principal other vehicle (POV) executed a right-hand turn into the subject vehicle (SV) path, and three turn-across-path scenarios, in which the SV executed a left turn across the path of an oncoming POV. The turn-across-path scenarios included the Euro NCAP car-to-car front turn-across-path (CCFtap) configuration defined in Euro NCAP Test Protocol—AEB Car-to-Car Systems, Version 4.3.1, Section 8.2.3 [3] with turn signal activation and robotic steering, a no-turn-signal configuration, and a manual-steering configuration. Testing was conducted at speeds where injuries commonly occur.

The primary objectives of this research were to evaluate how current intersection AEB systems perform in selected intersection crash scenarios, determine whether performance differs between turn-into-path and turn-across-path configurations, assess whether turn-across-path performance depends on protocol-specific conditions such as turn signal activation or robotic steering, and contextualize the results against AAA's 2022 evaluation of vehicles not equipped with intersection-specific AEB. The following report presents the study methodology, detailed results, key findings, and recommendations.

II. BACKGROUND

Intersection AEB systems are a subset of advanced driver assistance systems (ADAS) intended to reduce the frequency and severity of vehicle-to-vehicle collisions at intersections. These systems employ forward-facing sensors, typically cameras and radar, together with trajectory prediction to identify crossing or oncoming vehicles on a collision course and automatically apply braking when a collision is imminent.

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AAA's 2022 evaluation examined four production vehicles with standard AEB systems that did not include manufacturer-identified intersection AEB functionality. The study evaluated performance in two common intersection crash scenarios: a 48.3 km/h (30-mph) perpendicular (T-bone) crossing configuration and a left-turn-across-path configuration in which the SV turned left at 16.1 km/h (10 mph) across the path of an oncoming target vehicle traveling at 40.2 km/h (25 mph). In those evaluated intersection scenarios, none of the tested vehicle configurations provided an alert or braking intervention in any intersection scenario test run. The report concluded that the evaluated vehicle configurations were ineffective at mitigating or preventing collisions in those specific intersection scenarios and recommended that automakers incorporate collision mitigation capability for those crash types.

Regulators and consumer safety organizations have also recognized the importance of intersection scenarios. NHTSA published a draft Intersection Safety Assist System Confirmation Test in September 2019 for discussion purposes [4], and Euro NCAP incorporated CCFtap scenarios into its AEB car-to-car test protocol beginning in 2020 [3]. The Euro NCAP CCFtap protocol specifies turn-signal activation and a defined turning path. AAA used a steering robot to reproduce that path and evaluated two additional configurations: robotic steering without turn-signal activation and manual steering with turn-signal activation.

Although these developments have advanced the field, gaps remain in understanding how production intersection AEB systems perform in the most common U.S. intersection crash configurations. The present research uses AAA's 2022 evaluation as context for assessing how newer model year vehicles equipped with intersection-specific AEB functionality perform, both under the standardized Euro NCAP configuration and under relaxed, more real-world-representative conditions.

III. VEHICLE SELECTION & PREPARATION

A. ADAS Requirements

Vehicles included in this study were required to be equipped with intersection AEB as standard equipment. Test vehicles were confirmed to be in good operating condition, free of diagnostic alerts, telltales, or other indications of malfunction at the time of testing. All forward collision warning (FCW) /AEB systems were evaluated using the middle sensitivity setting or the next-latest setting, as specified by the manufacturer.

B. Test Vehicle Selection Process

Test vehicles were selected based on 2026 model year intersection AEB technology fitment data from industry sources and verified with the manufacturer. Selection criteria limited the sample to one vehicle model per manufacturer and prioritized vehicles with significant market penetration. All selected vehicles were required to be standard production models available for retail sale in the United States.

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C. Test Vehicles

Model Year	Automaker	Model	Vehicle Identification Number (VIN)	Mileage at Testing	Tire Info	Test Vehicle Weight (lbs)	Intersection AEB Fitment
2026	Chevrolet	Equinox	3GNAXHEG3TL267085	15054	FIRESTONE 235/65/R17	3932	Standard
2026	Ford	Explorer	1FMUK7KH7TGB21820	4493	PIRELLI 275/45/R21	4955	Standard
2026	Hyundai	Tucson	5NMJB3DE1TH709742	3763	KUMHO 235/60/R18	4001	Standard
2026	Tesla	Model Y	7SAYGDED8TF452739	7139	CONTINENTAL 255/45/R19	4684	Standard

Table 1: Test vehicle information at time of testing.

Vehicle / Target	Length (m)	Width (m)
2026 Chevrolet Equinox	4.65	1.90
2026 Ford Explorer	5.05	2.00
2026 Hyundai Tucson	4.64	1.86
2026 Tesla Model Y	4.80	1.92
GST (target)	4.02	1.71

Table 2: Vehicle and target footprint dimensions used for the footprint-gap (minimum-separation) calculations.

Documentation for each vehicle (VIN, odometer, tire data, test weight, and vehicle dimensions) is summarized in the tables above; photographs, owner's manuals, and vehicle emission control information/door-jamb labels are retained in the technical support records.



Figure 1: Test vehicles evaluated in this study. Image source: AAA.

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D. Test Vehicle Preparation

Test vehicles were acquired, inspected, and confirmed to be in good operating condition with no check-engine lights or similar indications of malfunction. Prior to testing, each vehicle was serviced to include ADAS sensor calibration, a four-wheel alignment, a brake system inspection and fluid level check, and installation of the latest software/firmware updates. Researchers verified that no warning lights were illuminated, that all intersection AEB components were free of damage, that no active Technical Service Bulletins or recalls affected intersection AEB operation, and that tires were inflated to placard pressure.

Manufacturer-specified system initialization procedures, including any required calibration drives and key cycling after AEB activation, were documented and followed throughout testing. Daily test preparation included sensor cleaning, manufacturer-required initialization procedures, weather condition documentation, and configuration of FCW/AEB timing to the middle or next-latest setting.

IV. TEST EQUIPMENT AND RESOURCES

A. Data Acquisition Equipment

1) Oxford Technical Solutions (OxTS) RT3000 V3 with RT-Range Capabilities: Each vehicle was outfitted with an OxTS RT3000 V3 with built-in RT-Range functionality. This inertial navigation system was used to capture vehicle kinematic information, such as position and orientation, and to process vehicle-to-target measurements relative to the vehicle under test. The RT3000 units interfaced with a site-installed global positioning system base station to incorporate real-time kinematics technology. All measurements from the unit were captured at a rate of 100 Hz.

Position Accuracy	0.01 m
Velocity Accuracy	0.01 m/s
Roll & Pitch Accuracy	0.03°
Heading Accuracy	0.1°
Slip Angle Accuracy	0.15°
Output Data Rate	100 Hz

Table 3: OxTS RT3000 specifications.

Forward Range	0.03 m root mean square (RMS)
Lateral Range	0.03 m RMS
Resultant Range	0.03 m RMS
Forward Velocity	0.02 m/s RMS
Lateral Velocity	0.02 m/s RMS
Resultant Velocity	0.02 m/s RMS
Resultant Yaw Angle	0.1° RMS
Lateral Distance to Lane	0.02 m RMS

Table 4: OxTS RT-Range S Hunter specifications.

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2) Electret Microphone with MAX4466 Amplifier: An Electret microphone, paired with a MAX4466 amplifier, was strategically positioned within each test vehicle to capture the auditory FCW events during each test run. Audio signals were recorded at a sampling rate of 20,000 Hz.

Directivity	Omnidirectional
Operating Frequency	20 – 20,000 Hz
Sensitivity	−44 ±2 dB
Operating Voltage	3 – 5.5 V dc
Current Consumption	0.5 mA max.
Signal-to-Noise Ratio	60 dBA
Power-Supply Rejection Ratio	112 dB

Table 5: Electret Microphone with MAX4466 specifications.

The FCW was detected from the cabin microphone by band-pass filtering at each vehicle's distinct chime frequency:

Test Vehicle	FCW Chime Frequency (Hz)
2026 Chevrolet Equinox	2000
2026 Ford Explorer	1800
2026 Hyundai Tucson	1500
2026 Tesla Model Y	1100

Table 6: Per-vehicle FCW chime frequencies used for microphone band-pass detection.

3) Futek LAU220 Pedal Force Sensor: Each vehicle was equipped with a brake pedal force sensor to verify that no braking intervention was applied by the test driver during test runs. Brake pedal force was captured at a rate of 100 Hz.

Rated Output (RO)	2 mV/V
Nonlinearity	±0.25% of RO
Hysteresis	±0.25% of RO
Nonrepeatability	±0.10% of RO
Off-Center Loading	±1% or better

Table 7: Futek LAU220 specifications.

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4) DEWESoft CAM-120 Cameras with CAM-BOX2 Distribution Box: Test vehicles were equipped with two synchronized cameras: one facing the instrument cluster to capture visual FCW alerts, and one exterior forward-facing camera to document and verify impact between the vehicle and the target during test runs.

Image Sensor	Sony ICX618
Sensor Type	Charge-coupled device (CCD)
Frames per Second (FPS)	120 FPS @ 640×480 px
Dynamic Range	32 dB (autogain function)
Shutter Time	58 ns – 60 s (autoshutter function)

Table 8: DEWESoft CAM-120 specifications.

5) Data Logging Equipment: Test vehicles were equipped with a DEWESoft DEWE-43A data logger to capture OxTS vehicle kinematics and range data via its integrated controller area network interface, along with pedal force measurements and FCW audio signals. Kinematic and range data were recorded at 100 Hz and time-synchronized with the pedal force, FCW audio, and video data. The data logger was equipped with anti-aliasing filters to attenuate frequencies above the Nyquist frequency.

6) Steering Robot: For robotic steering scenarios, the SV was equipped with an Anthony Best Dynamics (ABD) SR15 Orbit steering robot programmed to execute the Euro NCAP CCFtap turn path, consisting of a clothoid (start radius = 1500 m, end radius = 11.75 m, angle $\alpha = 20.93°$), followed by a fixed-radius arc (constant radius = 11.75 m, angle $\beta = 48.14°$), followed by a second clothoid (start radius = 11.75 m, end radius = 1500 m, angle $\alpha = 20.93°$).



Figure 2: ABD SR15 Orbit steering robot installed in the SV.

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B. Test Target Equipment

1) Guided Soft Target (GST) Platform: A GST was used as the dynamic carrier for the vehicle target. The GST is a low-profile, self-propelled robotic platform designed to support repeatable active-safety test scenarios while allowing the SV to drive over the platform during impact runs. The platform was controlled using satellite-based positioning and closed-loop path-following to coordinate target motion with the SV. ABD TrackFi PowerMesh was used for vehicle-to-target communication and synchronization. GST position and motion data were received by the OxTS RT3000 system and used to calculate the target kinematics relative to the SV.

2) Global Vehicle Target (GVT): The GVT was the Soft Car 360, a lightweight, durable, collapsible whole-vehicle target from Dynamic Research, Inc. (DRI) used with the GST platform. DRI describes the Soft Car 360 as separating into lightweight parts during impact to minimize the risk of damage to the SV. The hatchback version of the Soft Car 360 is Euro NCAP approved and conforms to ISO 19206-3:2021, which defines requirements for passenger vehicle surrogate targets used in active-safety testing [5]. The target is intended to provide representative vehicle characteristics for ADAS sensor detection, including visual, radar, and LiDAR-relevant attributes.



Figure 3: Global vehicle target (GVT) used in testing. Image Source: DRI

C. Test Facility

All closed-course testing was conducted on roadways specifically designed for standardized ADAS testing on the grounds of Minter Field Airport in Shafter, California.

Intersection-based test scenarios were conducted at an intersection specifically designed for ADAS evaluation, consisting of two 2-lane roadways with 12-foot (3.66 m) nominal lane widths and standard lane markings, intersecting at 90 degrees. There were no obstructions present that could impede visibility of vehicles approaching the intersection.

All test scenarios were conducted on dry asphalt free of visible moisture, with a consistent slope between level and 1 percent and a peak friction coefficient of at least 1.02. The surface was free of debris, potholes, and other irregularities that could cause significant variations in the trajectory of the test vehicles or target. All testing was performed during daylight in temperatures between 0°C and 40°C, with wind speeds at or below 10 m/s and no precipitation.

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Figure 4: Test track used for intersection-based scenario evaluation. Image Source: DRI

D. Test Scenarios

Four scenarios were evaluated across the two inquiries:

Scenario	Description
POV right turn into SV path	The POV turns right at 8 km/h (5 mph) into the path of the SV traveling straight at 48.3 km/h (30 mph).
Euro NCAP CCFtap	The SV turns left at 15 km/h (9.3 mph) across the path of an oncoming POV traveling at 30 km/h (18.6 mph), with the turn signal activated and robotic steering.
CCFtap without turn signal	The SV and POV follow the same speeds and paths as the Euro NCAP CCFtap scenario, with robotic steering but no turn signal activation.
CCFtap with manual steering	The SV and POV follow the same speeds and paths as the Euro NCAP CCFtap scenario, with the turn signal activated and manual steering.

Table 9: Test scenarios.

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V. INQUIRY #1: HOW DO EVALUATED INTERSECTION AEB SYSTEMS PERFORM WHEN A POV EXECUTES A RIGHT-HAND TURN INTO THE PATH OF THE SV?

A. Objective

To evaluate the ability of intersection AEB systems to detect and respond to a POV turning right into the SV's travel lane from a perpendicular lane.

B. Methodology

Each test vehicle was evaluated on a closed course under controlled daytime conditions. The SV traveled straight through the intersection at a constant speed of 48.3 km/h (30 mph) while the POV approached the intersection perpendicularly to the SV path and executed a right-hand turn into the path of the approaching SV at 8 km/h (5 mph). The choreography was timed such that, absent system intervention, the SV front right corner would contact the POV left rear corner.

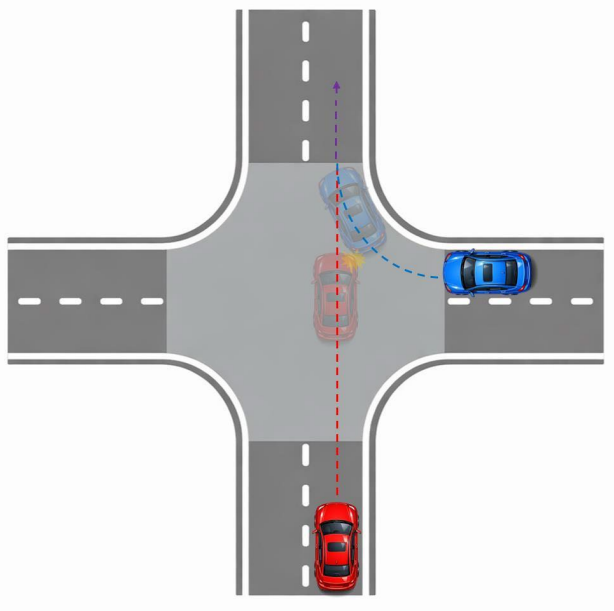


Figure 5: Test choreography—POV (blue) right-hand turn into the SV (red) path (turn-into-path scenario).

The test validity period began at time-to-collision (TTC) = 4 seconds. Test tolerances were established as follows:

- SV speed: ±1.0 km/h of the nominal test speed
- SV travel path lateral deviation: ±0.1 m (straight-line)
- SV yaw rate: ±1.0 degree per second
- POV longitudinal distance tolerance: ±0.10 m
- POV travel path lateral deviation: ±0.1 m
- POV speed: ±1.0 km/h of the nominal speed

Any test run in which the SV or POV deviated outside of these tolerances within the test validity period was deemed invalid and repeated. During each run, the driver maintained steady throttle application until

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AEB was activated. The accelerator pedal was then released to simulate a typical driver reaction, with no further braking or steering intervention provided. A target of five valid runs was conducted for each test vehicle. However, if a vehicle failed to provide any FCW or AEB response in the first three valid runs, testing for that vehicle was stopped to reduce the risk of damage to the SV, GST platform, or GVT. Metrics recorded included FCW occurrence and timing, AEB occurrence and timing, impact occurrence and relative impact speed, minimum separation distance, peak deceleration, and run-validity parameters including vehicle speed, path position, yaw rate, target position, target speed, and driver brake-pedal input.

C. Test Results

Results are presented by vehicle for the POV right-hand-turn-into-path scenario. Each table reports run-level FCW, AEB, impact, minimum separation, and peak deceleration outcomes. Impact speed is the magnitude of the difference between the SV and POV velocity vectors as contact.

1) Chevrolet Equinox:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	No	—	—	No	—	—	Yes	40.5	0.00	0.03
Run 2	Yes	18.72	1.60	No	—	—	Yes	40.9	0.00	0.01
Run 3	Yes	3.50	0.33	No	—	—	Yes	40.5	0.00	0.01
Run 4	Yes	20.01	1.70	Yes	2.77	0.26	Yes	36.1	0.00	0.62
Run 5	Yes	16.75	1.45	No	—	—	Yes	40.5	0.00	0.02

Table 10: 2026 Chevrolet Equinox run-level results—POV right-hand turn into SV path.

The 2026 Chevrolet Equinox issued an FCW in four of five valid runs (mean FCW TTC = 1.27 s) and applied AEB in one of five runs (mean AEB TTC = 0.26 s). The system did not prevent contact: the SV struck the POV in all five runs at a mean impact speed of 39.7 km/h.

2) Ford Explorer:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	No	—	—	No	—	—	Yes	39.9	0.00	0.01
Run 2	No	—	—	No	—	—	Yes	40.5	0.00	0.01
Run 3	No	—	—	No	—	—	Yes	40.4	0.00	0.01

Table 11: 2026 Ford Explorer run-level results—POV right-hand turn into SV path.

The 2026 Ford Explorer did not issue an FCW in any of the three valid runs and applied no AEB. The system did not prevent contact: the SV struck the POV in all three runs at a mean impact speed of 40.3 km/h.

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3) Hyundai Tucson:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied ?	Distance (m)	TTC (s)	Impact ?	Speed (km/h)		
Run 1	No	—	—	No	—	—	Yes	40.7	0.00	0.02
Run 2	No	—	—	No	—	—	Yes	40.5	0.00	0.01
Run 3	No	—	—	No	—	—	Yes	40.1	0.00	0.02

Table 12: 2026 Hyundai Tucson run-level results—POV right-hand turn into SV path.

The 2026 Hyundai Tucson did not issue an FCW in any of the three valid runs and applied no AEB. The system did not prevent contact: the SV struck the POV in all three runs at a mean impact speed of 40.4 km/h.

4) Tesla Model Y:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied ?	Distance (m)	TTC (s)	Impact ?	Speed (km/h)		
Run 1	Yes	19.86	1.68	Yes	9.88	0.91	No	—	1.85	0.99
Run 2	Yes	21.14	1.82	Yes	8.90	0.83	No	—	1.29	0.96
Run 3	Yes	19.97	1.70	Yes	9.52	0.87	No	—	1.53	0.98
Run 4	Yes	20.28	1.73	Yes	9.37	0.85	No	—	1.72	1.02
Run 5	Yes	19.58	1.67	Yes	9.26	0.85	No	—	1.63	0.99

Table 13: 2026 Tesla Model Y run-level results—POV right-hand turn into SV path.

The 2026 Tesla Model Y issued an FCW in all five valid runs (mean FCW TTC = 1.72 s) and applied AEB in all five runs (mean AEB TTC = 0.86 s, mean peak deceleration 0.99 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 1.60 m.

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VI. INQUIRY #2: HOW DO EVALUATED INTERSECTION AEB SYSTEMS PERFORM WHEN THE SV EXECUTES A LEFT TURN ACROSS THE PATH OF AN ONCOMING POV?

A. Objective

To evaluate the ability of intersection AEB systems to detect and respond to an imminent collision while the SV executes a left turn across the path of an oncoming POV, and to determine whether system performance is maintained when turn-signal use and steering method are varied to better represent real-world driving.

B. Methodology

Each test vehicle was evaluated on a closed course under controlled daytime conditions using the Euro NCAP CCFtap configuration [3]. The SV executed a left turn across the path of the oncoming POV at a turning speed of 15 km/h, following the prescribed clothoid-to-fixed-radius-to-clothoid path. The POV followed a straight-line path at 30 km/h in the lane adjacent to the SV's initial position, traveling in the opposite direction. SV and POV straight-line paths were positioned 1.75 m from the center of the dashed lane marking. The choreography was timed such that, absent system intervention, the SV front center would contact the POV front left corner.

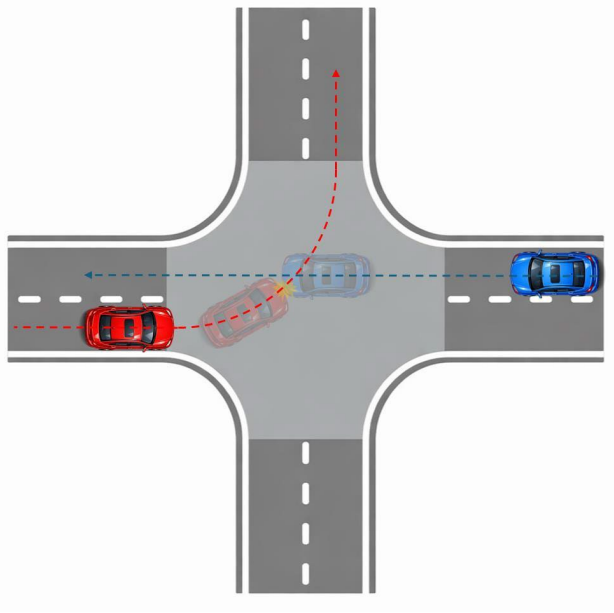


Figure 6: Test choreography—SV (red) turn across the POV (blue) path (turn-across-path scenarios).

Three scenario configurations were evaluated. The baseline configuration used robotic steering to follow the Euro NCAP CCFtap path with the specified turn-signal timing. The other configurations omitted turn-signal activation or used manual steering. The three scenarios are as follows:

1) With turn signal, steering robot (per Euro NCAP CCFtap): turn signal activated 1±0.5 second before T_{steer}; turn executed by the steering robot.
2) Without turn signal, steering robot: identical paths with the turn signal remaining off, assessing whether driver intent communication affects system response.

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3) With turn signal, manual steering: identical paths and signal timing with the turn executed manually by the test driver instead of the steering robot, capturing the steering variability present in real-world driving; lateral path and yaw criteria were documented but not scored for validity.

The test validity period began at TTC = 4 seconds. Test tolerances were established as follows:

- SV speed: ±1.0 km/h of the nominal test speed
- SV travel path lateral deviation: ±0.1 m for robotic-steering runs
- SV yaw rate: ±1.0 degree per second until T_{steer} for robotic-steering runs
- POV longitudinal distance tolerance: ±0.10 m
- POV travel path lateral deviation: ±0.1 m
- POV speed: ±1.0 km/h of the nominal speed
- Driver brake pedal force: ≤2.5 lb

For the manual-steering configuration, SV lateral path deviation and yaw rate criteria were not scored. This configuration was intentionally evaluated with relaxed path-control requirements to represent the potential variability of real-world turning behavior, where driver steering inputs and vehicle path position vary from run to run. Any test run in which the SV or POV deviated outside the applicable scored tolerances within the test validity period was deemed invalid and repeated, except where specifically noted as a marginal protocol deviation.

A total of 74 runs are reported as valid. Two Chevrolet Equinox turn-across-path runs with turn signal and steering robot were later found to be slightly above the SV speed tolerance and are reported as valid with marginal protocol deviations. These runs were retained because the deviations were minor and the FCW, AEB, and avoidance responses were consistent with the other runs in the same vehicle/configuration.

A target of five valid runs was conducted for each vehicle and scenario configuration. However, if a vehicle failed to provide any FCW or AEB response in the first three valid runs, testing for that vehicle/configuration was stopped after three valid runs to reduce the risk of damage to the SV, GST platform, or GVT. Metrics recorded included FCW occurrence and timing, AEB occurrence and timing, impact occurrence and relative impact speed, minimum separation distance, peak deceleration, and run-validity parameters including vehicle speed, path position, yaw rate, target position, target speed, and driver brake-pedal input.

C. Test Results

Results are presented by vehicle for each of the three turn-across-path configurations: with turn signal and steering robot, without turn signal and steering robot, and with turn signal and manual steering. Each table reports run-level FCW, AEB, impact, minimum separation, and peak deceleration outcomes.

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1) Chevrolet Equinox:

a) With Turn Signal + Steering Robot:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	10.28	0.88	Yes	11.28	0.94	No	—	0.69	1.00
Run 2	Yes	10.55	0.96	Yes	10.47	0.95	No	—	0.81	1.00
Run 3	Yes	13.91	1.17	Yes	11.62	1.00	No	—	0.82	1.09
Run 4	Yes	14.20	1.13	Yes	12.42	1.02	No	—	0.91	0.98
Run 5	Yes	14.21	1.17	Yes	11.95	1.00	No	—	0.85	0.98

Table 14: 2026 Chevrolet Equinox run-level results—SV turn across path, signal + steering robot (Euro NCAP CCFtap).

The 2026 Chevrolet Equinox issued an FCW in all five valid runs (mean FCW TTC = 1.06 s) and applied AEB in all five runs (mean AEB TTC = 0.98 s, mean peak deceleration 1.01 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.82 m. Two of these runs carried marginal protocol deviations because SV speed was slightly above the specified tolerance; both were retained as valid, as described in the methodology.

b) Without Turn Signal + Steering Robot:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	13.85	1.14	Yes	10.99	0.94	No	—	0.83	0.98
Run 2	Yes	13.79	1.16	Yes	12.44	1.07	No	—	0.87	1.04
Run 3	Yes	11.17	0.93	Yes	10.97	0.92	No	—	0.71	0.93
Run 4	Yes	12.47	1.08	Yes	12.10	1.06	No	—	0.87	0.95
Run 5	Yes	14.81	1.19	Yes	11.66	0.96	No	—	0.76	0.94

Table 15: 2026 Chevrolet Equinox run-level results—SV turn across path, no signal + steering robot.

The 2026 Chevrolet Equinox issued an FCW in all five valid runs (mean FCW TTC = 1.10 s) and applied AEB in all five runs (mean AEB TTC = 0.99 s, mean peak deceleration 0.97 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.81 m.

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c) With Turn Signal + Manual Steering:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	19.16	1.53	Yes	14.14	1.14	No	—	0.22	1.01
Run 2	Yes	19.86	1.57	Yes	13.74	1.11	No	—	0.57	1.05
Run 3	Yes	13.68	1.10	Yes	13.26	1.07	No	—	0.54	1.07
Run 4	Yes	16.35	1.39	Yes	13.32	1.16	No	—	0.73	1.00
Run 5	Yes	17.51	1.45	Yes	13.22	1.12	No	—	0.54	0.97

Table 16: 2026 Chevrolet Equinox run-level results—SV turn across path, signal + manual steering.

The 2026 Chevrolet Equinox issued an FCW in all five valid runs (mean FCW TTC = 1.41 s) and applied AEB in all five runs (mean AEB TTC = 1.12 s, mean peak deceleration 1.02 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.52 m.

2) Ford Explorer:

a) With Turn Signal + Steering Robot:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	12.48	1.10	Yes	13.75	1.17	No	—	0.67	1.08
Run 2	Yes	13.75	1.16	Yes	12.52	1.08	No	—	0.75	1.00
Run 3	Yes	13.97	1.17	Yes	12.69	1.08	No	—	0.80	1.04
Run 4	Yes	13.87	1.14	Yes	12.46	1.04	No	—	0.79	0.99
Run 5	Yes	13.93	1.15	Yes	12.00	1.01	No	—	0.77	1.00

Table 17: 2026 Ford Explorer run-level results—SV turn across path, signal + steering robot (Euro NCAP CCFtap).

The 2026 Ford Explorer issued an FCW in all five valid runs (mean FCW TTC = 1.14 s) and applied AEB in all five runs (mean AEB TTC = 1.08 s, mean peak deceleration 1.02 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.76 m.

b) Without Turn Signal + Steering Robot:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	14.20	1.19	Yes	12.81	1.09	No	—	0.73	0.97
Run 2	Yes	14.92	1.23	Yes	13.76	1.15	No	—	0.82	1.03
Run 3	Yes	14.63	1.20	Yes	13.88	1.14	No	—	0.84	1.05
Run 4	Yes	14.90	1.25	Yes	13.81	1.17	No	—	0.86	0.99
Run 5	Yes	14.48	1.19	Yes	13.14	1.10	No	—	0.79	1.00

Table 18: 2026 Ford Explorer run-level results—SV turn across path, no signal + steering robot.

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The 2026 Ford Explorer issued an FCW in all five valid runs (mean FCW TTC = 1.21 s) and applied AEB in all five runs (mean AEB TTC = 1.13 s, mean peak deceleration 1.01 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.81 m.

c) With Turn Signal + Manual Steering:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	14.99	1.29	Yes	14.71	1.27	No	—	0.86	1.05
Run 2	Yes	14.26	1.18	Yes	11.50	0.97	No	—	0.38	1.08
Run 3	Yes	13.79	1.14	Yes	12.73	1.06	No	—	0.55	1.04
Run 4	Yes	14.25	1.21	Yes	11.37	0.98	No	—	0.72	1.04
Run 5	Yes	15.33	1.27	Yes	12.19	1.03	No	—	0.60	1.03

Table 19: 2026 Ford Explorer run-level results—SV turn across path, signal + manual steering.

The 2026 Ford Explorer issued an FCW in all five valid runs (mean FCW TTC = 1.22 s) and applied AEB in all five runs (mean AEB TTC = 1.06 s, mean peak deceleration 1.05 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.62 m.

3) Hyundai Tucson:

a) With Turn Signal + Steering Robot:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	11.09	0.89	Yes	9.20	0.75	No	—	0.53	1.01
Run 2	Yes	10.18	0.85	Yes	9.20	0.77	No	—	0.50	1.00
Run 3	Yes	10.70	0.89	Yes	9.50	0.80	No	—	0.47	0.99
Run 4	Yes	9.94	0.80	Yes	8.42	0.69	No	—	0.40	0.98
Run 5	Yes	11.74	0.96	Yes	10.64	0.88	No	—	0.62	0.99

Table 20: 2026 Hyundai Tucson run-level results—SV turn across path, signal + steering robot (Euro NCAP CCFtap).

The 2026 Hyundai Tucson issued an FCW in all five valid runs (mean FCW TTC = 0.88 s) and applied AEB in all five runs (mean AEB TTC = 0.78 s, mean peak deceleration 0.99 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.50 m.

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b) Without Turn Signal + Steering Robot:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	No	—	—	No	—	—	Yes	45.8	0.00	0.03
Run 2	No	—	—	No	—	—	Yes	44.6	0.00	0.03
Run 3	No	—	—	No	—	—	Yes	44.8	0.00	0.04

Table 21: 2026 Hyundai Tucson run-level results—SV turn across path, no signal + steering robot.

The 2026 Hyundai Tucson did not issue an FCW in any of the three valid runs and applied no AEB. Testing was stopped after three valid runs because no FCW or AEB response was observed. The system did not prevent contact: the SV struck the POV in all three runs at a mean impact speed of 45.1 km/h.

c) With Turn Signal + Manual Steering:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	10.41	0.83	Yes	9.17	0.75	No	—	0.28	1.04
Run 2	Yes	10.08	0.86	Yes	8.87	0.77	No	—	0.71	1.00
Run 3	Yes	7.75	0.64	Yes	6.53	0.55	No	—	0.49	1.03
Run 4	Yes	5.35	0.47	Yes	3.75	0.34	No	—	0.26	1.07
Run 5	Yes	10.66	0.91	Yes	8.26	0.72	No	—	0.54	1.01

Table 22: 2026 Hyundai Tucson run-level results—SV turn across path, signal + manual steering.

The 2026 Hyundai Tucson issued an FCW in all five valid runs (mean FCW TTC = 0.74 s) and applied AEB in all five runs (mean AEB TTC = 0.63 s, mean peak deceleration 1.03 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.46 m.

4) Tesla Model Y:

a) With Turn Signal + Steering Robot:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	16.91	1.34	Yes	13.67	1.11	No	—	0.86	0.94
Run 2	Yes	16.31	1.35	Yes	13.62	1.15	No	—	0.61	0.97
Run 3	Yes	15.60	1.29	Yes	12.71	1.09	No	—	0.77	0.91
Run 4	Yes	15.98	1.30	Yes	11.67	0.97	No	—	0.62	0.95
Run 5	Yes	16.08	1.32	Yes	13.12	1.09	No	—	0.62	0.94

Table 23: 2026 Tesla Model Y run-level results—SV turn across path, signal + steering robot (Euro NCAP CCFtap).

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The 2026 Tesla Model Y issued an FCW in all five valid runs (mean FCW TTC = 1.32 s) and applied AEB in all five runs (mean AEB TTC = 1.08 s, mean peak deceleration 0.94 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.70 m.

b) Without Turn Signal + Steering Robot:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	15.50	1.26	Yes	11.51	0.97	No	—	0.67	0.92
Run 2	Yes	16.87	1.40	Yes	10.67	0.92	No	—	0.58	0.95
Run 3	Yes	16.71	1.37	Yes	10.06	0.85	No	—	0.46	0.95
Run 4	Yes	14.72	1.19	Yes	13.42	1.10	No	—	0.82	0.91
Run 5	Yes	15.46	1.26	Yes	13.97	1.15	No	—	0.77	0.93

Table 24: 2026 Tesla Model Y run-level results—SV turn across path, no signal + steering robot.

The 2026 Tesla Model Y issued an FCW in all five valid runs (mean FCW TTC = 1.30 s) and applied AEB in all five runs (mean AEB TTC = 1.00 s, mean peak deceleration 0.93 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.66 m.

c) With Turn Signal + Manual Steering:

Run No.	FCW			AEB			Impact		Min Dist (m)	Peak Decel (g)
	Alert?	Distance (m)	TTC (s)	Applied?	Distance (m)	TTC (s)	Impact?	Speed (km/h)		
Run 1	Yes	16.23	1.35	Yes	12.90	1.10	No	—	0.90	0.93
Run 2	Yes	19.35	1.58	Yes	16.41	1.36	No	—	0.86	0.98
Run 3	Yes	14.36	1.17	Yes	13.07	1.08	No	—	0.91	0.91
Run 4	Yes	13.42	1.14	Yes	12.94	1.11	No	—	1.06	0.95
Run 5	Yes	17.47	1.44	Yes	13.90	1.16	No	—	0.82	0.97

Table 25: 2026 Tesla Model Y run-level results—SV turn across path, signal + manual steering.

The 2026 Tesla Model Y issued an FCW in all five valid runs (mean FCW TTC = 1.34 s) and applied AEB in all five runs (mean AEB TTC = 1.16 s, mean peak deceleration 0.95 g). Contact with the POV was avoided in all five runs, with a mean minimum separation of 0.91 m.

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VII. DISCUSSION

A. How do Evaluated Intersection AEB Systems Perform when a POV Executes a Right-Hand Turn into the Path of the SV?

The turn-into-path scenario was the most challenging scenario evaluated. Across 16 valid runs, contact was avoided in only five runs, all by the Tesla Model Y. The Model Y issued an FCW and applied AEB in all five valid runs, avoiding the POV each time with a mean minimum separation of 1.60 m. The Chevrolet Equinox issued an FCW in four of five valid runs and applied AEB in one of five, but struck the POV in every run. The Ford Explorer and Hyundai Tucson provided no FCW or AEB response in the three valid runs conducted for each vehicle, and both struck the POV in every run. Mean impact speeds for non-avoided runs were 39.7 km/h for the Equinox, 40.3 km/h for the Explorer, and 40.4 km/h for the Tucson.

These results indicate that detecting and responding to a vehicle turning into the SV path from a perpendicular roadway is a significant capability gap for three of the four evaluated systems. The results also show that intersection AEB performance should not be assumed to generalize across intersection crash geometries, even among vehicles equipped with intersection AEB functionality.

Table 26 and Figure 7 summarize the POV right-hand-turn-into-path results by vehicle, including FCW occurrence, AEB application, impact avoidance, and average response distances.

Test Vehicle	Provided FCW	Applied AEB	Avoided POV
Chevrolet Equinox	4/5	1/5	0/5
Ford Explorer	0/3	0/3	0/3
Hyundai Tucson	0/3	0/3	0/3
Tesla Model Y	5/5	5/5	5/5

Table 26: POV right-hand turn into SV path—frequency of occurrences.

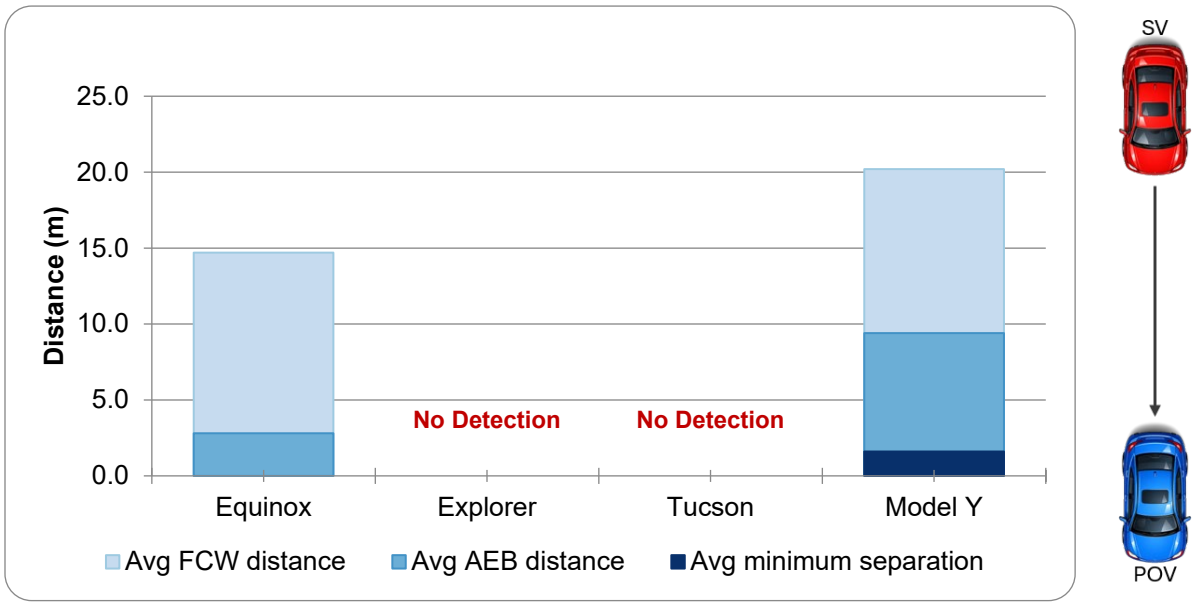


Figure 7: POV turn into SV path—average response distances by vehicle.

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B. How do Evaluated Intersection AEB Systems Perform when the SV Executes a Left Turn Across the Path of an Oncoming POV, and is Performance Maintained when Turn-Signal Use and Steering Method are Varied?

Turn-across-path performance was substantially stronger than turn-into-path performance under the full Euro NCAP CCFtap configuration. With turn signal activation and robotic steering, all four vehicles provided FCW, applied AEB, and avoided contact in every valid run. This indicates that the evaluated systems were generally effective in the standardized left-turn-across-path configuration.

Table 27 and Figure 8 summarize FCW occurrence, AEB application, impact avoidance, and average response distances for the turn-signal/steering-robot configuration.

Test Vehicle	Provided FCW	Applied AEB	Avoided POV
Chevrolet Equinox	5/5	5/5	5/5
Ford Explorer	5/5	5/5	5/5
Hyundai Tucson	5/5	5/5	5/5
Tesla Model Y	5/5	5/5	5/5

Table 27: SV turn across path, signal + steering robot (Euro NCAP CCFtap)—frequency of occurrences.

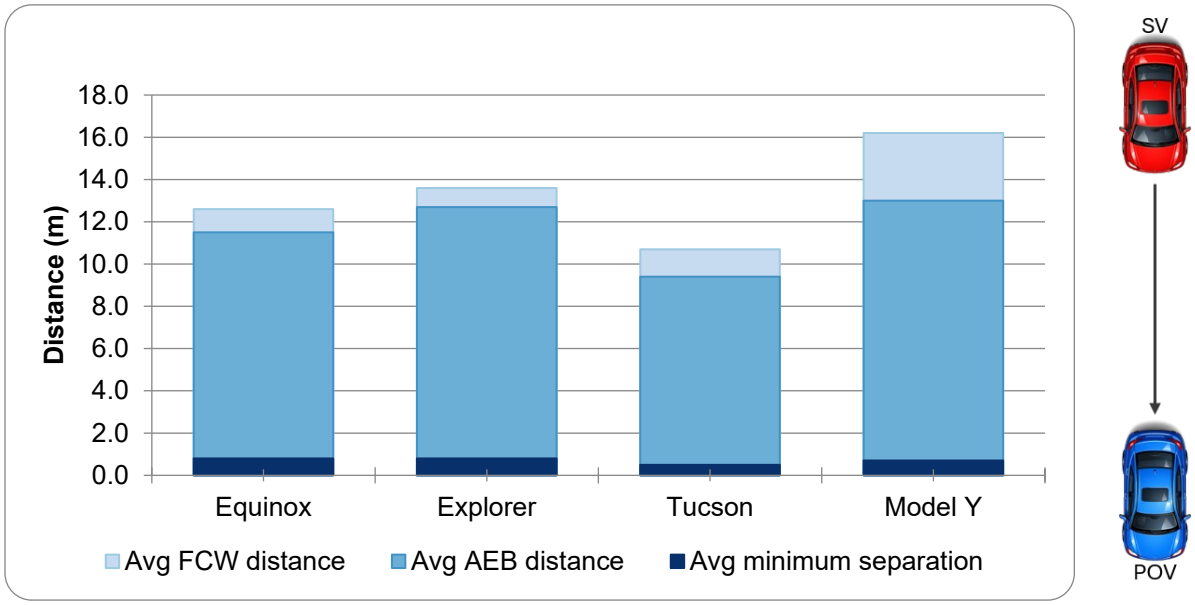


Figure 8: Turn across path, signal + steering robot—average response distances by vehicle.

Testing without turn signal activation exposed a clear vehicle-specific sensitivity. The Chevrolet Equinox, Ford Explorer, and Tesla Model Y continued to provide an FCW, apply AEB, and avoid contact in all valid no-signal runs. The Hyundai Tucson, however, did not provide an FCW or apply AEB in any of the three valid no-signal runs and struck the POV in each run. Because the Tucson avoided contact in all five valid runs when the turn signal was active, the no-signal results suggest that turn signal activation may be a required input or confirmation cue for that system's intersection AEB logic.

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Table 28 and Figure 9 summarize FCW occurrence, AEB application, impact avoidance, and average response distances for the no-turn-signal/steering-robot configuration.

Test Vehicle	Provided FCW	Applied AEB	Avoided POV
Chevrolet Equinox	5/5	5/5	5/5
Ford Explorer	5/5	5/5	5/5
Hyundai Tucson	0/3	0/3	0/3
Tesla Model Y	5/5	5/5	5/5

Table 28: SV turn across path, no signal + steering robot—frequency of occurrences.

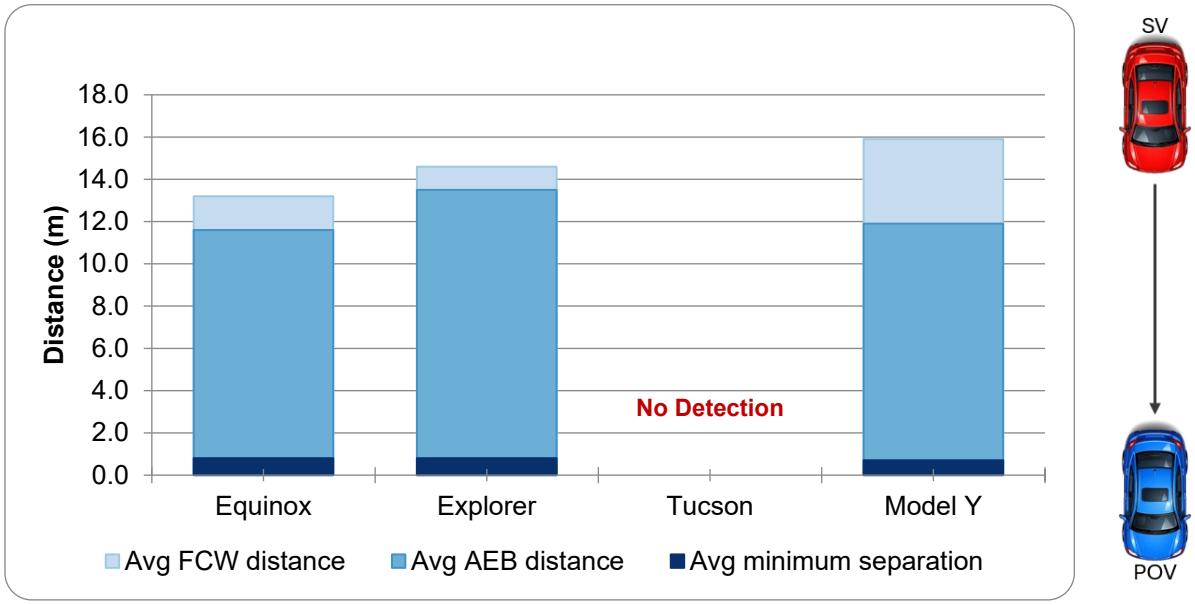


Figure 9: Turn across path, no signal + steering robot—average response distances by vehicle.

Manual steering introduced greater run-to-run path variability, as intended, but did not change the valid-run avoidance outcome. With turn signal activation and manual steering, all four vehicles provided FCW, applied AEB, and avoided contact in every valid run. These results suggest that the evaluated systems were generally robust to realistic steering variation in the tested turn-across-path configuration, while also showing that at least one system may depend on driver intent cues embedded in the standardized protocol.

Table 29 and Figure 10 summarize FCW occurrence, AEB application, impact avoidance, and average response distances for the turn-signal/manual-steering configuration.

Test Vehicle	Provided FCW	Applied AEB	Avoided POV
Chevrolet Equinox	5/5	5/5	5/5
Ford Explorer	5/5	5/5	5/5
Hyundai Tucson	5/5	5/5	5/5
Tesla Model Y	5/5	5/5	5/5

Table 29: SV turn across path, signal + manual steering—frequency of occurrences.

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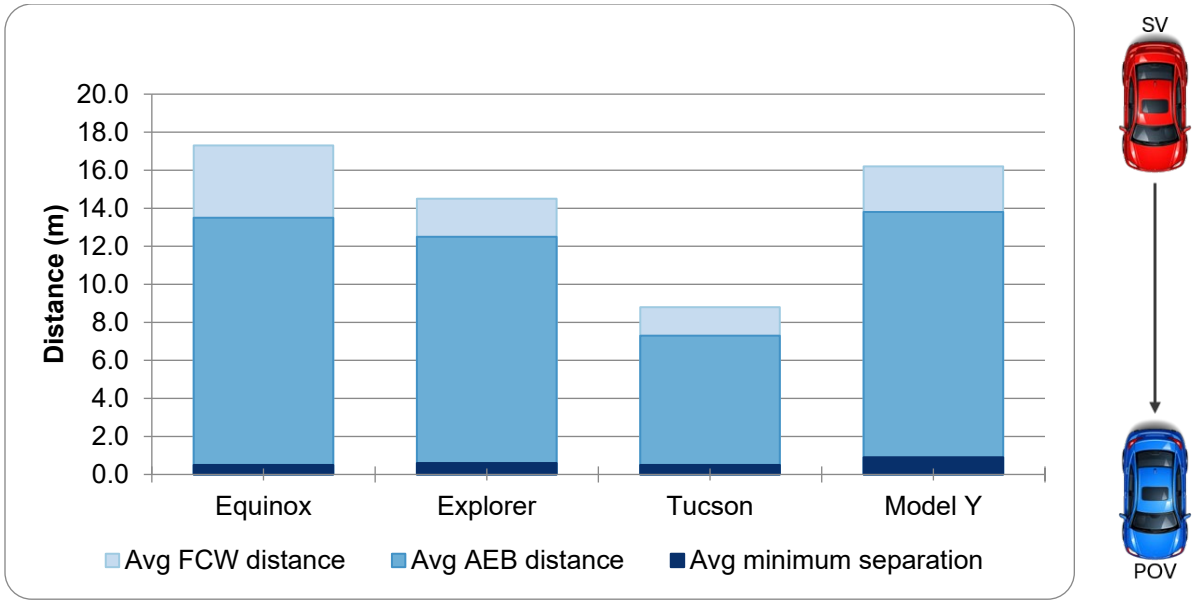


Figure 10: Turn across path, signal + manual steering—average response distances by vehicle.

C. How Does Performance Compare to AAA's 2022 Evaluation?

AAA's 2022 evaluation examined four production vehicles whose standard AEB systems did not include manufacturer-identified intersection AEB functionality. The study evaluated performance in two common intersection crash scenarios: a 48.3-km/h (30-mph) perpendicular (T-bone) crossing configuration and a left-turn-across-path configuration in which the SV turned left at 16.1 km/h (10 mph) across the path of an oncoming target vehicle traveling at 40.2 km/h (25 mph). In those evaluated intersection scenarios, none of the tested vehicle configurations provided an FCW or AEB intervention, and every test run resulted in a collision.

In contrast, all vehicles evaluated in the present study were equipped with intersection AEB as standard equipment and were specifically selected based on the presence of manufacturer-identified intersection AEB functionality. Under the Euro NCAP CCFtap configuration, all four vehicles provided an FCW, applied AEB, and avoided contact in every valid run. Performance was also maintained by most vehicles when tested without turn signal activation and under manual steering conditions. The Hyundai Tucson was the only evaluated vehicle that failed to respond in one of the modified turn-across-path configurations, providing no FCW or AEB response and striking the POV in all three valid runs conducted without turn signal activation.

Because the 2022 and 2026 evaluations used different vehicle selection criteria, scenario configurations, and test speeds, the comparison should be interpreted as context regarding the performance of production vehicle systems available at different points in time rather than a direct head-to-head comparison of a single technology. The 2022 evaluation examined vehicles whose standard AEB systems did not include intersection AEB functionality, whereas all vehicles evaluated in the present study were equipped with intersection AEB as standard equipment. Additionally, the 2022 evaluation used a 48.3-km/h (30-mph) perpendicular crossing scenario and a 16.1/40.2 km/h (10/25 mph) left-turn-across-path scenario, while the present study used the Euro NCAP CCFtap configuration at 15/30 km/h (9.3/18.6 mph) and a POV turn-into-path scenario at 48.3/8 km/h (30/5 mph).

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VIII. KEY FINDINGS

1. The turn-into-path scenario is a major capability gap. One vehicle avoided contact in all valid runs (five of five), while the other three vehicles struck the POV in every valid run. Of the three vehicles that struck the POV, one provided an FCW in four of five valid runs and applied AEB in one of five runs, while the other two provided no FCW or AEB response in the three valid runs conducted for each vehicle.
2. Under the Euro NCAP CCFtap configuration, turn-across-path performance was uniformly successful. All four vehicles avoided the POV in every valid run (20 of 20).
3. Relaxed turn-across-path conditions exposed vehicle-specific sensitivity to turn signal activation. When tested without turn signal activation, one vehicle provided no FCW or AEB response and struck the POV in all three valid runs, compared with full avoidance in all five valid runs with turn signal activation. Manual steering introduced path variability, but all vehicles provided an FCW, applied AEB, and avoided the POV in every valid manual-steering run.
4. Compared with AAA's 2022 evaluation, which examined vehicles whose standard AEB systems did not include manufacturer-identified intersection AEB functionality, the present study demonstrates the performance of production vehicles equipped with intersection AEB systems in common intersection crash scenarios. While all evaluated vehicles successfully avoided collisions under the Euro NCAP CCFtap configuration, performance remains inconsistent across crash geometries and manufacturers, with turn-into-path capability still limited.

IX. RECOMMENDATIONS

Manufacturers are encouraged to continue developing and refining intersection AEB systems with the objective of consistent collision avoidance or mitigation in turn-across-path and turn-into-path scenarios, which together account for a substantial share of two-vehicle injuries and fatalities. System robustness should not depend on protocol-specific conditions such as turn signal activation or idealized steering inputs, and systems should be designed to respond consistently across a variety of real-world intersection crash geometries.

Regulators and standards organizations are encouraged to incorporate a broader range of intersection-based scenarios, including turn-into-path configurations, into vehicle evaluation protocols at speeds where injuries and fatalities commonly occur. Expanding protocol coverage beyond idealized or single-geometry test cases would provide a more complete assessment of intersection AEB capability and system robustness.

For the driving public, it remains essential to understand the current limitations of intersection AEB technologies. While these systems can provide additional layers of safety, they are not a substitute for attentive driving. Drivers should always remain vigilant when approaching and traversing intersections, and relying on vehicle automation for intersection collision avoidance is not advised.

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X. REFERENCES

[1] National Highway Traffic Safety Administration, “Fatality Analysis Reporting System (FARS), 2020–2024 Annual Data Files,” U.S. Department of Transportation. Accessed July 2026.

[2] American Automobile Association, “Evaluation of Automatic Emergency Braking Systems,” September 2022. [Online]. Available: https://newsroom.aaa.com/wp-content/uploads/2022/09/Research-Report-2022-AEB-Evaluation-FINAL-9-26-22.pdf. [Accessed: 29 June 2026].

[3] Euro NCAP, “Test Protocol – AEB Car-to-Car Systems,” Version 4.3.1, February 2024. [Online]. Available: https://cdn.euroncap.com/cars/assets/euro_ncap_aeb_c2c_test_protocol_v431_532926aad1.pdf. [Accessed: 29 June 2026].

[4] National Highway Traffic Safety Administration, “Intersection Safety Assist System Confirmation Test,” Working Draft, September 2019. [Online]. Available: https://www.regulations.gov/document/NHTSA-2019-0102-0006. [Accessed: 29 June 2026].

[5] International Organization for Standardization, ISO 19206-3:2021, “Road vehicles—Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions—Part 3: Requirements for passenger vehicle 3D targets,” First edition, May 2021. [Online]. Available: https://www.iso.org/standard/70133.html. [Accessed: 29 June 2026].

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XI. APPROVALS

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