NHTSA's 2023 Light Vehicle Pedestrian Automatic Emergency Braking Research Test Summary

April 2024

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Suggested APA Format Citation:

Albrecht, H., Gerdus, E., Kearns, L., Rossman, A., & Ahern, Z. (2024, April). *NHTSA's 2023 Light Vehicle Pedestrian Automatic Emergency Braking Research Test Summary.* Washington, DC: National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS		

4. Title and Subtitle	5. Report Date
NHTSA's 2023 Light Vehicle Pedestrian Automatic Emergency Braking Research Test Summary	April 2024
	6. Performing Organization Code: NSR-120

7. Author(s)	8. Performing Organization Report No.
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9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
National Highway Traffic Safety Administration Vehicle Research and Test Center P.O. Box 37 East Liberty, OH 43319	11. Contract or Grant No.

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590	Report Jan23 – Apr24
	14. Sponsoring Agency Code

15. Supplementary Notes

[Can be left blank. Sometimes names the COR.]

16. Abstract

In 2023, NHTSA performed test track evaluations of the pedestrian automatic emergency braking systems (PAEB) of six light vehicles. Pedestrian crossing, stationary, and along path scenarios were performed under different ambient and subject vehicle lighting conditions at SV speeds ranging from 10 km/h to 65 km/h. Tests were performed following the test procedures outlined in the automatic emergency braking (AEB) systems for light vehicles notice for proposed rulemaking (NPRM) published in June 2023 [1]. Additional tests were performed to test the effects of user adjustable forward collision warning (FCW) and regenerative braking vehicle settings, the use of cruise control during a test, the type of object used as the obstruction in the obstructed test scenario, and variation in pedestrian height. Crash avoidance and SV impact speed results are summarized for each test condition and distinctions are made by vehicle settings, obstruction devices used, and mannequin size.

17. Key Words	18. Distribution Statement
Pedestrian Automatic Emergency Braking, PAEB, AEB, Crash Avoidance, Advanced Driver Assist Sysems, ADAS, Test Proceedures, FCW, Regenerative Braking, Cruise Control, Vehicle Test Device, VTD, Pedestrian Test Mannequin, PTM	Document is available to the public from the National Technical Information Service, www.ntis.gov.

19 Security Classif. (of this report)	20. Security Classif. (of this page)	21 No. of Pages	22. Price
Unclassified	Unclassified	44	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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List of Acronyms

ADAS	**Advanced Driver Assistance Systems**
AEB	**Automatic Emergency Braking**
FCW	**Forward Collision Warning**
NHTSA	**National Highway Traffic Safety Administration**
NPRM	**Notice of Proposed Rulemaking**
PAEB	**Pedestrian Automatic Emergency Braking**
PTM	**Pedestrian Test Mannequin**
SV	**Subject Vehicle**
TTC	**Time-to-Collision**
VTD	**Vehicle Test Device**

1. Introduction

In 2023, NHTSA performed test track evaluations of the pedestrian automatic emergency braking systems (PAEB) of six light vehicles. Pedestrian crossing path, along path stationary, and along path scenarios were performed under different ambient and subject vehicle lighting conditions at subject vehicle speeds ranging from 10 km/h to 65 km/h. Tests were performed following the test procedures outlined in the automatic emergency braking systems for light vehicles notice of proposed rulemaking (AEB NPRM) published in June 2023 [1]. Additional tests were performed to test the effects of user adjustable forward collision warning (FCW) and regenerative braking vehicle settings, the use of cruise control during a test, the type of object used as the obstruction in the obstructed test scenario, and variation in pedestrian height.

2. Test Methods and Protocol

Subject Vehicles

The six light vehicles used as the subject vehicles in this testing are detailed in *Table 2-1*. From left to right, model year, make/model, propulsion type, sensors, and the manufacturer stated speed range where PAEB system operates are listed.

Table 2-1 Subject Vehicles for PAEB Testing

Model Year	Make/Model	Propulsion Type	ADAS Sensors	Manufacturer Stated Speed Range Where PAEB System Operates (km/h)
2023	Nissan Pathfinder SL AWD	Internal Combustion	Camera and Radar	10 to 60
2023	Hyundai IONIQ 5 Limited AWD	Electric	Camera and Radar	10 to 65
2023	Toyota Corolla Hybrid FWD	Hybrid	Camera and Radar	5 to 80
2023	BMW iX xDrive50	Electric	Camera and Radar	5 to 250
2023	Ford F-150 Lightning Super Crew	Electric	Camera and Radar	5 to 80
2023	Mazda CX-90 AWD Turbo S Premium	Internal Combustion	Camera and Radar	10 to 80

Test Equipment

This section provides a short description of subject vehicle instrumentation and test track devices. A more detailed description with pictures of subject vehicle equipment and test track devices can be viewed in a published 2022 report [8].

Subject Vehicle Equipment

Each subject vehicle was equipped with instrumentation to measure and record all relevant measures of the subject vehicle and pedestrian test mannequin (PTM). Sensors monitored the position of the accelerator and brake pedals to detect driver input. A steering robot controlled the subject vehicle's lateral position. Inertial and position measurement sensors tracked the subject vehicle movement during tests. Thermocouples were installed on each wheel's brakes to monitor brake temperature. A microphone setup was used to monitor the audible FCW alerts. A data acquisition system collected test data. Instrumentation was powered by an external battery mounted inside each subject vehicle.

Test Devices

A surrogate pedestrian mannequin (adult and child) coupled to a mobile robotic platform simulated pedestrian body movements and forward motion with respect to a moving subject vehicle.

Obstruction Devices

Obstructed scenarios in this PAEB test series were conducted using vehicle test devices (VTDs) as obstructing devices. Multiple VTDs from Dynamic Research, Inc. [6] and 4active [7] were used. The VTDs used when testing each subject vehicle to obstruct the running child crossing path from the right tests are logged in Appendix A.

Prior agency research used real vehicles to obstruct the view of the crossing child pedestrian target in obstructed test scenarios. Supplemental tests in this series were conducted using a black 2010 Ford Fusion sedan positioned closest to the child PTM and a maroon 2022 Nissan Rogue SUV positioned behind the Ford Fusion.

A side view of real vehicles as obstruction devices and VTDs as obstruction devices in a representative layout are shown in Figure 2-1.

Figure 2-1 Obstruction Devices in Position

Test Scenarios

Tests were performed following the test procedures outlined in the NHTSA automatic emergency braking for light vehicles notice for proposed rulemaking published in June 2023. Crossing path scenarios feature the pedestrian mannequin crossing perpendicularly into the path of the moving subject vehicle. Stationary along path and moving along path scenarios feature the pedestrian mannequin standing or moving in line with the path of the moving subject vehicle. Additional tests were performed to assess the effects of supplemental vehicle settings whose states are specified as user-selectable in the NPRM, such as cruise control modes and regenerative braking settings. Tests were performed evaluating the impact of using either real vehicles or VTDs as obstructing devices in the obstructed running child, crossing path from the right scenario to evaluate the impact of pedestrian mannequin height on PAEB system performance, scenarios outlined in the NPRM that typically feature an adult mannequin were additionally performed using a child mannequin. These tests were outside the scope of the NPRM and therefore are outlined in the supplemental tests section.

Pedestrian Crossing Path Scenarios

Applicable PAEB test scenarios that feature the pedestrian crossing the path of the moving subject vehicle are shown in Figure 2-2. These test scenarios are intended to simulate a pedestrian walking or running perpendicularly into the path of a moving vehicle.

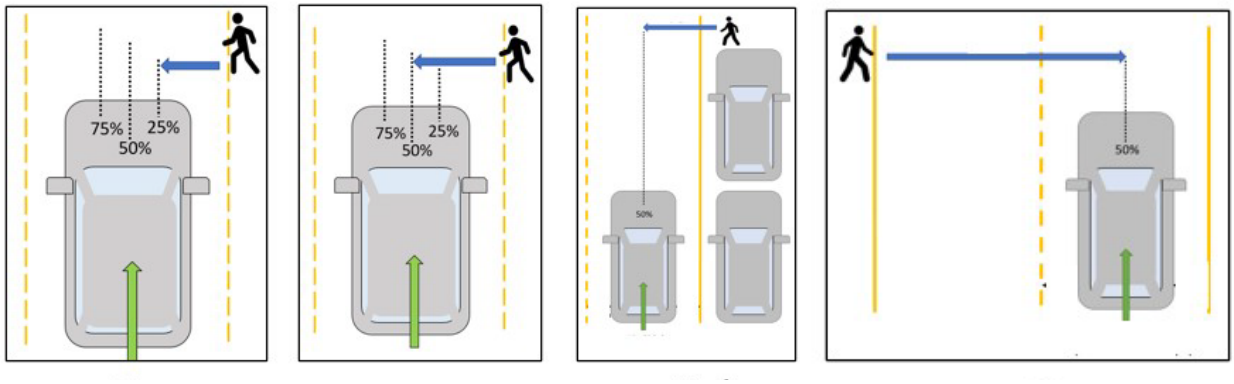

Figure 2-2 Illustration of Pedestrian Crossing Path Scenarios

Table 2-2 describes the test matrix followed by all subject vehicles for pedestrian crossing path scenarios conducted in this PAEB test series.

Table 2-2 Pedestrian Crossing Path Scenario Test Matrix

Scenario	Mannequin	Path Origin	SV Overlap (%)	Obstruction?	SV Speed Range (km/h)	Mannequin Speed (km/h)	Movement Classification	Light Condition
Pedestrian Crossing Path	Adult	Right	25	No	10-60	5	Walk	Daylight
	Adult	Right	50	No	10-60	5	Walk	Daylight
	Adult	Right	50	No	10-60	5	Walk	Darkness -Lower Beam
	Adult	Right	50	No	10-60	5	Walk	Darkness -Upper Beam
	Child	Right	50	Yes (VTDs)	10-50	5	Run	Daylight
	Adult	Left	50	No	10-60	8	Run	Daylight

Pedestrian Along Path Scenarios

Applicable PAEB test scenarios that feature the pedestrian target moving or remaining stationary along the path of the approaching subject vehicle are shown in Figure 2-3. These test scenarios are intended to simulate a pedestrian walking, running, or standing facing away from and along the path of an approaching vehicle.

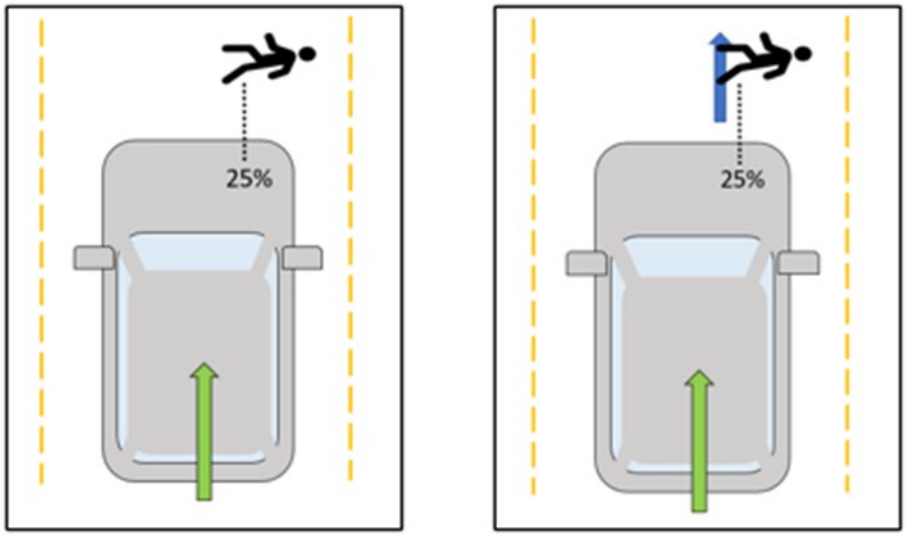

Figure 2-3 Illustration of Pedestrian Along Path Scenarios

Table 2-3 describes the test matrix followed by all subject vehicles for pedestrian along path scenarios in this testing series.

Table 2-3 Pedestrian Along Path Scenario Test Matrix

Scenario	Mannequin	Mannequin Orientation	SV Overlap (%)	SV Speed Range (km/h)	Mannequin Speed (km/h)	Movement Classification	Light Condition
Pedestrian Along Path	Adult	Facing Away From SV	25	10-55	0	Stationary	Daylight
	Adult	Facing Away From SV	25	10-55	0	Stationary	Darkness - Lower Beams
	Adult	Facing Away From SV	25	10-55	0	Stationary	Darkness - Upper Beams
	Adult	Facing Away From SV	25	10-65	5	Walk	Daylight
	Adult	Facing Away From SV	25	10-65	5	Walk	Darkness - Lower Beams
	Adult	Facing Away From SV	25	10-65	5	Walk	Darkness - Upper Beams

SV Test Speed Procedure

The test matrix conditions listed below allowed the agency to maximize the collection of performance data while reducing potential damage to the test devices and vehicles.

1) If the subject vehicle avoided contact with the mannequin on the first trial, the speed of the subject vehicle was increased, and the test was repeated.
2) If the subject vehicle contacted the mannequin in the first trial and the subject vehicle speed at impact was less than 50 percent of its initial speed, up to four additional trials were performed at the same initial speed.
3) If three of the four additional trails resulted in crash avoidance, the subject vehicle speed was increased, and the test was repeated.
4) If two of the four additional trails contacted the mannequin regardless of the subject vehicle speed reduction, testing was complete for that test condition.

In the testing outlined in this report, testing was advanced beyond the initial 10 km/h subject vehicle speed regardless of outcome for research purposes.

Supplemental Test Conditions

The NPRM specifies that subject vehicle user adjustable settings, such as FCW settings, regenerative braking settings, and cruise control, may be at any state during AEB or PAEB testing. The effects of user selections of these parameters on PAEB capabilities were supplementally evaluated on subject vehicles in this test series.

The NPRM specifies that obstructed running child crossing from the right tests be performed using VTDs as obstruction devices. This test scenario was performed with both real vehicles and VTDs as obstruction devices to evaluate the obstructing devices' impact on all subject vehicle PAEB capabilities.

Although many of the PAEB test scenarios in the NPRM only specify the use of an adult PTM, supplemental testing was performed using a child PTM in these scenarios to evaluate the impact of PTM height on PAEB system capabilities. Table 2-4 summarizes the subject vehicles on which supplemental conditions were tested.

Table 2-4 Subject Vehicle Supplemental Test Condition Application

	Nissan Pathfinder	Hyundai IONIQ 5	Toyota Corolla	BMW iX	Ford F-150 Lightning	Mazda CX-90
FCW Settings		✓		✓	✓	
Regenerative Braking Settings		✓		✓	✓	
Cruise Control	✓	✓	✓	✓	✓	✓
Adult and Child PTM	✓	✓	✓	✓	✓	✓
Obstruction Devices	✓	✓	✓	✓	✓	✓

Forward Collision Warning

Table 2-5 summarizes the supplemental PAEB test conditions performed to test the effect of user adjustable FCW distance/timing settings. Tests at specified scenarios and speeds were performed with the subject vehicle FCW set to the furthest or earliest available option, supplementing the main test series where these scenarios and speeds were tested with the subject vehicle FCW set to the closest or latest available option.

Table 2-5 FCW Supplemental Test Matrix

Scenario	SV Speeds (km/h)	Lighting Condition	Mannequin	FCW Setting
Pedestrian Crossing Path from the Right with 50% Overlap	10, 30, 60	Daylight	Adult	**Far**
Pedestrian Crossing Path from the Left with 50% Overlap	10, 30, 60	Daylight	Adult	**Far**
Pedestrian Along Path, Stationary with 25% Overlap	10, 30, 60	Daylight	Adult	**Far**
Pedestrian Along Path, Moving with 25% Overlap	10, 30, 60	Daylight	Adult	**Far**

Regenerative Braking

Table 2-6 summarizes the supplemental PAEB test conditions performed to test the effect of user adjustable regenerative braking settings. Tests at specified scenarios and speeds were performed with the subject vehicle set to the highest regenerative braking selection, supplementing the main test series where these scenarios and speeds were tested with the subject vehicle set to the lowest (or off) regenerative braking selection.

Table 2-6 Regenerative Braking Supplemental Test Matrix

Scenario	SV Speeds (km/h)	Lighting Condition	Mannequin	Regenerative Braking Setting
Pedestrian Crossing Path from the Right with 50% Overlap	10, 30, 60	Daylight	Adult	**High**
Pedestrian Crossing Path from the Left with 50% Overlap	10, 30, 60	Daylight	Adult	**High**
Pedestrian Along Path, Stationary with 25% Overlap	10, 30, 60	Daylight	Adult	**High**
Pedestrian Along Path, Moving with 25% Overlap	10, 30, 60	Daylight	Adult	**High**

Cruise Control

Table 2-7 summarizes the supplemental PAEB test conditions performed to test the effect of using cruise control to execute a test. Specific scenarios at 40 km/h were performed with the subject vehicle cruise control enabled, supplementing the main test series where cruise control was not enabled.

Table 2-7 Cruise Control Supplemental Test Matrix

Scenario	SV Speed (km/h)	Lighting Condition	Mannequin	Cruise Control
Pedestrian Crossing Path from the Right with 50% Overlap	40	Daylight	Adult	**Enabled and Set**
Pedestrian Along Path, Stationary with 25% Overlap	40	Daylight	Adult	**Enabled and Set**
Pedestrian Along Path, Moving with 25% Overlap	40	Daylight	Adult	**Enabled and Set**

Obstruction Devices

Table 2-8 summarizes the supplemental PAEB test condition performed to test the effect of using either real vehicles or VTDs as obstruction devices in obstructed running child crossing path from the right tests. Supplemental tests were performed using real vehicles as obstructing devices, enabling comparison to the main test series where VTDs were used as obstructing devices. The real vehicles used in the supplemental tests were a 2010 black Ford Focus closest to the PTM with a 2022 maroon Nissan Rogue located directly behind the Ford Focus.

Table 2-8 Obstruction Test Devices Supplemental Test Matrix

Scenario	Obstruction	SV Speed Range (km/h)	Lighting Condition	Mannequin	Obstruction Devices
Obstructed Running Child Crossing Path from the Right with 50% Overlap	Yes	10-60	Daylight	Child	**Real Vehicles**

Pedestrian Mannequin Size Table 2-9 summarizes the supplemental PAEB test conditions performed to test the effect of pedestrian height by using a child PTM instead of an adult PTM in scenarios for which the NPRM only specifies the use of an adult pedestrian mannequin.

Table 2-9 Pedestrian Mannequin Size Supplemental Test Matrix

Scenario ID	Obstruction	SV Speed Range [km/h]	Mannequin Speed [km/h]	Lighting Condition	Pedestrian Mannequin
Pedestrian Crossing Path from the Right with 25% Overlap	No	10-60	5	Daylight	**Child**
Pedestrian Crossing Path from the Right with 50% Overlap	No	10-60	5	Daylight	**Child**
Pedestrian Crossing Path from the Right with 50% Overlap	No	10-60	5	Darkness - Lower Beam	**Child**
Pedestrian Crossing Path from the Left with 50% Overlap	No	10-60	8	Daylight	**Child**
Pedestrian Along Path, Stationary with 25% Overlap	No	10-60	0	Daylight	**Child**
Pedestrian Along Path, Stationary with 25% Overlap	No	10-60	0	Darkness - Lower Beam	**Child**
Pedestrian Along Path, Moving with 25% Overlap	No	10-65	5	Daylight	**Child**

Subject Vehicle Preparation

Where unspecified, PAEB tests were performed with, when applicable, regenerative braking turned off or set to its lowest setting, FCW set to its nearest setting, and cruise control not enabled.

For all subject vehicles, after being fully instrumented and prior to testing, headlamp alignment was checked and adjusted according to manufacturer procedure. It should be noted that all subject vehicles required headlamp adjustment to meet manufacturer specifications. The BMW iX required one headlamp to be replaced by a BMW dealership after damage was incurred midway through PAEB testing.

Test Environment

All PAEB tests in this series were performed on a closed track at the Transportation Research Center, Inc. SMARTCenter facility in Ohio. The test location consists of a large, flat asphalt space with no disruptions or obstructions around the test environment. All tests were performed with the subject vehicle approaching the PTM from the southeast traveling in a straight line centered between a dashed white line on the left side of the vehicle and a solid white line on the

right side of the vehicle. The test location as seen from the forward view of a subject vehicle is shown in Figure 2-4.

Figure 2-4 PAEB Testing Location

All PAEB tests in this series were conducted on a dry road surface. All testing was completed within an ambient temperature range from 0°C (32°F) to 40°C (104°F) and a windspeed range of 0 km/h (0 mph) to 24 km/h (15 mph). Temperature and windspeed were monitored through facility sensors to ensure test validity.

Lighting Conditions

Daylight conditions were considered valid when ambient lighting was at or greater than 2,000 lux as measured by a light meter. Subject vehicle headlamps were turned off during daylight testing.

Darkness conditions were considered valid when ambient lighting was at or lower than 0.2 lux as measured by a light meter. All subject vehicles in darkness conditions were tested with both lower beams and upper beams activated as specified by the scenario.

3. Results

The results shown in the following section summarize the PAEB performance of the six subject vehicles evaluated in this test series. Crash avoidance results are separated by scenario, speed, lighting condition, and supplemental factors. Subject vehicles are generally listed in the order that they were tested.

Each result cell in the following tables is colored to indicate the subject vehicle's PAEB performance in response to the corresponding test and speed.

- Green cells represent crash avoidance in the first trial.
- Red cells represent contact with the mannequin in the first trial. The impact speed of the first test is shown in km/h.
- Grey cells with dashes represent that the specified test and speed was not performed.

Main Test Series Results

Daylight Conditions

Table 3-1 summarizes the PAEB crash avoidance results from daylight pedestrian crossing path scenarios Note that the obstructed running child crossing path from the right test results listed in Table 3-1 were performed using VTDs as obstruction devices as part of the main test series. The type and order of VTDs used for each subject vehicle are logged in Appendix A. Summarized results of the obstructed child crossing path from right tests performed using real vehicles as obstruction devices are summarized in Table 3-8.

Table 3-1 Daylight Pedestrian Crossing Path Crash Avoidance Summary

Test Scenario:	Adult Crossing Path from the Right, 25% Overlap						Adult Crossing Path from the Right, 50% Overlap						Child Obstructed Crossing Path from the Right, 50% Overlap						Adult Crossing Path from the Left, 50% Overlap					
SV Speed (km/h):	10	20	30	40	50	60	10	20	30	40	50	60	10	20	30	40	50	*60	10	20	30	40	50	*60
Nissan Pathfinder	A	A	A	A	A	14	A	A	A	A	A	A	6	A	A	A	30	-	A	A	A	A	A	27
Hyundai IONIQ 5	A	A	A	A	9	-	A	A	A	A	A	A	A	A	A	A	18	-	A	A	A	A	A	30
Toyota Corolla	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	24	A	A	A	A	A	A
BMW iX	A	A	A	A	A	13	A	A	A	A	A	A	A	A	A	A	A	22	A	A	A	A	A	A
Ford F-150 Lightning	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	13	-	-	7	A	A	A	A	A
Mazda CX-90	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	18	-	6	A	A	A	A	A

A	Crash avoidance
XX	Contact in first trial at XX km/h
-	Test was not performed

*Outside the range of SV speed specified in the light vehicle AEB NPRM for the following test conditions

Table 3-2 summarizes the PAEB crash avoidance results from daylight pedestrian along path tests.

Table 3-2 Daylight Pedestrian Along Path Crash Avoidance Summary

Test Scenario:	**Adult Along Path Stationary, 25% Overlap**							**Adult Along Path Moving, 25% Overlap**						
SV Speed (km/h):	10	20	30	40	50	55	60	10	20	30	40	50	60	65
Nissan Pathfinder	A	A	A	A	A	A	A	10	A	A	A	A	9	13
Hyundai IONIQ 5	A	A	A	A	A	A	A	A	A	A	A	A	A	20
Toyota Corolla	A	A	A	A	A	A	A	A	A	A	A	A	A	A
BMW iX	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ford F-150 Lightning	A	A	A	A	A	A	A	7	A	A	A	A	A	A
Mazda CX-90	A	A	A	A	A	A	A	6	A	A	A	A	A	A

A	Crash avoidance
XX	Contact in first trial at XX km/h

Darkness Conditions

Table 3-3 summarizes the PAEB crash avoidance results from darkness pedestrian crossing path scenarios.

Table 3-3 Darkness Pedestrian Crossing Path Crash Avoidance Summary

Test Scenario:	**Adult Crossing Path from the Right, 50% Overlap, Darkness**											
Lighting Condition:	**Lower Beam**						**Upper Beam**					
SV Speed (km/h):	10	20	30	40	50	60	10	20	30	40	50	60
Nissan Pathfinder	A	A	A	A	A	A	A	A	A	A	A	A
Hyundai IONIQ 5	A	A	A	A	A	34	A	A	A	A	A	12
Toyota Corolla	A	A	A	A	A	A	A	A	A	A	A	A
BMW iX	A	A	A	A	A	A	A	A	A	A	A	A
Ford F-150 Lightning	A	A	A	A	A	24	A	A	A	A	A	A
Mazda CX-90	A	A	A	A	A	A	A	A	A	A	A	A

A	Crash avoidance
XX	Contact in first trial at XX km/h

Table 3-4 summarizes the PAEB crash avoidance results from darkness pedestrian along path scenarios.

Table 3-4 Darkness Pedestrian Along Path Crash Avoidance Summary

Test Scenario:	Adult Along Path Stationary, 25% Overlap, Darkness														Adult Along Path Moving, 25% Overlap, Darkness													
Lighting Condition:	**Lower Beam**							**Upper Beam**							**Lower Beam**							**Upper Beam**						
SV Speed (km/h):	10	20	30	40	50	55	60	10	20	30	40	50	55	60	10	20	30	40	50	60	65	10	20	30	40	50	60	65
Nissan Pathfinder	A	A	20	-	-	-	-	A	A	A	A	A	A	A	8	19	-	-	-	-	-	8	18	-	-	-	-	-
Hyundai IONIQ 5	A	A	A	A	A	19	-	A	A	A	A	A	A	A	A	A	A	A	A	A	39	A	A	A	A	A	A	17
Toyota Corolla	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
BMW iX	A	A	A	A	16	A	24	A	A	A	A	A	A	A	9	A	A	A	28	-	-	9	A	A	A	A	A	A
Ford F-150 Lightning	A	A	A	30	-	-	-	A	A	A	A	A	A	A	A	A	A	A	15	15	-	A	A	A	A	A	A	A
Mazda CX-90	5	A	A	A	A	A	A	A	A	A	A	A	A	A	10	A	A	A	A	A	45	9	A	A	A	A	A	A

A	Crash avoidance
XX	Contact in first trial at XX km/h
-	Test was not performed

Supplemental Test Results

The crash avoidance results of the supplemental PAEB tests are displayed alongside the corresponding result from the main test series. Note that the PAEB test results displayed for the supplemental condition control selections (close FCW, low regenerative braking, cruise control off, VTDs as obstruction devices, and adult PTM) are reprinted from the main test series results for ease of comparison.

FCW Supplemental Test Results

Table 3-5 summarizes the PAEB crash avoidance results from supplemental tests performed to evaluate the impact of the user selection of the subject vehicles' FCW settings. PAEB tests with the subject vehicles' FCW set to alert at the furthest available distance from the target were performed to complement the corresponding tests from the main PAEB test series, where all tests were performed with the subject vehicles' FCW set to the closest available distance. Each evaluated subject vehicle's FCW setting, and selection names are logged in Appendix A.

Table 3-5 FCW Supplemental Test Results Summary

Test Scenario:		**Adult Crossing Path from the Right, 50% Overlap**			**Adult Crossing Path from the Left, 50% Overlap**			**Adult Along Path Stationary, 25% Overlap**			**Adult Along Path Moving, 25% Overlap**		
SV Speed (km/h):		10	30	60	10	30	60	10	30	60	10	30	60
Hyundai IONIQ 5	**Close FCW**	A	A	A	A	A	30	A	A	A	A	A	A
	Far FCW	A	A	18	A	A	30	A	A	A	A	A	A
BMW iX	**Close FCW**	A	A	A	A	A	A	A	A	A	A	A	A
	Far FCW	A	A	A	A	A	A	A	A	A	A	A	A
Ford F-150 Lightning	**Close FCW**	A	A	A	7	A	A	A	A	A	7	A	A
	Far FCW	A	A	A	A	A	A	A	A	A	A	A	A

A	Crash avoidance
XX	Contact in first trial at XX km/h

Regenerative Braking Supplemental Test Results

Table 3-6 summarizes the PAEB crash avoidance results from supplemental tests performed to evaluate the impact of the user selection of the subject vehicles' regenerative braking settings. PAEB tests with the subject vehicles' regenerative braking set to their highest available options were performed to complement the corresponding tests from the main PAEB test series, where all tests were performed with the subject vehicles' regenerative braking set as low as possible or turned off entirely if available. Each evaluated subject vehicle's regenerative braking setting and selection names are logged in Appendix A.

Table 3-6 Regenerative Braking Supplemental Test Results Summary

Test Scenario:		**Adult Crossing Path from the Right, 50% Overlap**			**Adult Crossing Path from the Left, 50% Overlap**			**Adult Along Path Stationary, 25% Overlap**			**Adult Along Path Moving, 25% Overlap**		
SV Speed (km/h):		10	30	60	10	30	60	10	30	60	10	30	60
Hyundai IONIQ 5	**Low Regen.**	A	A	A	A	A	30	A	A	A	A	A	A
	High Regen	A	A	18	A	A	30	A	A	A	A	A	A
BMW iX	**Low Regen.**	A	A	A	A	A	A	A	A	A	A	A	A
	High Regen	A	A	A	A	A	A	A	A	A	A	A	A
Ford F-150 Lightning	**Low Regen.**	A	A	A	7	A	A	A	A	A	7	A	A
	High Regen	A	A	A	5	A	A	A	A	A	A	A	A
A	Crash avoidance												
XX	Contact in first trial at XX km/h												

Cruise Control Supplemental Test Results

Table 3-7 summarizes the PAEB crash avoidance results from supplemental tests performed to evaluate the impact of enabling and setting cruise control. PAEB tests with the subject vehicles' cruise control enabled and set to 40 km/h were performed to complement the corresponding tests from the main PAEB test series, where tests with the subject vehicle traveling at 40 km/h with cruise control not enabled were performed.

Table 3-7 Cruise Control Supplemental Test Results Summary

Test Scenario:		Adult Crossing Path from the Right, 50% Overlap	Adult Along Path Stationary, 25% Overlap	Adult Along Path Moving, 25% Overlap
SV Speed (km/h):		40	40	40
Toyota Corolla	**Cruise Control Off**	A	A	A
	Cruise Control Enabled and Set	A	A	A
Nissan Pathfinder	**Cruise Control Off**	A	A	A
	Cruise Control Enabled and Set	A	A	A
Ford F-150 Lightning	**Cruise Control Off**	A	A	A
	Cruise Control Enabled and Set	A	A	A
BMW iX	**Cruise Control Off**	A	A	A
	Cruise Control Enabled and Set	A	A	A
Mazda CX-90	**Cruise Control Off**	A	A	A
	Cruise Control Enabled and Set	A	A	A
Hyundai IONIQ 5	**Cruise Control Off**	A	A	A
	Cruise Control Enabled and Set	A	A	A

A	Crash avoidance
XX	Contact in first trial at XX km/h

Obstruction Devices Supplemental Test Results

Table 3-8 summarizes the PAEB crash avoidance results from supplemental tests performed to evaluate the impact of using real vehicles and obstruction devices in obstructed running child crossing path from the right tests. These tests complement the tests performed in the main test series which used VTDs as obstruction devices.

Table 3-8 Obstruction Devices Supplemental Test Results Summary

Test Scenario:		**Child Obstructed Crossing Path from the Right, 50% Overlap**					
SV Speed (km/h):		10	20	30	40	50	*60
Toyota Corolla	**VTDs**	A	A	A	A	A	26
	Real Vehicles	A	A	A	A	A	A
Nissan Pathfinder	**VTDs**	6	A	A	A	30	-
	Real Vehicles	A	A	A	A	30	-
Ford F-150 Lightning	**VTDs**	A	A	A	13	-	-
	Real Vehicles	10	A	A	A	A	39
BMW iX	**VTDs**	A	A	A	A	A	22
	Real Vehicles	A	A	A	A	A	A
Mazda CX-90	**VTDs**	A	A	A	A	18	-
	Real Vehicles	A	A	A	A	17	-
Hyundai IONIQ 5	**VTDs**	A	A	A	A	18	-
	Real Vehicles	A	A	A	A	16	-

A	Crash avoidance
XX	Contact in first trial at XX km/h
-	Test was not performed.

*Outside the range of SV speed specified in the light vehicle AEB NPRM for the following test conditions

Pedestrian Mannequin Size Supplemental Test Results

Table 3-9 and Table 3-10 summarize the PAEB test results collected from supplemental tests evaluating the impact of mannequin height on PAEB test scenarios traditionally performed with an adult PTM. Supplemental tests were performed using a child

mannequin in place of an adult mannequin. The results from these tests are summarized alongside the results from the corresponding tests performed with an adult mannequin as part of the main PAEB test series.

Table 3-9 summarizes the PAEB daylight and darkness crossing test results collected with both a child mannequin and an adult PTM. Child pedestrian crossing path from the right with 50% overlap lower beam tests for the BMW iX were not performed because of headlamp damage.

Table 3-9 Pedestrian Crossing Path PTM Height Supplemental Test Results Summary

Test Scenario:		**Pedestrian Crossing Path from the Right, 25% Overlap**						**Pedestrian Crossing Path from the Right, 50% Overlap**						**Pedestrian Crossing Path from the Right, 50% Overlap**						**Pedestrian Crossing Path from the Left, 50% Overlap**					
Lighting Condition:		**Daylight**						**Daylight**						**Darkness - Lower Beam**						**Daylight**					
SV Speed (km/h):		10	20	30	40	50	60	10	20	30	40	50	60	10	20	30	40	50	60	10	20	30	40	50	60
Toyota Corolla	**Adult PTM**	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	Child PTM	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	34	-	-	A	A	A	A	A	A
Nissan Pathfinder	**Adult PTM**	A	A	A	A	A	14	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	27
	Child PTM	A	A	A	A	A	A	A	A	A	A	18	14	A	A	A	A	A	A	A	A	A	A	A	A
Ford F-150 Lightning	**Adult PTM**	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	24	7	A	A	A	A	A
	Child PTM	9	A	A	A	A	7	8	A	A	A	A	A	A	A	A	A	A	16	10	A	A	A	A	A
BMW iX	**Adult PTM**	A	A	A	A	A	13	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	Child PTM	A	A	A	A	A	A	A	A	A	A	A	A	-	-	-	-	-	-	A	A	A	A	A	A
Mazda CX-90	**Adult PTM**	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	6	A	A	A	A	A
	Child PTM	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	13	-	A	A	A	A	A	A
Hyundai IONIQ 5	**Adult PTM**	A	A	A	A	9	-	A	A	A	A	A	A	A	A	A	A	A	34	A	A	A	A	A	30
	Child PTM	A	A	A	A	A	30	A	A	A	A	A	27	A	A	A	A	A	21	A	A	A	A	A	A

A	Crash avoidance
XX	Contact in first trial at XX km/h
-	Test was not performed

Table 3-10 summarizes the PAEB daylight and darkness pedestrian along path test results collected with both a child and adult PTM.

Table 3-10 Pedestrian Along Path PTM Size Supplemental Test Results Summary

Test Scenario:		Pedestrian Along Path Stationary, 25% Overlap							Pedestrian Along Path Stationary, 25% Overlap							Pedestrian Along Path Moving, 25% Overlap						
Lighting Condition:		**Daylight**							**Darkness - Lower Beam**							**Daylight**						
SV Speed (km/h):		10	20	30	40	50	55	*60	10	20	30	40	50	55	*60	10	20	30	40	50	60	65
Toyota Corolla	**Adult PTM**	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	Child PTM	A	A	A	A	A	A	A	A	A	A	A	44	-	-	A	A	A	A	A	A	A
Nissan Pathfinder	**Adult PTM**	A	A	A	A	A	A	A	A	A	20	-	-	-	-	10	A	A	A	A	9	13
	Child PTM	A	A	A	A	A	A	A	A	16	-	-	-	-	-	10	A	A	A	A	A	A
Ford F-150 Lightning	**Adult PTM**	A	A	A	A	A	A	A	A	A	A	30	-	-	-	7	A	A	A	A	A	A
	Child PTM	10	A	A	A	A	A	A	10	A	A	A	45	-	-	10	A	A	A	A	A	A
BMW iX	**Adult PTM**	A	A	A	A	A	A	A	A	A	A	A	16	A	24	A	A	A	A	A	A	A
	Child PTM	A	A	A	A	A	A	A	A	A	A	A	25	-	-	A	A	A	A	A	A	A
Mazda CX-90	**Adult PTM**	A	A	A	A	A	A	A	5	A	A	A	A	A	A	6	A	A	A	A	A	A
	Child PTM	A	A	A	A	A	A	A	A	A	A	A	23	-	-	A	A	A	A	A	A	A
Hyundai IONIQ 5	**Adult PTM**	A	A	A	A	A	A	A	A	A	A	A	A	19	-	A	A	A	A	A	A	20
	Child PTM	A	A	A	A	A	A	A	A	A	A	A	A	33	-	A	A	A	A	A	A	8

A	Crash avoidance
XX	Contact in first trial at XX km/h
-	Test was not performed

*Outside the range of SV speed specified in the light vehicle AEB NPRM for the following test conditions

4. Conclusions

Main Test Series Conclusions

The following conclusions and observations were made from the main PAEB series testing and results.

- All subject vehicles displayed full crash avoidance in the pedestrian crossing path from right tests, with a 50% overlap carried out in the main test series during daylight with an adult PTM.
- Obstructed running child crossing from the right tests resulted in the most contact with the PTMs of any daytime scenario in the main test series, with most subject vehicles unable to avoid contact at speeds of 50 km/h.
- Several subject vehicles impacted the PTM at an initial speed of 10 km/h but went on to avoid contact at higher speed increments. This can be seen in both pedestrian crossing and along path scenarios and in all lighting conditions.
- All subject vehicles displayed better pedestrian crash avoidance results in daylight conditions than in darkness.
- Overall, subject vehicles displayed better pedestrian crash avoidance results in darkness with upper beams than with lower beams. This trend is particularly evident when comparing the main test series pedestrian crossing path from the right darkness tests with lower beams and upper beams, but the trend can also be seen in along path tests in dark lighting conditions and in other crossing tests in darkness conditions.
- The Toyota Corolla met all performance requirements of crash avoidance for all test scenarios outlined in the NPRM.

Supplemental Test Series Conclusions

The following conclusions and observations were made from supplemental PAEB testing and results.

- No significant effect on PAEB performance from user selection of FCW settings can be seen in the test results.
- No significant effect on PAEB performance from user selection of regenerative braking settings can be seen in the test results.
- Enabling and setting cruise control had no observable effect on PAEB performance as all subject vehicles achieved full avoidance both while cruise control was enabled and set and when tested at the same speed without cruise control.
- Similar PAEB performance results were observed for most subject vehicles when using real vehicles and VTDs as obstructions.
- In most scenarios, PAEB performance results for the child mannequin were similar to the test results of the adult mannequin.

5. References

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Appendix A: Testing Parameters

Appendix Table A-1 Log of VTDs Used in Obstructed Running Child Crossing Path from the Right Tests

Subject Vehicle	VTD in Front	VTD in Back
Nissan Pathfinder	DRI Soft Car 360	DRI Soft Car 360
Hyundai IONIQ 5	DRI Soft Car 360	4activeC2 v7.1
Toyota Corolla	DRI Soft Car 360	DRI Soft Car 360
BMW iX	4activeC2 v7.1	4activeC2 v7.1
Ford F-150 Lightning	4activeC2 v7.1	4activeC2 v7.1
Mazda CX-90	4activeC2 v7.1	4activeC2 v7.1

Appendix Table A-2 Supplemental User-Selectable Settings Log

	FCW			Regenerative Braking		
Subject Vehicle	**Setting Name**	**Near Selection**	**Far Selection**	**Setting Name**	**Low Selection**	**High Selection**
Hyundai IONIQ 5	Warning Timing	Late	Standard		Level 0	i-Pedal
BMW iX	Forward Collision Mitigation	Late	Early	Energy recovery in D	Low	High
Ford F-150 Lightning	Pre-Collision Assist Alert Sensitivity	Low	High	1-Pedal Drive	Off	On

Appendix B: Testing Procedures

Appendix Table B-1 PAEB Test Validity Conditions

Test Conditions and Parameters	Range/Tolerance
Ambient Temperature	0°C (32°F) to 40° C (104°F)
Wind Speed	0.0 m/s to 6.7 m/s (15 mph)
Ambient Illumination Daylight	>= 2,000 lux
Ambient Illumination Darkness	<= 0.2 lux
Subject Vehicle Speed Tolerance	±1.6 km/h (±1.0 mph)
Subject Vehicle Accelerator Pedal Release	within 500 milliseconds
Subject Vehicle Yaw Rate	±1.0 deg/s
Subject Vehicle Path Deviation from Center	0.3 m (1.0 ft)
PTM Subject Vehicle Overlap Tolerance	0.15 m (0.5 ft)
Subject Vehicle Hottest Axle's Brake Temperatures	65°C (149°F) to 100° C (212°F)
PTM Forward Speed Tolerance	0.4 km/h (±0.2 mph)
PTM Start Distance Crossing from Right	4.0 ± 0.1 m (13.1 ft)
PTM Start Distance Crossing from Left	6.0 ± 0.1 m (19.6 ft)
PTM Acceleration Distance	1.5 m (4.9 ft)

Pedestrian Crossing Path

Subject Vehicle Approach to a Pedestrian Crossing Path

For each test, the following test parameters were used:

- The mannequins start distance from the right: 4.0 ± 0.1 m (13.1 ft)
- The mannequins start distance from the left: 6.0 ± 0.1 m (19.6 ft)
- The mannequins speed when starting from the right was 5 km/h (3.1 mph) and acceleration distance of 1.5 m (4.9 ft)
- The mannequins speed when starting from the left was 8 km/h (4.9 mph) and acceleration distance of 1.5 m (4.9 ft)

Subject Vehicle Approach

For an individual test trial to be valid, the following held true throughout the test:

A. The subject vehicles driver's seatbelt was latched.
B. The subject vehicle driver cycled the ignition.
C. The subject vehicle was driven at the initial speed for each test.
    1. 10 km/h (6.2 mph)
    2. 20 km/h (12.4 mph)
    3. 30 km/h (18.6 mph)
    4. 40 km/h (24.8 mph)
    5. 50 km/h (31.0 mph)
    6. 60 km/h (37.2 mph)
D. The test begins when the longitudinal Time-to-Collision (TTC) = 4.0 seconds.
E. When the subject vehicle speed is 10-60 km/h, the TTC at 4.0 seconds will occur at the following distance.
    1. 10 km/h (6.2 mph): TTC = 4.0 seconds occurs at 11.1 m (36.4 ft)
    2. 20 km/h (12.4 mph): TTC = 4.0 seconds occurs at 22.2 m (72.9 ft)
    3. 30 km/h (18.6 mph): TTC = 4.0 seconds occurs at 33.3 m (109.3 ft)
    4. 40 km/h (24.8 mph): TTC = 4.0 seconds occurs at 44.4 m (144.8 ft)
    5. 50 km/h (31.0 mph): TTC = 4.0 seconds occurs at 55.5 m (182.2 ft)
    6. 60 km/h (37.2 mph): TTC = 4.0 seconds occurs at 66.6 m (218.7 ft)
F. The subject vehicle maintained the center of the lane using a robot steering controller.
G. The yaw rate of the subject vehicle was verified to be within ± 1.0 deg/s.
H. The subject vehicle driver modulated the throttle, using smooth inputs, to maintain a constant subject vehicle speed.
I. The subject vehicle driver was instructed not to apply any force to the brake pedal unless the mannequin is contacted, or the front of the subject vehicle has crossed the path of the mannequin.
J. The instant the subject vehicle PAEB warning event is presented (visual, haptic, or audible) the throttle was fully released (within 500 msec). If no warning event is presented by the PAEB system, the subject vehicle driver was instructed to modulate the throttle to maintain a constant speed until either the onset of PAEB

or, if the subject vehicle's PAEB system does not activate, the end of the test occurs (i.e., contact with the mannequin).

Validity Period

A. The valid test interval begins when the longitudinal TTC of the subject vehicle = 4.0 seconds.
B. The test is over when any of the following occurs for pedestrian crossing path scenarios:
    1. The subject vehicle contacts the mannequin; or
    2. The subject vehicle stops (through PAEB activation) before contacting the mannequin; or
    3. The mannequin clears the forward path of the subject vehicle.

End-of-Test Instructions

A. After the test is complete, the subject vehicle driver manually applied force to the brake pedal, bringing the vehicle to a stop (if necessary), and placed the transmission in park (automatic transmission).
B. The subject vehicle driver cycled the ignition.
C. The test is complete.

Speed Reduction

The magnitude of the subject vehicle speed reduction attributable to PAEB intervention is calculated in one of two ways, depending on whether a test trial concludes with the subject vehicle colliding with the mannequin. For pedestrian crossing path scenarios:

A. If the subject vehicle contacts the mannequin during a test trial, the PAEB speed reduction is calculated by subtracting the subject vehicle speed at the time of contact (i.e., when longitudinal range becomes zero) from the subject vehicle speed calculated from TTC = 4.0 seconds.
B. If the subject vehicle does not contact the mannequin during a test trial (i.e., PAEB intervention prevents the crash), the subject vehicle speed at the time of contact is taken to be zero. The speed reduction is therefore equal to the subject vehicle speed at TTC = 4.0 seconds.

Pedestrian Along Path

Subject Vehicle Approach to a Pedestrian Along Path

For each test, the following test parameters were used:

- The mannequin speed for pedestrian along path, stationary was 0 km/h (0 mph).
- The mannequin speed for pedestrian along path, moving was 5 km/h (3.1 mph) and acceleration distance was 1.5 m (4.9 ft)

Subject Vehicle Approach

For an individual test trial to be valid, the following held true throughout the test:

A. The subject vehicle driver's seatbelt was latched.
B. The subject vehicle driver cycled the ignition.
C. The subject vehicle was driven at the initial speed for each test.
    1. 10 km/h (6.2 mph)
    2. 20 km/h (12.4 mph)
    3. 30 km/h (18.6 mph)
    4. 40 km/h (24.8 mph)
    5. 50 km/h (31.0 mph)
    6. 55 km/h (34.2 mph) (Only for pedestrian along path, stationary scenario)
    7. 60 km/h (37.2 mph)
    8. 65 km/h (40.4 mph) (Only for pedestrian along path, moving scenario)

A. For pedestrian along path, moving only, mannequin motion begins when the longitudinal TTC of the subject vehicle = 7.0 seconds.
    1. 10 km/h (6.2 mph): TTC = 7.0 seconds occurs at 19.4 m (63.7 ft)
    2. 20 km/h (12.4 mph): TTC = 7.0 seconds occurs at 38.8 m (127.5 ft)
    3. 30 km/h (18.6 mph): TTC = 7.0 seconds occurs at 58.3 m (191.3 ft)
    4. 40 km/h (24.8 mph): TTC = 7.0 seconds occurs at 77.7 m (255.1 ft)
    5. 50 km/h (31.0 mph): TTC = 7.0 seconds occurs at 97.2 m (318.9 ft)
    6. 60 km/h (37.2 mph): TTC = 7.0 seconds occurs at 116.6 m (382.7 ft)
    7. 65 km/h (40.4 mph): TTC = 7.0 seconds occurs at 126.3 m (414.6 ft)
B. The test begins when the longitudinal TTC of the subject vehicle = 4.0 seconds.
    1. 10 km/h (6.2 mph): TTC = 4.0 seconds occurs at 11.1 m (36.4 ft)
    2. 20 km/h (12.4 mph): TTC = 4.0 seconds occurs at 22.2 m (72.9 ft)
    3. 30 km/h (18.6 mph): TTC = 4.0 seconds occurs at 33.3 m (109.3 ft)
    4. 40 km/h (24.8 mph): TTC = 4.0 seconds occurs at 44.4 m (144.8 ft)
    5. 50 km/h (31.0 mph): TTC = 4.0 seconds occurs at 55.5 m (182.2 ft)
    6. For pedestrian along path, stationary only, 55 km/h (34.2 mph): TTC = 4.0 seconds occurs at 61.1 m (200.3 ft)
    7. 60 km/h (37.2 mph): TTC = 4.0 seconds occurs at 66.6 m (218.7 ft)
    8. For pedestrian along path, moving only, 65 km/h (40.4 mph): TTC = 4.0 seconds occurs at 72.2 m (237.0 ft)
C. The subject vehicle maintained the center of the lane using a robot steering controller.

D. The yaw rate of the subject vehicle was checked to be within ± 1.0 deg/s.
E. The subject vehicle driver modulated the throttle, using smooth inputs, to maintain a constant subject vehicle speed.
F. The subject vehicle driver was instructed not to apply any force to the brake pedal unless the mannequin is contacted, or the subject vehicle has come to a complete stop (speed = 0) because the PAEB system has activated and prevented mannequin contact.
G. The instant the subject vehicle PAEB warning event is presented (visual, haptic, or audible) the SV throttle was fully released (within 500 msec). If no subject vehicle warning event is presented by the subject vehicle PAEB system, the subject vehicle driver was instructed to modulate the throttle to maintain a constant speed until either the onset of PAEB or, if the subject vehicle's PAEB does not activate, the end of the test occurs (i.e., contact with the mannequin).

Validity Period

A. The valid test interval begins when the longitudinal TTC of the subject vehicle = 4.0 seconds.
B. Test ends when any of the following occurs:
    1. Test scenario pedestrian along path, stationary
        i. The subject vehicle comes in contact with the mannequin; or
        ii. The subject vehicle comes to a stop before making contact with the mannequin.
    2. Test scenario along path, moving:
        i. The subject vehicle comes in contact with the mannequin; or
        ii. One second after the velocity of the subject vehicle becomes less than or equal to that of the pedestrian mannequin.

End-of-Test Instructions

A. After the test is complete, the subject vehicle driver shall manually apply force to the brake pedal, bring the vehicle to a stop (if necessary), and place the transmission in park.
B. The test trial is complete.

Speed Reduction

The magnitude of the subject vehicle speed reduction attributable to PAEB intervention is calculated in one of three ways, depending on whether a test trial concludes with the subject vehicle colliding with the mannequin.

A. For all pedestrian along path scenarios: If the subject vehicle contacts the mannequin during a test trial, the PAEB speed reduction is calculated by subtracting the subject vehicle speed at the time of contact (i.e., when longitudinal range becomes zero) from the subject vehicle speed calculated from TTC = 4.0 seconds.
B. For pedestrian along path, stationary scenario: If the subject vehicle does not contact the mannequin during a test trial (i.e., PAEB intervention prevents the crash), the subject vehicle speed at the time of subject vehicle and mannequin

contact is taken to be zero. The speed reduction is therefore equal to the subject vehicle speed at TTC = 4.0 seconds.

C. For pedestrian along path, moving scenario: If the subject vehicle does not contact the mannequin during a test trial (i.e., PAEB intervention prevents the crash), the speed reduction is calculated by subtracting the subject vehicle speed at the minimum longitudinal subject vehicle to mannequin range during the validity period from the subject vehicle speed at TTC = 4.0 seconds.

Appendix C: Test Results

Appendix Table C-1 Nissan Pathfinder Full Crossing Results

2023 Nissan Pathfinder SL AWD																															
V_{SV} (km/h)	Crossing																														
	Pedestrian Crossing Path from Right with 25% Overlap								Pedestrian Crossing Path from Right with 50% Overlap																						
	Adult				Child				Adult												Child										
	Daylight				Daylight				Daylight				Lower Beam				Upper Beam				Daylight				Lower Beam					
10	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance					
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
20	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance					
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
30	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance					
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance					
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40 (CC)									Avoidance																					
									-	-	-	-																		
50	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				17.5				Avoidance					
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	15.8	A	A	-	-	-	-		
60	14.2				Avoidance				Avoidance				Avoidance				Avoidance				13.9				Avoidance					
	37.2	41.9			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	20			-	-	-	-		

V_{SV} (km/h)	Crossing															
	Obstructed Running Child Crossing Path from the Right								Pedestrian Crossing Path from the Left							
	Child								Adult				Child			
	Real Vehicles				VTDs				Daylight				Daylight			
10	Avoidance				6.3				Avoidance				Avoidance			
	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
20	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	30.3				30.1				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	-				-				27				Avoidance			
	-	-	-	-	-	-	-	-	24.6	A	22.2	-	-	-	-	-

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-2 Nissan Pathfinder Full Along Path Results

2023 Nissan Pathfinder SL AWD																				
V_{SV} (km/h)	Along Path																			
	Pedestrian Along Path, Stationary																			
	Adult												Child							
	Daylight				Lower Beam				Upper Beam				Daylight				Lower Beam			
10	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Avoidance				Avoidance				Avoidance				Avoidance				16.3			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Avoidance				19.9				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Avoidance				-				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)	Avoidance																			
	-	-	-	-																
50	Avoidance				-				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	Avoidance				-				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	Avoidance				-				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V_{SV} (km/h)	Along Path																			
	Pedestrian Along Path, Moving																			
	Adult												Child							
	Daylight				Lower Beam				Upper Beam				Daylight							
10	9.8				7.9				7.9				9.8							
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
20	Avoidance				18.5				18.3				Avoidance							
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
30	Avoidance				-				-				Avoidance							
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
40	Avoidance				-				-				Avoidance							
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
40 (CC)	Avoidance																			
	-	-	-	-																
50	Avoidance				-				-				Avoidance							
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
60	8.8				-				-				Avoidance							
	19.9	A	A	A	-	-	-	-	-	-	-	-	-	-	-	-				
65	13.3				-				-				Avoidance							
	A	A	21.5	A	-	-	-	-	-	-	-	-	-	-	-	-				

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-3 Hyundai IONIQ 5 Full Crossing Results

2023 Hyundai Ioniq 5 Limited AWD									
	Crossing								
V_{SV} (km/h)	Pedestrian Crossing Path from Right with 25% Overlap		Pedestrian Crossing Path from Right with 50% Overlap						
	Adult	Child	Adult					Child	
	Daylight	Daylight	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight	Lower Beam
10	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)
20	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)			Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)
30	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)
40	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)			Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)
40 (CC)			Avoidance (-, -, -, -)						
50	8.7 (9.9, A, 6.7, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)			Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)
60	- (-, -, -, -)	30.4 (-, -, -, -)	Avoidance (-, -, -, -)	18.6 (26, 17, -, -)	17.6 (15, 14, -, -)	33.6 (-, -, -, -)	12 (A, A, A, A)	26.6 (21, 14, -, -)	20.9 (31, 44, -, -)

	Crossing					
V_{SV} (km/h)	Obstructed Running Child Crossing Path from the Right		Pedestrian Crossing Path from the Left			
	Child		Adult			Child
	Real Vehicles	VTDs	Daylight	High Regen	Far FCW	Daylight
10	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)
20	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)			Avoidance (-, -, -, -)
30	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)
40	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)	Avoidance (-, -, -, -)			Avoidance (-, -, -, -)
50	15.9 (17, 21, -, -)	18 (17, 18, -, -)	Avoidance (-, -, -, -)			Avoidance (-, -, -, -)
60			30.2 (-, -, -, -)	30.4 (-, -, -, -)	26.2 (25, 22, ,)	Avoidance (-, -, -, -)

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-4 Hyundai IONIQ 5 Full Along Path Results

2023 Hyundai Ioniq 5 Limited AWD

Along Path — Pedestrian Along Path, Stationary

V_{SV} (km/h)	Adult Daylight	Adult High Regen	Adult Far FCW	Adult Lower Beam	Adult Upper Beam	Child Daylight	Child Lower Beam
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
20	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -			- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
40	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -			- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
40 (CC)	Avoidance						
	- | - | - | -						
50	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -			- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
55	Avoidance			19	Avoidance	Avoidance	33.2
	- | - | - | -			A | 11 | 12 | -	- | - | - | -	- | - | - | -	- | - | - | -
60	Avoidance	Avoidance	Avoidance	-	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -

Along Path — Pedestrian Along Path, Moving

V_{SV} (km/h)	Adult Daylight	Adult High Regen	Adult Far FCW	Adult Lower Beam	Adult Upper Beam	Child Daylight
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
20	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
40	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
40 (CC)	Avoidance					
	- | - | - | -					
50	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
60	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -	- | - | - | -
65	19.5			38.9	16.5	7.7
	A | 6.2 | 16 | -			- | - | - | -	17 | 20 | - | -	6.3 | 6.7 | |

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-5 Toyota Corolla Full Crossing Results

2023 Toyota Corolla Hybrid FWD							
V_{SV} (km/h)	Crossing						
	Pedestrian Crossing Path from Right with 25% Overlap		Pedestrian Crossing Path from Right with 50% Overlap				
	Adult	Child	Adult			Child	
	Daylight	Daylight	Daylight	Lower Beam	Upper Beam	Daylight	Lower Beam
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
40	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	34
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
40 (CC)			Avoidance				
			- - - -				
50	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	-
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
60	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	-
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -

V_{SV} (km/h)	Crossing			
	Obstructed Running Child Crossing Path from the Right		Pedestrian Crossing Path from the Left	
	Child		Adult	Child
	Real Vehicles	VTDs	Daylight	Daylight
10	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -
20	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -
30	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -
40	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -
50	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -
60	Avoidance	25.9	Avoidance	Avoidance
	- - - -	A A 15.2 A	- - - -	- - - -

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-6 Toyota Corolla Full Along Path Results

2023 Toyota Corolla Hybrid FWD																				
V_{SV} (km/h)	Along Path																			
	Pedestrian Along Path, Stationary																			
	Adult												Child							
	Daylight				Lower Beam				Upper Beam				Daylight				Lower Beam			
10	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)	Avoidance																			
	-	-	-	-																
50	Avoidance				Avoidance				Avoidance				Avoidance				43.5			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	Avoidance				Avoidance				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	Avoidance				Avoidance				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

V_{SV} (km/h)	Along Path															
	Pedestrian Along Path, Moving															
	Adult												Child			
	Daylight				Lower Beam				Upper Beam				Daylight			
10	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)	Avoidance															
	-	-	-	-												
50	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-7 BMW iX Full Crossing Results

2023 BMW iX xDrive50									
	Crossing								
V_{SV} (km/h)	Pedestrian Crossing Path from Right with 25% Overlap		Pedestrian Crossing Path from Right with 50% Overlap						
	Adult	Child	Adult					Child	
	Daylight	Daylight	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight	Lower Beam
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	-
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	-
	- - - -	- - - -	- - - -			- - - -	- - - -	- - - -	- - - -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	-
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
40	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	-
	- - - -	- - - -	- - - -			- - - -	- - - -	- - - -	- - - -
40 (CC)			Avoidance						
			- - - -						
50	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	-
	- - - -	- - - -	- - - -			- - - -	- - - -	- - - -	- - - -
60	13.4	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	-
	A 11 A A	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -

	Crossing					
V_{SV} (km/h)	Obstructed Running Child Crossing Path from the Right		Pedestrian Crossing Path from the Left			
	Child		Adult			Child
	Real Vehicles	VTDs	Daylight	High Regen	Far FCW	Daylight
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20	Avoidance	Avoidance	Avoidance			Avoidance
	- - - -	- - - -	- - - -			- - - -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
40	Avoidance	Avoidance	Avoidance			Avoidance
	- - - -	- - - -	- - - -			- - - -
50	Avoidance	Avoidance	Avoidance			Avoidance
	- - - -	- - - -	- - - -			- - - -
60	Avoidance	22.1	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	15 30 - -	- - - -	- - - -	- - - -	- - - -

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-8 BMW iX Full Along Path Results

2023 BMW iX xDrive50

Along Path — Pedestrian Along Path, Stationary

V_{SV} (km/h)	Adult					Child	
	Daylight	**High Regen**	**Far FCW**	**Lower Beam**	**Upper Beam**	**Daylight**	**Lower Beam**
10	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -
20	Avoidance - - - -			Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -
30	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -
40	Avoidance - - - -			Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -
40 (CC)	Avoidance - - - -						
50	Avoidance - - - -			16.2 A 18 A A	Avoidance - - - -	Avoidance - - - -	24.6 A 23 49 -
55	Avoidance - - - -			Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	- - - - -
60	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	24.1 38 60 A A	Avoidance - - - -	Avoidance - - - -	- - - - -

Along Path — Pedestrian Along Path, Moving

V_{SV} (km/h)	Adult					Child
	Daylight	**High Regen**	**Far FCW**	**Lower Beam**	**Upper Beam**	**Daylight**
10	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	9.2 - - - -	9.3 - - - -	Avoidance - - - -
20	Avoidance - - - -			Avoidance - - - -	Avoidance - - - -	Avoidance - - - -
30	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -
40	Avoidance - - - -			Avoidance - - - -	Avoidance - - - -	Avoidance - - - -
40 (CC)	Avoidance - - - -					
50	Avoidance - - - -			28.4 - - - -	Avoidance - - - -	Avoidance - - - -
60	Avoidance - - - -	Avoidance - - - -	Avoidance - - - -	- - - - -	Avoidance - - - -	Avoidance - - - -
65	Avoidance - - - -			- - - - -	Avoidance - - - -	Avoidance - - - -

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-9 Ford F-150 Lightning Full Crossing Results

2023 Ford F-150 Lightning Super Crew									
V_{SV} (km/h)	Crossing								
	Pedestrian Crossing Path from Right with 25% Overlap		Pedestrian Crossing Path from Right with 50% Overlap						
	Adult	Child	Adult					Child	
	Daylight	Daylight	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight	Lower Beam
10	Avoidance	9.1	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	8.4	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -			- - - -	- - - -	- - - -	- - - -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
40	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -			- - - -	- - - -	- - - -	- - - -
40 (CC)			Avoidance						
			- - - -						
50	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -			- - - -	- - - -	- - - -	- - - -
60	Avoidance	7.3	Avoidance	Avoidance	Avoidance	24.4	Avoidance	Avoidance	16
	- - - -	A 25 A A	- - - -	- - - -	- - - -	34 A 31 -	- - - -	- - - -	23 20 - -

V_{SV} (km/h)	Crossing					
	Obstructed Running Child Crossing Path from the Right		Pedestrian Crossing Path from the Left			
	Child		Adult			Child
	Real Vehicles	VTDs	Daylight	High Regen	Far FCW	Daylight
10	9.5	Avoidance	7.3	5.1	Avoidance	10.2
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20	Avoidance	Avoidance	Avoidance			Avoidance
	- - - -	- - - -	- - - -			- - - -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
40	Avoidance	13.1	Avoidance			Avoidance
	- - - -	11 A 17 -	- - - -			- - - -
50	Avoidance	-	Avoidance			Avoidance
	- - - -	- - - -	- - - -			- - - -
60	39.1	-	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-10 Ford F-150 Lightning Full Along Path Results

2023 Ford F-150 Lightning Super Crew							
	Along Path						
	Pedestrian Along Path, Stationary						
	Adult					Child	
	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight	Lower Beam
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	9.6	10.4
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
	- - - -			- - - -	- - - -	- - - -	- - - -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
40	Avoidance			29.8	Avoidance	Avoidance	Avoidance
	- - - -			- - - -	- - - -	- - - -	- - - -
40 (CC)	Avoidance						
	- - - -						
50	Avoidance			-	Avoidance	Avoidance	44.9
	- - - -			- - - -	- - - -	- - - -	- - - -
55	Avoidance			-	Avoidance	Avoidance	-
	- - - -			- - - -	- - - -	- - - -	- - - -
60	Avoidance	Avoidance	Avoidance	-		Avoidance	-
	- - - -	- - - -	- - - -	- - - -		- - - -	- - - -

V_{SV} (km/h)	Along Path					
	Pedestrian Along Path, Moving					
	Adult					Child
	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight
10	6.6	Avoidance	Avoidance	Avoidance	Avoidance	10.4
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20	Avoidance			Avoidance	Avoidance	Avoidance
	- - - -			- - - -	- - - -	- - - -
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
40	Avoidance			Avoidance	Avoidance	Avoidance
	- - - -			- - - -	- - - -	- - - -
40 (CC)	Avoidance					
	- - - -					
50	Avoidance			14.9	Avoidance	Avoidance
	- - - -			A A A A	- - - -	- - - -
60	Avoidance	Avoidance	Avoidance	15.2	Avoidance	Avoidance
	- - - -	- - - -	- - - -	A 55 44 A	- - - -	- - - -
65	Avoidance			-	Avoidance	Avoidance
	- - - -			- - - -	- - - -	- - - -

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-11 Mazda CX-90 Full Crossing Results

V_{SV} (km/h)	2024 Mazda CX-90 AWD Turbo S Premium																											
	Crossing																											
	Pedestrian Crossing Path from Right with 25% Overlap								Pedestrian Crossing Path from Right with 50% Overlap																			
	Adult				Child				Adult												Child							
	Daylight				Daylight				Daylight				Lower Beam				Upper Beam				Daylight				Lower Beam			
10	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)									Avoidance																			
									-	-	-	-																
50	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				12.5			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	A	21	-
60	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

V_{SV} (km/h)	Crossing															
	Obstructed Running Child Crossing Path from the Right								Pedestrian Crossing Path from the Left							
	Child								Adult				Child			
	Real Vehicles				VTDs				Daylight				Daylight			
10	Avoidance				Avoidance				6.2				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	17.03				18.2				Avoidance				Avoidance			
	22	8.9	-	-	A	13	14		-	-	-	-	-	-	-	-
60	-				-				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed

Appendix Table C-12 Mazda CX-90 Full Along Path Results

2023 Mazda CX-90 AWD Turbo S Premium																				
V_{SV} (km/h)	Along Path																			
	Pedestrian Along Path, Stationary																			
	Adult												Child							
	Daylight				Lower Beam				Upper Beam				Daylight				Lower Beam			
10	Avoidance				5.4				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Avoidance				Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)	Avoidance																			
	-	-	-	-																
50	Avoidance				Avoidance				Avoidance				Avoidance				23.4			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	9.3	-	-
55	Avoidance				Avoidance				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	Avoidance				Avoidance				Avoidance				Avoidance				-			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

V_{SV} (km/h)	Along Path															
	Pedestrian Along Path, Moving															
	Adult												Child			
	Daylight				Lower Beam				Upper Beam				Daylight			
10	6.3				9.5				8.9				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)	Avoidance															
	-	-	-	-												
50	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	Avoidance				Avoidance				Avoidance				Avoidance			
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	Avoidance				44.6				Avoidance				Avoidance			
	-	-	-	-					-	-	-	-	-	-	-	-

Avoidance	A	Full Avoidance on Test
X	X	Contact at X (km/h)
-	-	Test not Performed