



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

April 2024

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16. Abstract In 2023, NHTSA performed test track (PAEB) of six light vehicles. Pedestri- different ambient and subject vehicle were performed following the test pro- light vehicles notice for proposed rule performed to test the effects of user a settings, the use of cruise control duri scenario, and variation in pedestrian b	c evaluations of the pedestrian automat an crossing, stationary, and along path lighting conditions at SV speeds rangi ocedures outlined in the automatic eme emaking (NPRM) published in June 20 djustable forward collision warning (Fong a test, the type of object used as the peight Crash avoidance and SV impact	ic eme scenar ng fror rgency 23 [1]. CW) a obstru	rgency braking sys rios were performed n 10 km/h to 65 km braking (AEB) sys Additional tests w nd regenerative bra action in the obstrue results are summa	tems d under n/h. Tests stems for ere king vehicle cted test rized for	
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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
РТМ	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.

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

Table 2-1 Subject Vehicles for PAEB Testing

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.

Scenario	Mannequin	Path Origin	SV Overlap (%)	Obstruction?	SV Speed Range (km/h)	Mannequin Speed (km/h)	Movement Classification	Light Condition
	Adult	Right	25	No	10-60	5	Walk	Daylight
Pedestrian Crossing Path	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

Table 2-2 Pedestrian Crossing Path Scenario Test Matrix

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.

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

Table 2-3 Pedestrian Along Path Scenario Test Matrix

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.

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



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.

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

Table 2-5 FCW Supplemental Test Matrix

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.

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

Table 2-7 Cruise Control Supplemental Test Matrix

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%	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.

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

Table 2-9 Pedestrian Mannequin Size Supplemental Test Matrix

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.

Te	est Scenario:	Ad th	ult C ne Rig	rossi ght, 2	ng Pa 25% C	th fr Verla	om ap	Ad th	ult C ne Rig	rossi ght, 5	ng Pa 60% C	ith fro Overla	om ap	Ch Pa	ild O ith fr	bstru om t Ove	icted he Rig erlap	Cros ght, !	sing 50%	A	dult C the L	crossi eft, 5	ing Pa 0% C	ath fr Iverla	om ap
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
Niss	an Pathfinder	А	А	А	А	А	14	А	А	А	А	А	А	6	А	А	А	30	-	А	А	А	А	А	27
Ну	Hyundai IONIQ 5 A A A A 9			-	А	А	А	А	А	А	А	А	А	А	18	-	А	А	А	А	А	30			
То	Toyota Corolla A A A			А	Α	А	А	А	А	А	А	А	А	А	А	А	А	24	А	А	А	А	А	А	
	BMW iX	А	А	А	А	А	13	А	А	А	А	А	А	Α	А	Α	А	А	22	А	А	А	А	А	А
Ford	F-150 Lightning	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	13	-	-	7	А	А	А	А	А
Iv	1azda CX-90	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	18	-	6	А	А	А	А	А
А	A Crash avoidance																								
XX	Contact in first trial at XX km/h																								
-	Test was not pe	rforn	ned																						

Table 3-1 Daylight Pedestrian Crossing Path Crash Avoidance Summary

*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.

	Test Scenario:	A	dult A	long 25%	; Path 6 Ove	n Stat rlap	iona	ry,	Ad	ult Al	long O	Path verla	Movi Ip	ing, 2	25%
S	V Speed (km/h):	10	20	30	40	50	55	60	10	20	30	40	50	60	65
N	issan Pathfinder	А	А	А	А	А	А	А	10	А	А	А	А	9	13
H	Iyundai IONIQ 5	А	А	А	А	А	Α	Α	А	А	А	А	Α	А	20
	Toyota Corolla	А	А	А	А	А	Α	Α	А	А	А	А	Α	А	Α
	BMW iX	А	А	А	А	А	Α	А	А	А	А	А	Α	А	Α
Foi	rd F-150 Lightning	А	А	А	А	А	А	Α	7	А	А	А	Α	А	Α
	Mazda CX-90	А	А	А	А	А	А	Α	6	А	А	А	Α	А	Α
А	Crash avoidance														
XX	Contact in first trial at XX km/h														

Table 3-2 Daylight Pedestrian Along Path Crash Avoidance Summary

Darkness Conditions

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

-	Tost Sconaria:	Adult Crossing Path from the Right, 50% Overlap,												
	lest Scenario.						Dark	ness						
Ligl	hting Condition:		L	owei	Bea	m			ι	Ipper	Bea	m		
SV	′ Speed (km/h):	10	20	30	40	50	60	10	20	30	40	50	60	
Nis	ssan Pathfinder	Α	А	Α	А	Α	А	А	Α	А	Α	А	А	
Ну	undai IONIQ 5	А	А	Α	Α	Α	34	А	Α	А	Α	Α	12	
т	oyota Corolla	А	А	А	А	А	А	А	А	А	А	А	А	
	BMW iX	А	Α	А	А	Α	А	А	А	А	А	А	А	
Ford	d F-150 Lightning	А	А	А	А	А	24	А	А	А	А	А	А	
	Mazda CX-90	А	Α	Α	Α	Α	А	А	Α	А	Α	Α	А	
А	Crash avoidance													
XX	Contact in first trial at XX km/h													

 Table 3-3 Darkness Pedestrian Crossing Path Crash Avoidance Summary

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

Т	est Scenario:			Adult	Alon	g Path	n Stati	ionar	y, 259	% Ov	erlap	, Dar	knes	5				Adu	lt Alo	ng Pa	th M	oving	, 25%	5 Ove	lap,	Dark	ness		
Ligh	ting Condition:			Lov	wer B	eam					Upp	oer B	eam					Lov	ver B	eam					Upp	oer Be	eam		
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
Nis	san Pathfinder	А	Α	20	-	-	-	-	А	А	А	А	А	А	А	8	19	-	-	-	-	-	8	18	-	-	-	-	-
Ну	undai IONIQ 5	А	А	А	А	А	19	-	А	А	А	Α	А	А	А	А	А	А	Α	А	А	39	А	А	А	Α	А	А	17
Тс	oyota Corolla A A A A A A			А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А			
	BMW iX	А	Α	Α	Α	16	А	24	А	Α	А	Α	А	А	А	9	А	А	А	28	-	-	9	А	А	Α	А	Α	А
Ford	F-150 Lightning	А	А	А	30	-	-	-	А	А	А	А	А	А	А	А	А	А	Α	15	15	-	А	А	А	А	А	А	А
Ν	/lazda CX-90	5	Α	А	Α	А	А	А	А	А	Α	Α	А	А	Α	10	А	А	А	А	Α	45	9	А	А	Α	А	А	А
А	A Crash avoidance																												
ХХ	XX Contact in first trial at XX km/h																												
-	Test was not pe	rforn	ned																										

Table 3-4 Darkness Pedestrian Along Path Crash Avoidance Summary

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.

	Test Scenario: SV Speed (km/h): Close FCW Hyundai IONIQ 5 Close FCW BMW iX Close FCW Far FCW Close FCW Far FCW Close FCW Far FCW Close FCW			Adul rossi ith fro e Rig 6 Ove	t ng om ht, erlap	C Pa ti 50%	Adul rossi ith fro he Le 6 Ove	t ng om ft, erlap	Adı Sta	ult Al Path tiona 25% overla	ong ary, p	Adu N O	ult Al Path Iovin 25% Verla	ong g, ap
	SV Speed (km/h):			30	60	10	30	60	10	30	60	10	30	60
Ī		Close FCW	А	А	А	А	А	30	А	А	А	А	А	Α
		Far FCW	А	А	18	А	А	30	А	А	А	А	А	А
		Close FCW	А	А	А	А	А	А	А	А	А	А	А	А
	DIVIVVIA	Far FCW	Α	А	А	А	А	А	А	А	А	А	А	Α
	Found F 150 Linkstoine	Close FCW	А	А	А	7	А	А	А	А	А	7	А	Α
	Ford F-150 Lightning Far FCW		А	А	А	А	А	А	А	А	А	А	А	Α
А	Crash avoidance													
XX	Contact in first trial at XX	km/h												

Table 3-5 FCW Supplemental	l Test Results Summary
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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.

	Test Scenar	io:	C Pa th 50%	Adul rossi th fro e Rig 6 Ove	t ng om ht, erlap	C Pa tł 50%	Adul rossi th fro ne Le 6 Ove	t ng om ft, erlap	Adı Sta O	ult Al Path tiona 25% verla	ong ary, Ip	Adu N O	ult Al Path Iovin 25% verla	ong g, p
	SV Speed (km	/h):	10	30	60	10	30	60	10	30	60	10	30	60
		Low Regen.	А	А	А	А	А	30	А	Α	Α	А	А	А
		High Regen	А	А	18	А	А	30	А	А	А	А	А	А
		Low Regen.	А	А	А	А	А	А	А	А	А	А	А	А
	DIVIVV IX	High Regen	А	А	А	А	А	А	А	А	А	А	А	Α
5.0	nd E 1E0 Liebtwine	Low Regen.	А	Α	А	7	А	А	А	А	А	7	Α	А
FO	Ford F-150 Lightning High Regen			А	А	5	А	А	А	А	А	А	А	Α
А	Crash avoidance													
XX	Contact in first trial	at XX km/h												

Table 3-6 Regenerative Braking Supplemental Test Results Summary

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.

	-	Test Scenario:	Adult Crossing Path from the Right, 50% Overlap	Adult Along Path Stationary, 25% Overlap	Adult Along Path Moving, 25% Overlap							
	S۱	/ Speed (km/h):	40	40	40							
-	Fovota Carolla	Cruise Control Off	А	А	А							
	loyota Corona	Cruise Control Enabled and Set	А	А	А							
NI:	acon Dothfindor	Cruise Control Off	А	А	А							
	ssan Pathinder	Cruise Control Enabled and Set	А	А	А							
For	d E 1E0 Liabtaina	Cruise Control Off	А	А	А							
FOR	a F-150 Lightning	Cruise Control Enabled and Set	А	А	А							
	DRAVAL IV	Cruise Control Off	А	А	А							
		Cruise Control Enabled and Set	А	А	А							
	Manda CV 00	Cruise Control Off	А	А	А							
		Cruise Control Enabled and Set	А	А	А							
L		Cruise Control Off	A	A	A							
п		Cruise Control Enabled and Set	A	A	A							
А	Crash avoidance											
XX	Contact in first trial at XX km/h											

Table 3-7 Cruise Control Supplemental Test Results Summary

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.

	Test Scenario:		Child Ok	structed C	rossing Pat	h from the	Right, 50%	Overlap
	SV Speed (km/h):		10	20	30	40	50	*60
	Toyota Corolla	VTDs	А	А	А	А	А	26
	Toyota Corolla	Real Vehicles	А	А	А	А	А	А
	Nisson Dathfindar	VTDs	6	А	А	А	30	-
	Nissan Patilinuer	Real Vehicles	А	А	А	А	30	-
	Foud F 150 Lightning	VTDs	А	А	А	13	-	-
	Ford F-150 Lightning	Real Vehicles	10	А	А	А	А	39
		VTDs	А	А	А	А	А	22
	BIVIW IX	Real Vehicles	А	А	А	А	А	А
	Marda CV 00	VTDs	А	А	А	А	18	-
		Real Vehicles	А	А	А	А	17	-
		VTDs	А	А	А	А	18	-
		Real Vehicles	А	А	А	А	16	-
А	Crash avoidance							
ХХ	Contact in first trial at XX km/	า						
-	Test was not performed.							

Table 3-8 Obstruction Devices Supplemental Test Results Summary

*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.

	Test Scenari	o:	Pe	destr from	ian C the F	rossi Right	ng Pa , 25%	ath	Pe	destr from	ian C the I	Crossi Right	ing Pa , 50%	ath 6	Pe	destr from	ian C the	Crossi Right	ng Pa , 50%	ath 6	Pe	destr from	ian C i the	rossi Left,	ng Pa 50%	ath
Pedestrian Crossing PartPedestrian Crossing PartPartPedestrian Crossing PartPartPartPart																										
	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
_		Adult PTM	Α	Α	Α	Α	Α	Α	Α	А	А	Α	Α	Α	А	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α
10	oyota Corolla	Child PTM	А	Α	Α	Α	Α	Α	А	А	А	А	А	Α	А	Α	Α	34	-	-	Α	Α	Α	Α	Α	Α
Nia	nor Dothfindor	Adult PTM	Α	А	Α	А	Α	14	Α	Α	Α	Α	Α	Α	А	А	Α	Α	Α	А	А	Α	Α	Α	А	27
INIS	san Patnfinder	Child PTM	Α	А	А	А	Α	Α	Α	Α	Α	Α	18	14	А	А	Α	А	Α	Α	А	Α	Α	Α	Α	Α
Ford	5 150 Lightning	Adult PTM	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	24	7	А	Α	Α	А	Α
Foru	F-150 Lightning	Child PTM	9	А	А	Α	Α	7	8	Α	Α	А	А	Α	А	А	А	А	А	16	10	А	Α	Α	A	А
		Adult PTM	Α	А	Α	А	Α	13	А	А	Α	Α	Α	Α	А	А	Α	Α	Α	Α	А	Α	Α	Α	А	А
	BIVIVV IX	Child PTM	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	А	-	-	-	-	-	-	А	Α	Α	Α	А	Α
	Marda CV 00	Adult PTM	А	Α	А	Α	Α	Α	Α	Α	Α	А	Α	А	Α	Α	Α	А	А	А	6	А	Α	Α	А	Α
ľ		Child PTM	А	А	А	Α	Α	Α	A	A	A	А	А	А	A	А	А	А	13	-	А	Α	Α	Α	А	Α
Цл		Adult PTM	А	Α	Α	Α	9	-	Α	Α	Α	А	А	Α	Α	Α	Α	Α	Α	34	А	Α	Α	Α	А	30
пу		Child PTM	А	А	Α	А	Α	30	А	А	А	А	А	27	А	А	А	Α	А	21	А	Α	А	Α	А	А
А	Crash avoidance		_											_												
XX	Contact in first t	rial at XX km/	′h																							
-	Test was not per	formed																								

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

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

	Test Scenari	o:		Ped Stati	lestri onar	an A y, 25	long % Ov	Path /erlap	0	Ped	estri	an Al 25%	ong P % Ove	ath S erlap	tatio	nary,	Ped	lestri	an A 25%	long ove	Path rlap	Movi	ing,
	Lighting Condit	tion:			D	aylig	ht				Dar	knes	s - Lo	wer E	Beam				D	aylig	ht		
	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
т	iovota Corolla	Adult PTM	А	А	А	А	Α	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А	А
I	Oyota Corolla	Child PTM	А	А	А	А	Α	А	А	А	А	А	А	44	-	-	А	А	А	А	А	А	А
NI	soon Dothfindor	Test Scenario: Lighting Condition: SV Speed (km/h): SV vota Corolla Adult PTM Child PTM Adult PTM an Pathfinder Adult PTM Child PTM Adult PTM Adult PTM Adult PTM	Α	А	А	А	Α	Α	А	А	А	20	-	I	-	-	10	А	А	А	А	9	13
INIS	ssan Patninder	rest scenario: ighting Condition: SV Speed (km/h): ta Corolla Child PTM Child PTM Child PTM Child PTM Child PTM	Α	Α	А	А	Α	Α	А	А	16	-	-	-	-	-	10	А	А	А	А	Α	А
Ford	E 150 Lightning	Test Scenario: .ighting Condition: SV Speed (km/h): ta Corolla Adult PTM Child PTM Pathfinder Adult PTM Child PTM Child PTM Adult PTM Adult PTM Adult PTM	А	А	А	А	Α	А	А	А	А	А	30	I	-	-	7	А	А	А	А	А	А
FOIL	r-150 Lightning	Child PTM	10	А	А	А	Α	Α	А	10	А	А	А	45	-	-	10	А	А	А	А	А	А
	DRAMA IN	Adult PTM	А	А	А	А	А	Α	А	А	А	Α	А	16	А	24	А	А	А	А	А	А	А
	DIVIVV IX	Child PTM	А	А	А	А	А	Α	А	А	А	Α	А	25	-	-	А	А	А	А	А	А	А
		Adult PTM	А	Α	Α	А	Α	Α	А	5	А	Α	А	А	А	А	6	А	А	А	А	А	А
l	iviazda CX-90	Child PTM	Α	Α	Α	Α	Α	Α	Α	А	А	Α	А	23	-	-	А	А	А	Α	Α	А	Α
		Adult PTM	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	А	19	-	А	А	А	Α	Α	Α	20
Ну	/undai IONIQ 5	Child PTM	А	А	А	А	А	А	А	А	А	А	А	А	33	-	А	А	А	А	А	А	8
А	Crash avoidance																						
ХХ	Contact in first tr	ial at XX km/ł	۱																				
-	Test was not perf	formed																					

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

*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		Regene	rative Brak	ing
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

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	$\pm 1.0 \text{ deg/s}$
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	$4.0 \pm 0.1 \text{ m} (13.1 \text{ ft})$
PTM Start Distance Crossing from Left	$6.0 \pm 0.1 \text{ m} (19.6 \text{ ft})$
PTM Acceleration Distance	1.5 m (4.9 ft)

Appendix Table B-1 PAEB Test Validity Conditions

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: $4.0 \pm 0.1 \text{ m} (13.1 \text{ ft})$
- The mannequins start distance from the left: $6.0 \pm 0.1 \text{ m} (19.6 \text{ ft})$
- 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

											2023	Nissa	n Pa	thfind	er SL	AW	D											
														Cros	sing													
V _{sv}	Pe	destr	ian C witł	rossir 1 25%	ng Par 6 Ove	th fro rlap	om Rig	ght					Р	edest	rian (Crossi	ing P	ath fr	om R	ight v	vith 5	0% O	verla	ւթ				
(km/h)		Ad	ult			Ch	nild							Ad	ult									Ch	ild			
		Day	light			Day	light			Day	light		Ι	lower	Bear	n	I	Upper	Bear	n		Dayl	ight		L	ower	Beam	
10		Avoi	dance			Avoi	dance	1		Avoi	dance	1		Avoi	lance			Avoi	dance	1		Avoid	ance			Avoid	ance	
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20		Avoi	dance			Avoi	dance			Avoi	dance			Avoi	lance			Avoi	dance			Avoid	lance			Avoid	ance	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30		Avoi	dance	1		Avoi	dance	1		Avoi	dance	1		Avoi	lance			Avoi	dance	1		Avoid	lance			Avoic	ance	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40		Avoi	dance			Avoi	dance			Avoi	dance	1		Avoi	lance			Avoi	dance			Avoid	ance			Avoic	ance	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)										Avoi	dance	1																
. ,			1				1		-	-	-	-			1				1			17	~					
50		Avoi	dance			Avoi	dance			Avoi	dance	1		Avoi	lance			Avoi	dance			17.	.5			Avoic	ance	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	15.8	A	A	-	-	-	-
60	27.2	14	•. <i>L</i>			Avoi	dance	1		Avoi	dance			Avoi	lance			AVOI	dance		20	15.	.9			Avoic	ance	
	37.2	41.9			-	-	-	- Crea	-	-	-	-	-	-	-	-	-	-	-	-	29	20			-	-	-	-
	Ohat	moto	d Du	nnina	Chil	1 Cro	coina	Doth	ssing																			—
V _{sv}	Obst	inucte	u Ku fr	om th	e Ria	i Ciu: ht	ssing	I ath	Ped	estria	an Cr	ossing	g Patl	ı fron	the l	Left		Av	voidar	nce	А		Full	ΙΔνοί	dance	on T	est	
(km/h)				Ch	nild	;iit				Ac	hilt			Ch	ild				X		x		C	ontact	at X	(km/ł	1)	
	R	eal V	ehicle	es es		VT	Ds			Dav	light			Dav	light				-		-		Te	est no	t Per	forme	., d	
		Avoi	dance	~~		6	.3			Avoi	dance			Avoi	lance												-	
10	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-												
20		Avoi	dance			Avoi	dance			Avoi	dance			Avoi	lance													
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
20		Avoi	dance			Avoi	dance			Avoi	dance			Avoi	lance													
30	-	-	-	-	1	-	-	1	-	•	-	1	I	-	-	-												
40		Avoi	dance			Avoi	dance			Avoi	dance			Avoi	lance													
40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
50		30	0.3			30).1			Avoi	dance			Avoi	lance													
00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
60			-				-			2	27			Avoi	lance													
	-	-	-	-	-	-	-	-	24.6	Α	22.2	-	-	-	-	-												

Appendix Table C-1 Nissan Pathfinder Full Crossing Results

						2023	Nissa	ın Pa	thfind	er SL	AW	D							
									Along	g Path	1								
V _{sv}						Р	edest	trian .	Along	Path	, Stat	tionai	у						
(кт/п)					Ad	lult									Cł	nild			
		Daylight		I	Lower	Bear	n	ι	Jpper	Bear	n		Day	light		I	lowei	Bea	m
10		Avoidance	•		Avoi	dance			Avoi	dance			Avoi	dance			Avoi	dance	
10	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20		Avoidance			Avoi	dance	1		Avoi	dance			Avoi	dance			16	5.3	1
	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30		Avoidance			19	9.9	1		Avoi	dance			Avoi	dance				-	-
	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40		Avoidance				-	-	-	Avoi	dance	[Avoi	dance	[-	-
	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)		Avoidance																	
	-		-	_					<u>.</u>	1				1					
50		Avoidance				-			AVOI	hance			AV01	dance				-	
	-		-	-	-	-	-	-	-	- donoo	-	-	-	- danaa	-	-	-	-	-
55		Avoidance	; T			-			Avoi	lance			Avoi	dance				-	
	-	Avoidance	<u> </u>	-	-	-	-	-	Avoi	dance		-	Avoi	dance		-	-		-
60	_	Avoidance	Í I	-		_	_	_	Avon	lance	_	_	AVOI	uanee	_	_	_		_
				I			Along	r Patl				I	L						
								,											
V _{SV}					Pede	striai	1 Alor	ıg Pa	th, M	oving							Av	oidai	nce
(km/h)					Ad	lult							Cł	nild				Х	
		Daylight		I	Lower	Beau	n	l	Jpper	Bear	n		Dav	light				-	
10		9.8	-		7	0					11			<u> </u>					
10	-				- /	.9	_		7	.9	11		9	.8					
20			-	-	-	.9 -	-	-	- 7	.9 -	n -	-	9	.8	-				
		Avoidance	- 2	-	- 18	.9 - 3.5	-	-	7 - 18	.9 - 3.3	n -	-	9 - Avoi	.8 - dance	-				
	-	Avoidance	- -	-	- 18 -	.9 - 3.5 -	-	-	7 - 18 -	.9 - 3.3 -	- -	-	9 - Avoi -	.8 - dance -	-				
30	-	Avoidance Avoidance	- - -	-	- 18	.9 - 3.5 -	-	-	7 - 18 -	.9 - 3.3 -	n - -	-	9 - Avoi - Avoi	.8 - dance - dance	-				
30	-	Avoidance Avoidance 	- - -	-	- 18 -	.9 - 3.5 - - -	-	-	7 - - - -	.9 - 3.3 - -	-	-	9 Avoi - Avoi -	.8 dance dance dance	-				
30 40	-	Avoidance Avoidance Avoidance	- - - - -	-	- 18 -	.9 - 3.5 - - -	-	-	7	.9 	-	-	9 Avoi - Avoi - Avoi	dance	-				
30 40	-	Avoidance Avoidance Avoidance 	- - - -	-	- 18	.9 - 3.5 - - -	-	-	7	.9 	- -	-	9 Avoi - Avoi - Avoi -	.8 - dance - dance - dance -	-				
30 40 40 (CC)	-	Avoidance Avoidance Avoidance Avoidance	- - - - - - -	-	- 18	.9 - 3.5 - - - -	-	-	7 - - - -	.9 	-	-	9 Avoi - Avoi - Avoi	dance - dance - dance -	-				
30 40 40 (CC)	-	Avoidance Avoidance Avoidance Avoidance		-		.9 - 3.5 - - -	-	-	7 - - - - -	.9 - 3.3 - - - -	-		9 Avoi - Avoi - Avoi -	.8 - dance - dance - dance -	-				
30 40 40 (CC) 50	-	Avoidance Avoidance Avoidance Avoidance Avoidance		- - - -	- 18	.9 - 3.5 - - -	-	-	7 - - - - - -	.9 - 3.3 - - - - -	-		9 Avoi - Avoi - Avoi - Avoi	.8 - dance - dance - dance - dance	-				
30 40 40 (CC) 50	-	Avoidance Avoidance Avoidance Avoidance Avoidance Avoidance Avoidance		- - - - - - - - - - - - -	- 18 - - - - -	.9 - 3.5 - - - - -	-	-	7 - - - - -	.9 	-		9 Avoi - Avoi - Avoi - Avoi	dance	-				
30 40 40 (CC) 50 60	- - - - - -	Avoidance Avoidance Avoidance Avoidance Avoidance Avoidance					-	-		.9 	-		9 Avoi - Avoi - Avoi - Avoi - Avoi	dance dance dance dance dance	-				
30 40 40 (CC) 50 60		Avoidance Avoidance Avoidance Avoidance Avoidance Avoidance 8.8 A A A A	- - - - - - - - - - - - - - - - -			- - - - - - - - - -		-	7 - 18 - - - - - - - - -	.9 	-		9 Avoi - Avoi - Avoi - Avoi - Avoi -	dance - dance - dance - dance - dance - dance	-				

Appendix Table C-2 Nissan Pathfinder Full Along Path Results

А

Х

-

Full Avoidance on Test Contact at X (km/h)

Test not Performed

				2023 Hyunda	i Ioniq 5 Limited A	AWD			
			1		Crossing				
Vsv	Pedestrian Cro	ssing Path from		P	edestrian Crossin	g Path from Right	t with 50% Overla	ар	
(km/h)	Right with 2	5% Overlap Child			Adult	0 0		- Chi	ild
	Davlight	Davlight	Davlight	High Regen	Far FCW	Lower Beam	Upper Beam	Davlight	Lower Beam
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
10									
20	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
20			- - - -			- - - -	- - - -		
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance
				- - - -	- - - -				
40	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
	- 1 - 1 - 1 -		Avoidance						- 1 - 1 - 1 - 1
40 (CC)									
50	8.7	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
50	9.9 A 6.7 -								
60	-	30.4	Avoidance	18.6	17.6	33.6	12	26.6	20.9
00				26 17	15 14	- - - -	A A A A	21 14	31 44
			Cro	ssing					
Vsv	Crossing Path	from the Dight	Р	edestrian Crossing	g Path from the L	eft	Avoidance	A Full Avoid	lance on Test
(km/h)	<u>Crossing 1 atri</u> Ch	nild		Adult		Child	X	X Contact	at X (km/h)
	Real Vehicles	VTDs	Daylight	High Regen	Far FCW	Daylight	-	- Test not	Performed
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance			
10			- - - -	- - - -	- - - -	- - - -			
20	Avoidance	Avoidance	Avoidance			Avoidance	-		
				A	A		-		
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance			
	Avoidance	Avoidance	Avoidance			Avoidance			
40							1		
50	15.9	18	Avoidance			Avoidance			
30	17 21	17 18				- - - -			
60			30.2	30.4	26.2	Avoidance	4		
					25 22				

Appendix Table C-3 Hyundai IONIQ 5 Full Crossing Results

			2023 Hyunda	i Ioniq 5 Limited A	AWD		
				Along Path			
V _{sv}			Pedestr	ian Along Path, St	ationary		
(km/h)			Adult			Ch	nild
	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)							
50	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance
30							
55	Avoidance			19	Avoidance	Avoidance	33.2
	- - - -			A 11 12 -			- - - -
60	Avoidance	Avoidance	Avoidance	-	Avoidance	Avoidance	Avoidance
	- - - -		- - - - - -		- - - -	- - - -	- - - -
			Along	g ratii			
Vsv			Pedestrian Alo	ng Path, Moving			Avoidance A
(km/h)			Adult			Child	ХУ
	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight	
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
10							
20	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
20			- - - -	- - - -	- - - -		
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
	- - - -	- - - -	- - - -	<u>- - - -</u>			
40	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
40 (CC)	Avoidance						
40 (CC)							
50	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
	- - - -	- - - -	- - - -	<u> - </u>	<u>- - - -</u>	- - - -	
60	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
		- - - -	- - - -				
65	A 6.2 16 -				16.5	6.3 6.7	

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

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

										202	3 To	yota	Cor	olla	Hyb	rid F	WD											
														Cro	ssing	;												
V _{SV}	P	edes Rig	trian ght w	Cro ith 2	ssin 5%	g Pa Ove	th fro rlap	m				Р	edes	tria	n Cro	ossin	g Pa	th fr	om	Righ	t wit	h 509	% O	verla	ıp			
(кш/п)		Ad	lult			C	hild							A	dult									Ch	ild			
		Day	light	;		Day	/light	;		Day	/light	t	L	owe	r Bea	m	U	pper	Bea	am		Day	light		L	ower	Bea	ım
10		Avoi	danc	e		Avoi	dance	e		Avoi	danc	e		Avoi	danc	e		Avoi	danc	e		Avoi	lance	e		Avoi	danc	e
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20		Avoi	danc	e		Avoi	dance	e		Avoi	danc	e		Avoi	idanco	e		Avoi	danc	e		Avoi	lance	e		Avoi	danc	e
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30		Avoi	danc	e		Avoi	dance	e		Avoi	danc	e		Avoi	idanco	e		Avoi	danc	e		Avoi	lance	e	1	Avoi	danc	e
50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40		Avoi	danc	e		Avoi	dance	e		Avoi	danc	e		Avoi	danc	e		Avoi	danc	e		Avoi	lance	e		3	4	
40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)										Avoi	danc	e																
40 (CC)									-	-	-	-																
50		Avoi	danc	e		Avoi	dance	e		Avoi	danc	e		Avoi	idanc	e		Avoi	danc	e		Avoi	lance	e			-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60		Avoi	danc	e		Avoi	dance	e		Avoi	danc	e		Avoi	idanco	e		Avoi	danc	e		Avoi	lance	e			-	-
00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
								Cros	ssing	3																		
Ver		Obs	truct	ed F	Runn	ing (Child		P	edes	trian	Cro	ssin	g Pa	th fro	m		Av	oida	nce	Α							
(km/h)	(loss	ing I	Path	fron	n the	Rig	ht				the	Left										Full /	Avoid	danc	e on	Test	t
(1111/11)				Ch	nild					Ad	lult			C	hild				X		Х		Cor	ntact	r at X	(km	n/h)	
	R	eal V	ehic.	les		V	IDs .			Day	/light	t		Day	vlight				-		-		Tes	st no	t Pei	form	ned	
10		Avoi	dance	e		Avoi	dance	e		Avoi	danc	e		Avo	danc	e												
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
20		Avoi	dance	e		Avoi	dance	e		Avo1	danc	e		Avo	danc	e												
	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-												
30	-	Avoi -		-	-	Avoi -	dance	-	-	Avoi -		e -	-	Avo:		-												
		Avoi	danc	e		Avoi	dance	e		Avoi	danc	e		Avoi	idanc	e												
40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1											
		Avoi	danc	e		Avoi	dance	e		Avoi	danc	e		Avoi	idanc	e	1											
50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1											
(0)		Avoi	dance	e		2	5.9			Avoi	danc	e		Avoi	idanco	e	1											
60	-	-	-	-	А	Α	15.2	А	-	-	-	-	-	-	-	-]											

Appendix Table C-5 Toyota Corolla Full Crossing Results

		2023 Toyota	Corolla Hybrid F	WD		
			Along Path			
V _{sv}		Pedestr	ian Along Path, St	ationary		
(km/h)		Adult		Ch	nild	
	Daylight	Lower Beam	Upper Beam	Daylight	Lower Beam	
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
10						
20	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
20						
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
30						
40	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
40						
	Avoidance					
+0 (CC)						
50	Avoidance	Avoidance	Avoidance	Avoidance	43.5	
30						
55	Avoidance	Avoidance	Avoidance	Avoidance	-	
55						
60	Avoidance	Avoidance	Avoidance	Avoidance		
00						
		Along	g Path			
V _{sv}		Pedestrian Alo	ng Path, Moving		Avoidance A	Full Avoidance on Test
(Km/h)		Adult		Child	X X	Contact at X (km/h)
	Daylight	Lower Beam	Upper Beam	Daylight		Test not Performed
10	Avoidance	Avoidance	Avoidance	Avoidance		
10						
20	Avoidance	Avoidance	Avoidance	Avoidance		
20						
30	Avoidance	Avoidance	Avoidance	Avoidance		
00						
40	Avoidance	Avoidance	Avoidance	Avoidance		
40 (CC)	Avoidance					
10 (CC)						
50	Avoidance	Avoidance	Avoidance	Avoidance		
50	- - - -		- - - -	- - - -		
60	Avoidance	Avoidance	Avoidance	Avoidance		
00	- - - -	- - - -	- - - -	- - - -		
65	Avoidance	Avoidance	Avoidance	Avoidance		
05	- - - -			- - - -		

Appendix Table C-6 Toyota Corolla Full Along Path Results

	2023 BMW iX xDrive50												
	Crossing Pedestrian Crossing Path from												
Vsv	Right with 25	5% Overlap		Р	edestrian Crossin	g Path from Right	t with 50% Overla	p					
(km/h)	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	-				
20			- - - -			- - - -	- - - -		- - - -				
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance					
				- - - -	- - - -				- - - -				
40													
40 (00)			Avoidance										
40 (CC)													
50	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance					
				Avaidanaa	Avaidanaa				- - - -				
60	A 11 A A							Avoidance					
			Cro	ssing									
Var	Obstructed R	unning Child	Р	edestrian Crossino	Path from the La	>ft	Avoidance	А					
(km/h)	Crossing Path f	from the Right			,		N N	Full Avoidance on Test					
x · · ,	Chi Real Vahiclas	lld VTDe	Devlight	Adult High Regen	For FCW	Child Devlight	X X Contact at X (km/h)						
	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance		- 10311101	renormed				
10													
20	Avoidance	Avoidance	Avoidance			Avoidance							
				A	A								
30													
40	Avoidance	Avoidance	Avoidance			Avoidance							
-10			- - - -										
50	Avoidance	Avoidance	Avoidance			Avoidance							
	Avoidance	22.1	Avoidance	Avoidance	Avoidance	Avoidance	1						
60		15 30					1						

Appendix Table C-7 BMW iX Full Crossing Results

			2023 B	MW iX xDrive50				
Vsv								
(km/h)			nild					
	Davlight	High Regen	Far FCW	Lower Beam	Unner Beam	 Davlight	Lower Beam	
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
10								
20	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance	
20	- - - -				- - - -			
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
	- - - -		- - - -	- - - -		- - - -	- - - -	
40	Avoidance	-		Avoidance	Avoidance	Avoidance	Avoidance	
	Avoidance				- - - -			
40 (CC)	Avoluance	1						
	Avoidance			16.2	Avoidance	Avoidance	24.6	
50				A 18 A A			A 23 49 -	
55	Avoidance			Avoidance	Avoidance	Avoidance	-	
					- - - -			
60	Avoidance	Avoidance	Avoidance	24.1	Avoidance	Avoidance		
	- - - -	- - - -	<u> - - -</u>	38 60 A A				
			Along	g Path				
V _{sv}			Pedestrian Alo	ng Path, Moving			Avoidance	A Full Avoidance on Test
(km/h)			Adult			Child	Х	X Contact at X (km/h)
	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight	-	- Test not Performed
10	Avoidance	Avoidance	Avoidance	9.2	9.3	Avoidance		
10								
20	Avoidance	-		Avoidance	Avoidance	Avoidance		
		Avoidanaa	Avoidance					
30	Avoluance	Avoluance	Avoluance	Avoluance	Avoidance	Avoidance		
	Avoidance			Avoidance	Avoidance	Avoidance		
40		1						
40 (CC)	Avoidance							
40 (CC)								
50	Avoidance			28.4	Avoidance	Avoidance		
				- - - -		- - - -		
60	Avoidance	Avoidance	Avoidance		Avoidance	Avoidance		
							•	
65	Avoluance				Avoluance	Avoluance		
							J	

Appendix Table C-8 BMW iX Full Along Path Results

	2023 Ford F-150 Lightning Super Crew													
	Padastrian Crossin	a Path from			Crossing									
Vsv	Right with 25%	o Overlap		Р	edestrian Crossin	g Path from Right	t with 50% Overla	ւթ						
(km/h)	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					
	Avoidance	Avoidance	Avoidance		- - - -	Avoidance	Avoidance	Avoidance	Avoidance					
20														
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance					
50		<u> - -</u> -					- - - -							
40	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance					
	- - - - -	1-1-1-				- - - -	- - - -	- - - -	- - - -					
40 (CC)														
50	Avoidance	Avoidance	Avoidance			Avoidance	Avoidance	Avoidance	Avoidance					
50														
60	Avoidance	7.3	Avoidance	Avoidance	Avoidance	24.4	Avoidance	Avoidance	16					
	A	25 A A		<u></u>		34 A 31 -	- - - -		23 20					
	Obstructed Rum	ning Child	Cro	ssing										
V _{sv}	Crossing Path from	m the Right	Pe	edestrian Crossing	g Path from the Le	Avoidance	A Full Avoid	dance on Test						
(km/h)	Child			Adult		Child	Х	X Contact	at X (km/h)					
	Real Vehicles	VTDs	Daylight	High Regen	Far FCW	Daylight	-	- Test not	t Performed					
10	9.5	Avoidance	7.3	5.1	Avoidance	10.2								
	Avoidance	Avoidance	Avoidance	- - - -		Avoidance								
20														
30	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance								
50				- - - -	- - - -									
40	Avoidance	13.1	Avoidance			Avoidance	-							
	Avoidance	A 1/ -	Avoidance			Avoidance	-							
50							1							
60	39.1	-	Avoidance	Avoidance	Avoidance	Avoidance								
60														

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

	1		2023 Ford F-15	50 Lightning Super	Crew									
	Along Path													
	Pedestrian Along Path, Stationary													
		nild												
	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight	Lower Beam							
10	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	9.6	10.4							
		- - - -	- - - -											
20														
20	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance							
30														
40	Avoidance			29.8	Avoidance	Avoidance	Avoidance							
				- - - -		- - - -								
40 (CC)	Avoidance													
50	Avoidance			-	Avoidance	Avoidance	44.9							
	- - - -			- - - -		- - - -								
55	Avoidance	l			Avoidance	Avoidance								
	Avoidance	Avoidance	Avoidance			Avoidance								
60				- - - -										
V _{sv}			Pedestrian Alo	ng Path, Moving			Avoidance A							
(km/h)			Adult			Child	X X							
	Daylight	High Regen	Far FCW	Lower Beam	Upper Beam	Daylight								
10	6.6	Avoidance	Avoidance	Avoidance	Avoidance	10.4								
		- - - -	- - - -											
20	Avoidance			Avoidance	Avoidance	Avoidance								
	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance								
30														
40	Avoidance			Avoidance	Avoidance	Avoidance								
	Avoidance													
40 (CC)														
50	Avoidance			14.9	Avoidance	Avoidance								
		Avoidance	Avoidance	A A A A										
60	Avoidance			A 55 44 A	Avoidance	Avoidance								
	Avoidance			-	Avoidance	Avoidance								
65				- - - -										

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

Full Avoidance on Test

Contact at X (km/h) Test not Performed

	1							2024	Ma	zda	CX-	90 A	WD	Tur	bo S	Prer	niun	n									
	Crossing																										
V _{sv}	Pedestrian Crossing Path from Right with 25% Overlap								Pedestrian Crossing Path from Right with 50% Overlap																		
(km/h)	Adult Child								Adult Child																		
	Da	ylight	t		Day	light		Ι	Day	light		L	owe	r Bea	ım	U	ppe	r Be	am		Day	light		Lo	ower	·Bea	m
10	Avoidance Avoidance				A	voie	danc	e	1	Avo	idanc	e		Avo	idan	ce		Avoi	dance		Avoidance						
10					-	-	-	-	-	-	-	-	-	-	-	-	-	-									
20	Av	oidanc	e	1	Avoi	dance	e	A	voi	danc	e	1	Avo	idanc	e		Avo	idan	ce		Avoi	dance		ŀ	Avoi	dance	;
20		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Av	oidanc	e	1	Avoi	dance	e	A	voi	danc	e	1	Avo	idanc	e		Avo	idan	ce		Avoi	dance		Avoidance			
		-	-	-	<u> </u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Av	oidanc	e	1	Avoi	dance	e	A	voie	danc	e	1	Avo	idanc	e		Avo	idan	ce		Avoi	dance		A	Avoi	dance	;
••		-	-	-	<u> </u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40 (CC)						Avoidance																					
()																											
50	Av	oidanc	e	1	Avoi	dance	e	A	voie	danc	e	1	Avo	idanc	e		Avo	idan	ce		Avoi	dance			12	2.5	
		-	-	-	<u> </u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	Α	21	-
60	Avoidance Avoidance				e	A	voi	danc	e	1	Avo	idanc	e		Avo	idan	ce		Avoi	dance				-			
		-	-	-	<u> </u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
						~	Cros	ssing						-		ļ					-						
Vsv	0	bstruc	ted I	Kunn	ing (Child		Pede	stri	an C	ross	ing I	'ath	fron	1 the	Avoidance			A					dance on Test			
(km/h)	Cro	ssing	Path	tron	n the	Rigi	nt				L	ett						77		37		Full A		anc	e on	l est	
· ,	Deal	Vakia	<u>Cr</u>	nid	N /7	CD.		т	Ad	lult Eala				hild uliak	_			X		X		Con	tact	atx	(KII	i/n)	
	Keal	vent	cies			dana		1	<i>ay</i>				Da	idono	0	ł		-		-		rest	no	t Per	TOTI	ied	
10	AV	Jidano		1	Avoi	dance	-		0.	.∠	1	1	400	Idanc	e I												
	Δv	- pidanc		-	- Avoi	- dance	- _	-		- danc	- -	-	-	- idane													
20	Av	Juane				uane		- 1	-				100	Tuane													
	Δv	- nidanc	<u> </u>	-	Avoi	- dance		- Δ		- danc	- -	_	Δv_0	idanc	р - е												
30		-	-	-	_	-	-	-	-	-	<u> </u>	-	-	-	Ĭ-												
	Av	oidanc	e		Avoi	dance		A	void	danc	e	,	Avo	idanc	e												
40			Ť		T						Ē	-	1.0	1	Ť	ł											
		-	-	-	-	-	-	-	-	-	-	-	-	-	-												
=0	- -	7.03	<u> -</u>	-	- 18	- 3.2	-	- A'	- voio	- danc	е –	-	- Avo	- idanc	е -												
50	- 1 22 8.	7.03 9 -	- -	- A	- 18 13	- 3.2 14	-	- A'	- voic	- danc -	- e -	- -	- Avo -	idanc	e -												
50	- 1 22 8.	7.03 9 -	-	- A	18 13	- 3.2 14	-	- A' -	- voic - voic	- danc - danc	e - e	- -	- Avo - Avo	idanc - idanc	e - e												

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

		2023 Mazda CX-9	90 AWD Turbo S 1	Premium		
V _{sv}						
(km/h)		Adult		Ch	nild	
	Daylight	Lower Beam	Upper Beam	Daylight	Lower Beam	
10	Avoidance	5.4	Avoidance	Avoidance	Avoidance	
10						
20	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
20						
20	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
30						
40	Avoidance	Avoidance	Avoidance	Avoidance	Avoidance	
40						
	Avoidance					
40 (CC)						
70	Avoidance	Avoidance	Avoidance	Avoidance	23.4	
50					19 9.3	
55	Avoidance	Avoidance	Avoidance	Avoidance	-	
33						
60	Avoidance	Avoidance	Avoidance	Avoidance	-	
00						
		Along	g Path			
V _{sv}		Pedestrian Alor	ng Path, Moving		Avoidance A	Full Avoidance on Tost
(km/h)		Adult		Child	V V	Contact at X (km/h)
	Devlight	Lower Ream	Unner Beam	Davlight		Test not Performed
	6.3	9 5	8 9	Avoidance		rest not renormed
10						
	Avoidance	Avoidance	Avoidance	Avoidance		
20						
	Avoidance	Avoidance	Avoidance	Avoidance		
30						
40	Avoidance	Avoidance	Avoidance	Avoidance		
40						
	Avoidance					
+0 (CC)						
50	Avoidance	Avoidance	Avoidance	Avoidance		
50						
60	Avoidance	Avoidance	Avoidance	Avoidance		
00						
65	Avoidance	44.6	Avoidance	Avoidance		
05						

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