June 4, 2025 Highway Investigation Report HIR-25-03

Vehicle Collision with Stopped School Bus and Student Pedestrian

Town of Excelsior, Wisconsin
May 12, 2023

Abstract: On May 12, 2023, about 7:21 a.m. central daylight time, a 2016 Bluebird school bus operated by the Reedsburg School District stopped to board students in the westbound lane of State Highway 23/33 in the Town of Excelsior, Sauk County, Wisconsin. As the bus slowed nearly to a stop, the driver deactivated the bus's amber lights and activated the red lights and extended the stop arm. A 2010 Ford F-150 pickup truck, operated by a 17-year-old driver, was traveling west behind the bus. As the pickup truck approached the rear of the school bus, the driver braked and swerved the truck to the right, sideswiped the right-rear corner of the bus, continued across the paved shoulder onto a private driveway, and struck a 13-year-old student pedestrian who was waiting to board the bus. The student pedestrian sustained fatal injuries, and the pickup truck driver sustained minor injuries. The school bus driver and the 16 student passengers on the school bus were not injured. The safety issues identified in this investigation are driver distraction from cell phone use and lack of collision avoidance and injury mitigation technology. The National Transportation Safety Board makes one new recommendation to the National Highway Traffic Safety Administration and reiterates one recommendation to phone manufacturers. Seven recommendations are classified in this report.

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Acronyms and Abbreviations

ADDW	advanced driver distraction warning
AEB	automatic emergency braking
CDL	commercial driver's license
CFR	*Code of Federal Regulations*
DMS	driver monitoring systems
EMS	emergency medical services
Euro NCAP	European New Car Assessment Programme
FCW	forward collision warning
FMVSS	Federal Motor Vehicle Safety Standard
GTR	Global Technical Regulation
GVWR	gross vehicle weight rating
IIHS	Insurance Institute for Highway Safety
NCAP	New Car Assessment Program
NHTSA	National Highway Traffic Safety Administration
NPRM	notice of proposed rulemaking
NTSB	National Transportation Safety Board
PAEB	pedestrian automatic emergency braking
RAAS	Reedsburg Area Ambulance Station
RFD	Reedsburg Fire Department
RPD	Reedsburg Police Department

SCSO	Sauk County Sheriff's Office
SH 23/33	State Highway 23/33
SUV	sport utility vehicle
USDOT	US Department of Transportation
WMUTCD	Wisconsin Manual on Uniform Traffic Control Devices
WSP	Wisconsin State Patrol

Executive Summary

What Happened

On May 12, 2023, about 7:21 a.m. central daylight time, a 2016 Bluebird 71-passenger school bus operated by the Reedsburg School District stopped to board students in the westbound lane of State Highway 23/33 (SH 23/33) near Northwoods Drive in the Town of Excelsior, Sauk County, Wisconsin. At this location, SH 23/33 is a two-lane, two-way roadway with paved shoulders and a 55-mph speed limit.

As the bus slowed nearly to a stop, the driver deactivated the flashing amber lights and activated the flashing red lights at the front and rear of the bus and extended the left-side-mounted stop arm. The driver of a 2010 Ford F-150 pickup truck that had been traveling behind the bus braked and swerved to the right, sideswiped the bus's right-rear corner, continued across the paved shoulder onto a private driveway, and struck a 13-year-old student pedestrian who was waiting to board the bus. The student pedestrian sustained fatal injuries, and the 17-year-old pickup truck driver sustained minor injuries. The school bus driver and the 16 student passengers on the school bus were not injured.

What We Found

The pickup truck driver braked and swerved in response to the slowing and stopped school bus, but his actions were too late because he was distracted by his cell phone texting activity. This crash occurred despite the fact that as the bus was slowing as it approached the stop, the bus driver had activated the bus's flashing amber warning lights, flashing red lights, and stop arm.

We found that a cell phone lock-out system that disables the use of features that are not related to the driving task can reduce cell phone–related distracted driving crashes. Likewise, driver monitoring systems that can detect and alert a distracted driver and bring their attention back to the driving task can also reduce cell phone–related distracted driving crashes. Additionally, the National Highway Traffic Safety Administration's (NHTSA) 2013 Driver Distraction Guidelines are lacking because they do not incorporate advances in technology in the past 12 years and focus only on visual-manual distraction of in-vehicle electronic devices.

The pickup truck was not equipped with collision avoidance technology such as forward collision warning or automatic emergency braking (AEB) systems. Had the pickup truck been equipped with an AEB system meeting the minimum performance requirements set in Federal Motor Vehicle Safety Standard No. 127, the collision with the school bus could have been avoided or at least mitigated, which would also have prevented or mitigated the collision with the student pedestrian. The pickup truck's high and blunt hood design (a front end that is more vertical than sloped) combined with its speed at the time of the collision contributed to the student pedestrian's fatal injuries.

The National Transportation Safety Board determines that the probable cause of the fatal crash in the Town of Excelsior, Wisconsin, was the pickup truck driver's distracted driving due to his texting, resulting in his collision with the right-rear corner of the school bus and with the student pedestrian waiting to board the school bus. Contributing to the severity of the injuries to the student pedestrian was the pickup truck's speed, as well as its height and the shape of its front end.

What We Recommended

As a result of the investigation, we recommended that NHTSA develop and publish Driver Distraction Guidelines that address the design of current original equipment in-vehicle electronic devices, portable electronic devices, and aftermarket electronic devices to prevent driver distraction. Due to the failure of the cell phone companies to implement or respond to our past recommendation, we also reiterated a recommendation to the cell phone manufacturers to develop a distracted driving lock-out mechanism that will automatically disable any driver-distracting functions when a vehicle is in motion and install the mechanism in the default setting on all new devices and apply it during major software updates.

Five recommendations issued to NHTSA and one to Ford Motor Company addressing vehicle collision avoidance and injury mitigation technologies are classified in this report. One recommendation to the phone manufacturers regarding lock-out mechanisms is classified in this report.

1 Factual Information

1.1 Crash Narrative

On May 12, 2023, about 7:21 a.m. central daylight time, a 2016 Bluebird 71-passenger school bus operated by the Reedsburg School District stopped to board students in the westbound lane of State Highway 23/33 (SH 23/33) near Northwoods Drive in the Town of Excelsior, Sauk County, Wisconsin (see figure 1). At this location, SH 23/33 is a two-lane, two-way roadway with paved shoulders and a 55-mph speed limit. It was daylight and the road was dry.[1]

As the bus slowed, the driver activated flashing amber lights at the front and rear of the school bus; as the bus came to a stop, the driver deactivated the amber lights and activated the red flashing lights and extended the left-side-mounted stop arm. A 2010 Ford F-150 pickup truck, operated by a 17-year-old driver, was traveling west behind the bus. As the pickup truck approached the rear of the school bus, the driver braked and swerved the pickup truck to the right, sideswiped the right-rear corner of the bus, continued across the paved shoulder onto a private driveway, and struck a 13-year-old student pedestrian who was waiting to board the bus. The student pedestrian sustained fatal injuries, and the pickup truck driver sustained minor injuries. The school bus driver and the 16 student passengers on the school bus were not injured.

Figure 1. Overview map of the collision area on State Highway 23/33 in the Town of Excelsior, Wisconsin. (Source: Google Earth; annotated by NTSB)

[1] Visit ntsb.gov to find additional information in the public docket for this NTSB accident investigation (case number HWY23FH012). Use the CAROL Query to search safety recommendations and investigations.

1.1.1 Crash Events

The school bus driver told the NTSB that he arrived at the bus garage around 6:45 a.m., conducted a pretrip inspection, and then departed on his route. After completing student pickups at five earlier stops, the bus driver said he turned right onto SH 23/33 from Highway 23 and stopped at stop 7.[2] Stop 7 is about 0.85 miles east of stop 8, the crash location (see figure 2). The bus driver said he recalled that the pickup truck was behind the bus at stop 7. The pickup truck driver told law enforcement that he left his house around 7:08 or 7:09 a.m. He said he turned from SH 23 onto SH 23/33 behind the school bus and the bus soon stopped. According to video footage from the school bus's onboard cameras, the bus was at stop 7 from 7:19:38 to 7:19:52 a.m.[3] The pickup truck can be seen in the video footage at this time.

Figure 2. Image showing school bus route leading up to the crash (Source: Google Maps; annotated by NTSB)

[2] The school bus did not stop at stop 1 because there were no students to be picked up.

[3] The school bus was equipped with four video cameras that are described in section 1.5.1. Metadata in the video file indicated that the bus's speed was recorded to within a tenth of a mile per hour; the time was recorded to a hundredth of a second. After the crash, the time was found to differ from GPS time. An investigator from the Sauk County Sheriff's Office recorded the screen of his phone displaying the time from "time.is," a known time standard, using the bus video system. The time displayed on the phone was compared against the time stamped on the video to provide a time correction of 3:23. All video times used in this report are corrected times for the displayed times in the video footage.

After accelerating away from stop 7, by 7:20:04 the bus's speed was 22.4 mph, and the pickup truck is no longer seen in the bus's onboard video footage. The footage showed the bus's maximum speed between stops 7 and 8 was 39.2 mph, which occurred at 7:20:32. The bus driver said he activated the amber warning lights just before Northwoods Drive (about 900 feet before stop 8) which, according to the video footage, was at 7:20:43 when the bus's speed was 36.0 mph. The video footage showed the bus's speed continued to gradually decrease; at 7:20:51, the speed was 26.1 mph, at 7:20:53 it was 20.5 mph, and at 7:20:55 it was 13.7 mph. The bus continued to slow; at 7:20:58 a.m., 14.6 seconds after it crossed Northwoods Drive, the bus's red lights were flashing, its stop arm was extended, and its speed was 3.7 mph. Also at this time, the pickup truck can be seen again approaching the rear of the school bus in the video footage. In his interview with the NTSB, the bus driver said he usually waits for oncoming traffic to clear before putting out the stop arm so that the cars "don't slam on the brakes." A driver who was behind the pickup truck told law enforcement that he saw the "blinking lights" on the back of the school bus in front of him and began to slow down. Another driver in the oncoming lane told law enforcement that she saw the "yellow bus lights activate." She also indicated the bus began to slow down but she was not sure where the bus was stopping. She said the red lights came on as she passed the bus.

At 7:20:59 a.m., the footage shows the bus at a complete stop in the westbound travel lane of SH 23/33 at stop 8. According to the bus video footage, the pickup truck struck the right-rear corner of the school bus about 0.2 seconds after the bus came to a complete stop. About 0.6 seconds later, the student pedestrian waiting to board the bus was struck by the pickup truck, pushed forward by the vehicle's momentum, and then overrun. The pickup truck's estimated speed in the last second before swerving to the right and colliding with the bus was about 54 mph.[4] Figure 3 shows the final rest position of the school bus, the pickup truck, and the student pedestrian.

[4] The NTSB estimated the pickup truck's speed using the video footage from the school bus's rearward-facing camera. The estimated speed was about 54 mph within a range of 50 to 58 mph. Neither the impact with the school bus nor the student pedestrian triggered the pickup truck's airbag control module.

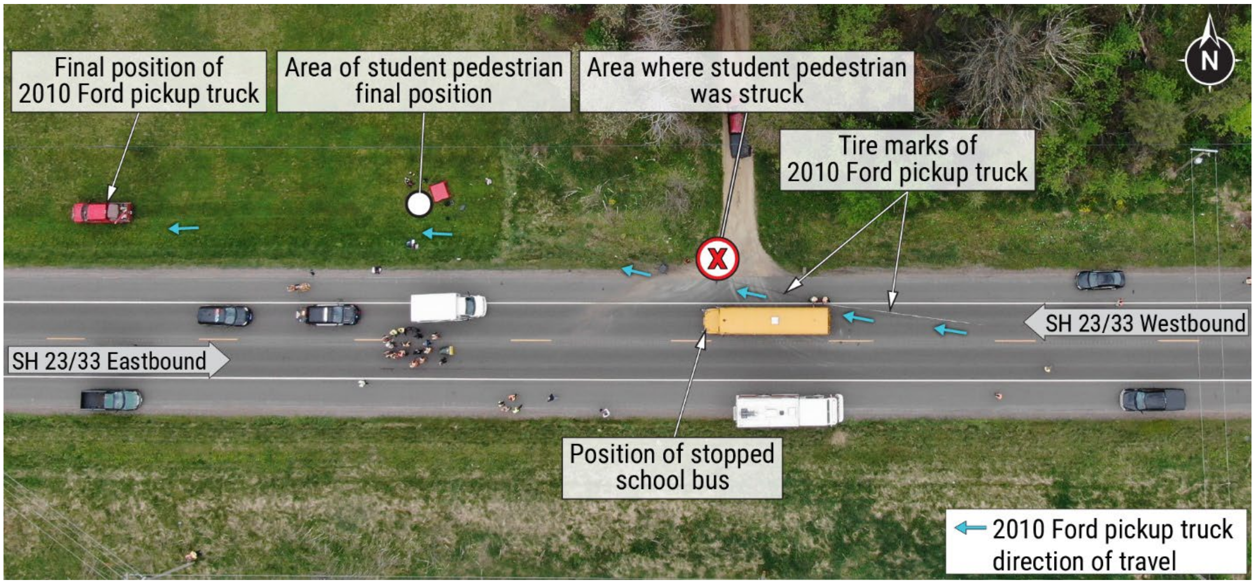

Figure 3. Aerial image of the crash scene showing final rest positions of the school bus, pickup truck, and student. (Source: Sauk County Sheriff's Office; annotated by NTSB)

In his interview with law enforcement, the bus driver said he saw one student by the mailbox about 15 feet away from the bus door. Another student was farther up the driveway. He opened the door and the student by the mailbox "took a couple steps toward the bus." He estimated she was about 10 feet from the bus when she was struck by the pickup truck.

The pickup truck driver said in his interview with law enforcement that he was following behind the bus and estimated he was traveling about 55 or 60 mph. He said he did not "remember much" but indicated he "remember[ed] looking up and seeing lights and recognizing that it [the bus] was stopped and got on the brakes and tried to get over." The driver following behind the pickup truck who said he began to slow when the bus's lights came on also said that it did not look like the pickup truck was stopping, and that it "veered to the right."

1.1.2 Crash Scene

The crash occurred about 3,143 feet into a straight section of westbound SH 23/33. The location of tire friction marks made by the pickup truck at the crash site are identified in figure 3, above. They start in the westbound lane and begin about 61 feet from the rear of where the school bus was stopped. They continue across the westbound lane and into the shoulder. The pickup truck's final rest position was about 290 feet west of the rear of the school bus, facing west. The student's final rest position was about 100 feet northwest from the initial contact with the pickup truck.

1.2 Injuries and Restraint Use

The 13-year-old female student pedestrian who was waiting to board the bus was fatally injured. A second student pedestrian, who was also to board the bus but was farther from the impact area, was not injured. Neither the school bus driver nor the 16 passengers on the school bus sustained injuries. The school bus was not equipped with passenger seat belts, but the driver was restrained by a lap/shoulder belt.

The Wisconsin motor vehicle crash report completed by the Sauk County Sheriff's Office (SCSO) stated that the 17-year-old pickup truck driver had a suspected minor injury but was not treated or transported by emergency medical services (EMS) to a hospital. According to the police report, the pickup truck driver was restrained by a lap/shoulder belt. The pickup truck's airbags did not deploy during the crash events.

1.3 Emergency Response

The SCSO was the primary law enforcement agency to respond to the crash and was assisted by the City of Reedsburg Police Department (RPD). The Reedsburg Fire Department (RFD) and the Reedsburg Area Ambulance Station (RAAS) provided fire/rescue and EMS support. The SCSO received the initial notification from a 911 call at 7:21 a.m. The first RPD officer arrived at 7:29 a.m. followed by the first SCSO unit at 7:30 a.m., the RAAS at 7:35 a.m., and RFD at 7:42 am. Emergency personnel assisted the struck student, but she was pronounced dead at the scene. Students from the bus were transported on another school bus to a local middle school for parent pickup. The other, uninjured student pedestrian remained at the scene at her residence. The highway was reopened at 12:23 p.m.

1.4 Highway Information

SH 23/33 is an undivided highway consisting of two 12-foot-wide travel lanes, one each in the westbound and eastbound directions. The lanes were separated by a broken yellow line. Paved shoulders bordered each travel lane. In the area of the crash, the westbound shoulder was about 8 feet wide and the eastbound shoulder was about 9 feet wide. Rumble strips were present in both shoulders as well as along the centerline of the roadway.[5] A driveway for a private residence was located on the north side of SH 23/33 and intersected with the shoulder at an approximate 90-degree angle. The roadway leading up to and through the collision location was

[5] See the *Wisconsin Facilities Development Manual*.

straight and had a downhill grade that varied between 0.27% and 0.33% in the westbound direction of travel.

There were no School Bus Stop Ahead (S3-1) signs near the crash. According to the *Wisconsin Manual on Uniform Traffic Control Devices* (WMUTCD), the School Bus Stop Ahead sign should be installed in advance of school bus stops when stopped buses are “not visible to road users for an adequate distance.” On a 55-mph roadway, the WMUTCD recommends a minimum sight distance of 610 feet. In the westbound lane, there were no obstructions from the intersection of SH 23/33 and Northwoods Drive, which was about 900 feet from the crash location.[6]

A 55-mph speed limit sign was located about 1.5 miles east of the crash location. A speed study conducted along SH 23/33 between 7 a.m. and 9 a.m. on May 24 and 25, 2023, showed the 85th percentile speed for the roadway was 60 mph and the average traffic volume for the roadway was 725 vehicles per hour.[7]

1.5 Vehicle Information

1.5.1 2016 Blue Bird School Bus

The 2016 Blue Bird BB Conventional school bus was a 71-passenger type C school bus with a gross vehicle weight rating (GVWR) of 31,000 pounds.[8] The crash damage was concentrated to the lower-right corner on the back of the bus, as well as to the rear on the right side (see figure 4). Following the collision, the Wisconsin State Patrol (WSP) inspected the bus and found it to be in good operating condition. According to the WSP report, the bus was equipped with air brakes that met federal standards, all six tires were the recommended tire size and had adequate tread depth, and emergency exits and windows were in proper working order.

The WSP found that all the front and rear lights (headlamps, turn signal/hazard warning lights, amber oscillating warning lamps, and red stop lamps) were working properly, including a small rear tail/stop lamp dangling by electrical wires after being damaged in the crash (see figure 5). The stop arm on the driver’s side of the bus

[6] See the *Wisconsin Manual on Uniform Traffic Control Devices* (WMUTCD).

[7] The Wisconsin Department of Transportation contracted MSA Professional Services to perform the speed study.

[8] GVWR is the total maximum weight that a vehicle is designed to carry when loaded, including the weight of the vehicle plus fuel, passengers, and cargo.

illuminated and both the stop arm and the crossing gate in the front of the bus extended as designed.[9]

Figure 4. Postcollision photograph of the 2016 Blue Bird school bus showing damage to the right-rear corner. (Source: NTSB)

[9] See Title 49 *Code of Federal Regulations* (CFR) 571.131. The term "stop signal arm" is used in FMVSS 131, School Bus Pedestrian Safety Devices; however, the safety device is commonly referred to as a "stop arm." In this report, wherever possible, the term "stop arm" is used.

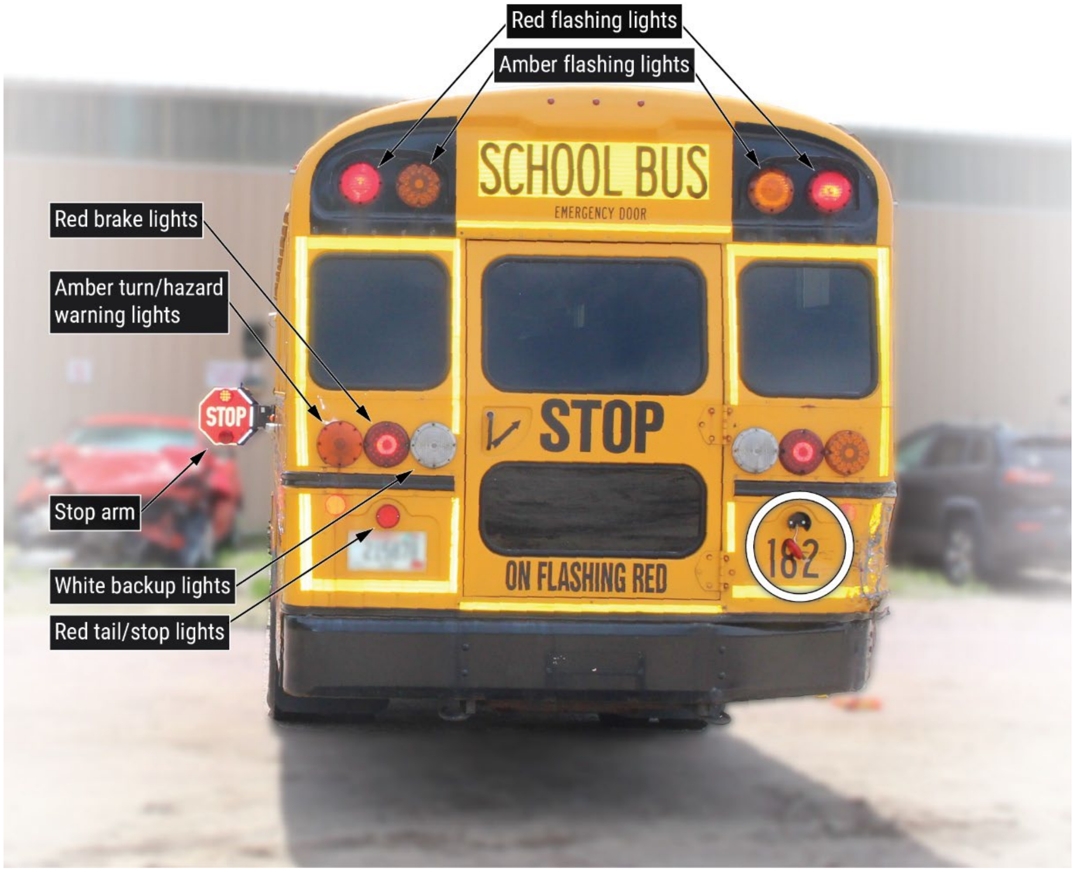

Figure 5. Postcollision photograph of the rear of the school bus; a dangling tail/stop lamp, circled in white, was still functional. (Source: WSP; annotated by NTSB)

The amber lights are activated by a warning lamps switch. The red lamps are on a separate two-stage switch; the first stage activates the red flashing lights, stop arm, and crossing gate, and the second stage opens the loading door on the right side of the bus.

The school bus was equipped with an REI BUS-WATCH SD40 mobile digital video recording system.[10] The system consisted of four cameras, and their positions and views are detailed in table 1. The video file from the cameras contained a composite view of four channels of video.

[10] See the REI website for information about [camera systems for surveillance and fleet management](#).

Table 1. Bus video system camera positions and views.

Channel	Position	View
1	Rear ceiling	Forward facing with seating and passengers visible
2	Exterior left side of bus, near stop arm	Extended stop arm, opposite lanes of traffic
3	Front of bus/windshield	Rear facing with seating and passengers visible
4	Above and left of the driver's seat	Facing loading door showing driver's right hand, dash, stairwell, and loading door

The bus passed a WSP inspection on June 27, 2022. According to the maintenance logs from June 21, 2022, through May 8, 2023, reported issues were repaired.

1.5.2 2010 Ford F-150 Pickup Truck

The 2010 Ford F-150 pickup truck had a GVWR of 7,200 pounds and its hood height (from the ground to the top front of the hood) was 47 inches. As shown in figure 6, the pickup truck sustained damage to the front grille, hood, and windshield, as well as along the length of the driver's side. The center of the grille was broken and displaced outward from the vehicle. The leading edge of the hood in the center-left area was deformed downward and aft. Contact damage, which consisted of crumpling, scrapes, scratches, and black material transfers, extended along the length of the driver's side of the vehicle.

Figure 6. Postcollision photograph of the 2010 Ford F-150 pickup truck. (Source: SCSO)

The WSP performed a postcrash vehicle inspection on the pickup truck. The inspection found no precrash defects with the steering, braking, and electrical systems, and all four wheels and tires were in good condition. The National Highway Traffic Safety Administration (NHTSA) safety recall database showed no recalls for the vehicle.

WSP retrieved data from the pickup truck's airbag control module and found that it did not record any events related to the collision.[11] The pickup truck was not equipped with, and was not required to be equipped with, collision avoidance or mitigation technologies. The pickup truck was not equipped with an original equipment or aftermarket system capable of displaying information from a cell phone.[12]

1.6 Driver Information

1.6.1 School Bus Driver

The school bus driver was 47 years old. He obtained his Class B Wisconsin commercial driver's license (CDL) with passenger, school bus, and tanker endorsements in October 2022.[13] He had a corrective lens restriction and was wearing glasses at the time of the collision. His medical certificate was issued in September 2022 and had an expiration date of September 2024; it listed no health issues or medications. His driving record showed he had been involved in a non-commercial vehicle property-damage crash in November 2020.

Following the collision, the bus driver consented to a voluntary blood draw at 8:39 a.m. at the SCSO's request. Toxicological testing performed by the Wisconsin Department of Justice Division of Forensic Sciences State Crime Laboratory was negative for alcohol and other drugs.[14]

[11] For event data to be transferred to the event data recorder, a pre-programmed threshold must be met. Typically, events are recorded if the vehicle's airbag system deploys or the vehicle's longitudinal or lateral velocity experiences an accumulated change equal to or exceeding 5 mph (8 km/h) within 150 milliseconds, as required by 49 *CFR* 563, Event Data Recorders.

[12] *Original equipment* refers to equipment, such as an electronic device, that is installed in the vehicle at time of manufacture. *Aftermarket devices* refers to equipment installed after manufacture.

[13] A Wisconsin Class B license is for the operation of a commercial motor vehicle. This is defined as "any single vehicle with a GVWR, actual weight, or registered weight over 26,000 pounds, or such vehicle towing a vehicle with a GVWR, actual weight, or registered weight of 10,000 pounds or less."

[14] The sample was tested for the presence of amphetamines, methamphetamines, cocaine metabolites, opiates, benzodiazepines, cannabinoids (marijuana), fentanyl, buprenorphine, ketamine, and zolpidem.

In his interview with the NTSB, the bus driver said he had his personal phone with him on the day of the crash but was not using it. Based on the video footage, the bus driver was not using a cell phone at the time of the collision.

The driver stated that he typically went to bed around 9:00 p.m. The morning of the crash, he woke up around 4:00 a.m., worked on his farm, and arrived at the bus garage between 6:30 and 6:45 a.m.

1.6.2 Pickup Truck Driver

The 17-year-old pickup truck driver held a probationary Class D Wisconsin driver's license.[15] His license was issued June 2021 with an expiration date of June 2024. The driver was involved in a property-damage crash in July 2021. No moving violations or points were listed on his driving record.

Postcrash toxicological testing performed by the Wisconsin Department of Justice Division of Forensic Sciences State Crime Laboratory on a blood sample collected from the pickup truck driver at 9:13 a.m. was negative for alcohol and other drugs.[16] The driver told police he had taken Tylenol the night before the collision. No other information regarding medication or medical condition was reported.

On the day of the crash, the pickup truck driver was traveling from his residence to the Reedsburg Area High School, where he was a student. He traveled this route regularly, although on the day of the crash he said he was earlier than normal due to a scheduled meeting. According to the SCSO report, the driver said he woke up around 6:00 a.m. on the day of the crash and left his house around 7:08 a.m. on his trip to school. In addition to reviewing call and text logs from the driver's cell phone, the SCSO used forensic cell phone extraction software to ascertain more detailed cell phone activity, which is shown in table 2. The last activity before the crash (7:20:59) was at 7:20:55 a.m., when an image had been selected and inserted in the text box but not sent. The SCSO report stated that the image was the first in the photos gallery and appeared to be unrelated to the ongoing text conversation. All the incoming and outgoing text messages shown in table 2 were from and to the same family member.

[15] A Wisconsin Class D license is for the operation of automobiles, light trucks, and mopeds. See section 1.9.2.1 for additional information on probationary and graduated licenses in Wisconsin.

[16] The sample was tested for the presence of amphetamines, methamphetamines, cocaine metabolites, opiates, benzodiazepines, cannabinoids (marijuana), fentanyl, buprenorphine, ketamine, and zolpidem.

Table 2. Summary of call and text message activity on the pickup truck driver's cell phone.

Time	Activity	Note
7:06–7:08 a.m.	Incoming text messages[a]	Photos attached
7:16:43 a.m.	Outgoing text message[b]	
7:17:09 a.m.	Outgoing text message[b]	
7:17:39 a.m.	Incoming text mesage[b]	
7:18:55 a.m.	Incoming text message[b]	Photos attached
7:20:40 a.m.	Outgoing text message[b]	
7:20:50 a.m.	Incoming text message[b]	
7:20:55 a.m.	Photo inserted in text box[b]	Message not sent and photo appeared to be unrelated to ongoing text conversation according to law enforcement
7:22 a.m.	Outgoing phone calls[a]	2 phone calls/1 FaceTime call

[a] Source: SCSO crash report.

[b] Source: SCSO forensic cell phone extraction.

The pickup truck driver said in his first interview with law enforcement that he was looking at his radio or the field before he looked up and saw the bus. In his second interview with law enforcement, he said "yeah, I just remember looking out my window to the left, just looking in that field, looking around and I just remember my eyes going back to the road and seeing the lights and recognizing the bus was stopping. I slammed on the brakes and tried to swerve." When asked by the SCSO in the second interview if he called, spoke with, or messaged anyone on the way to school, the driver indicated he texted a family member about graduation cards.[17]

1.7 Reedsburg School District Bus Operations

The Reedsburg School District owned and operated the school bus. The district serves about 2,800 students at two elementary schools, one intermediate school, one middle school, and one high school. The district is responsible for transporting about 1,500 students along 22 different routes daily. At the time of the crash, the district owned 36 school buses and employed 35 CDL-licensed drivers, 3 mechanics, and a transportation director.

The Reedsburg School District maintains driver and vehicle records files, conducts training, and has an alcohol and controlled-substance program in place as

[17] The NTSB contacted the driver's attorney to conduct an additional interview, but the attorney declined the interview request.

required by state and federal regulations.[18] Records show that the driver met school bus driver qualifications, received his CDL training for school and passenger endorsements through the district, and completed bus evacuation drill training. Although the district has an alcohol and controlled-substance program, it did not conduct postcrash drug and alcohol testing as required in 49 *CFR* 382.303.[19] As noted in section 1.6.1, the driver voluntarily submitted to testing performed by the SCSO, and the results were negative for alcohol and other drugs.

1.7.1 School Bus Route and Stop Guidance for School Bus Drivers

Wisconsin school districts establish official school bus routes and stops. The stops must account for traffic and pedestrian safety.[20] All of the stops on this route, including stop 8, were established by the Reedsburg School District.

The *Wisconsin Commercial Driver's Manual* contains specific instructions for school bus drivers as they approach their stops.[21] Among other actions, the manual states that bus drivers should "turn on flashing amber warning lights at least 300 feet before stopping in a 45 mile per hour or greater speed zone or at least 100 feet before stopping in a less than 45 mile per hour speed zone."

The manual also instructs school bus drivers to "stop in the farthest right driving lane." This reflects Wisconsin state law, which states that "except where there are special loading zones where the bus is entirely off the traveled portion of the highway, the bus shall be stopped on the traveled portion of the highway in the lane

[18] Transportation performed by the federal government, states, or political subdivisions of a state, is generally exempted from the Federal Motor Carrier Safety Regulations. The regulations generally do not apply to school bus operations, including those performed by Indian tribal governments (49 *CFR* Part 390.3T(f)(1)). Nonetheless, there are several exceptions to that principle. The commercial driver's license and drug and alcohol testing regulations in 49 *CFR* Parts 383 and 382, respectively, apply to all drivers of commercial motor vehicles, as defined in 49 *CFR* Part 383, including school buses. All school bus drivers are subject to the distracted driving regulations (see section 390.3T(f)(1)). In addition, school bus operations would be subject to the regulations if they involve compensation for transportation to non-school events.

[19] The school district assumed that the toxicological testing conducted by the SCSO fulfilled the district's obligation under 49 *CFR* Part 382.303.

[20] See Wisconsin Statutes Chapter Trans 300.16: Driver requirements.

[21] According to the Wisconsin Department of Transportation *Commercial Driver's Manual*, section 10.2.1 (December 2024), additional instructions include approaching the stop slowly, looking for pedestrians, traffic, and objects, continuously checking all mirrors, determining if other drivers have observed flashing amber warning lights and have time to stop, activating the stop arm only after stopping, and checking that all traffic has stopped before opening the door and signaling students to approach the bus.

farthest to the right which is improved, designed or ordinarily used for vehicular travel, excluding the berm or shoulder."[22]

1.8 Weather

Weather data for May 12, 2023, was obtained for Dane County Regional Truax Field in Madison, Wisconsin, about 40 miles from the location of the crash. The temperature was 61°F, the skies were cloudy, and winds were calm. No precipitation was reported.

1.9 Additional Information

1.9.1 Approaching a School Bus with Its Warning Lights On

School buses, including the bus involved in this crash, are equipped with amber and red flashing lights. Flashing amber lights are used to indicate that a school bus is preparing to stop to load or unload students at a stop.[23] Flashing red lights indicate the bus is stopped to load and unload students.

It is illegal in all 50 states, the District of Columbia, and the Commonwealth of Puerto Rico to pass a school bus that is stopped to load or unload passengers with its red lights flashing and stop arm extended (Wright and others 2024).[24] Wisconsin law states that all vehicles must stop "not less than 20 feet" from the front or the rear of a stopped school bus when it is displaying flashing red lights, and motorists "shall remain stopped until the bus resumes motion or the operator extinguishes the flashing red warning lights."[25]

1.9.2 Wisconsin Driving Laws

1.9.2.1 Driver Licensing

Wisconsin has three levels of driver licensing: instruction permit, probationary license, and regular license.[26] An instruction permit is issued to applicants learning to

[22] Wisconsin Statutes Chapter Trans 300.16(8).

[23] See https://nasdpts.org/NSTSP-Documents, appendix D.

[24] Some exceptions are specified for vehicles traveling on a divided roadway.

[25] See Wisconsin Statutes 346.48: Vehicles to stop for school buses displaying flashing lights.

[26] For additional information on Wisconsin instruction permits, see the Wisconsin Department of Transportation page for differences between an instruction permit, probationary license, and regular license.

drive a vehicle and requires applicants to complete a knowledge test. The *Wisconsin Motorists' Handbook* is the basis of the knowledge test; it contains information on operating a vehicle near a school bus and discusses dangerous driving behaviors including cell phone use.[27] Probationary licenses are issued to all new drivers regardless of age.[28] A probationary license is a valid license and has additional penalties and restrictions. For example, demerit points are doubled for moving traffic convictions after the first conviction for all probationary license holders.[29] Drivers under the age of 18 with a probationary license have additional restrictions such as adhering to nighttime and passenger restrictions as required by Wisconsin's graduated driver licensing law.[30] A regular license is issued after successful completion of the probationary license requirements.

1.9.2.2 Cell Phone Use While Driving

Wisconsin's inattentive driving law prohibits a driver from engaging in an activity, other than driving, that interferes with their ability to drive the vehicle safely.[31] Wisconsin's law specifically prohibits texting while driving (Wisconsin Statutes 346.89(3), but the state does not prohibit handheld or hands-free cell phone use for making calls while driving for most drivers.[32] Drivers with a probationary license or instruction permit may not text or use a handheld or hands-free cell phone while driving, except to report an emergency.[33] Wisconsin allows for primary enforcement of its texting and cell phone laws.[34] Offenders can receive a ticket, a fine, and four demerit points for inattentive driving.

[27] For details, see the *Wisconsin Motorists' Handbook*.

[28] For additional information, see the Wisconsin probationary driver license requirements webpage.

[29] A license is suspended when a driver receives 12 or more demerit points in a 12-month period. See Wisconsin's point system webpage for details.

[30] The passenger and nighttime driving restrictions are part of the graduated driver licensing program for new drivers under age 18. The restrictions are in effect for the first 9 months of having the probationary license but can be extended if the driver receives a moving violation traffic ticket, violates the graduated driver licensing restrictions, or if the probationary license is suspended or revoked. The pickup truck driver was not subject to the passenger and nighttime driving restrictions because he had held his probationary license for more than 9 months.

[31] See Wisconsin Statutes 346.89: Inattentive Driving.

[32] Wisconsin prohibits the use of handheld phones in highway maintenance or construction areas, railroad maintenance or construction areas, utility work areas, or emergency or roadside response areas, except to report an emergency (Wisconsin Statutes 346.89 (4m)).

[33] See Wisconsin Statutes 346.89(4)(a): Inattentive Driving.

[34] See the Wisconsin Department of Transportation page on Cell Phones, Driving and the Law for details about these laws.

2 Analysis

2.1 Introduction

As the school bus was slowing and coming to a stop in the westbound lane of SH 23/33 to pick up student passengers, the driver deactivated the flashing amber lights and activated the flashing red lights at the front and rear of the bus and extended the stop arm. The 17-year-old driver of the pickup truck that was following the school bus braked just before impact and swerved to the right; the pickup truck sideswiped the right-rear corner of the bus, continued across the paved shoulder onto a driveway, and struck and killed a 13-year-old student pedestrian waiting for the bus. The pickup truck driver sustained minor injuries. The school bus driver and the 16 student passengers on the school bus were not injured.

The analysis first examines factors that could be excluded as causing the crash or contributing to the severity of its outcomes. Next, the analysis discusses the crash event (section 2.2). Finally, the analysis discusses the following safety issue areas:

- Driver distraction from cell phone use (section 2.3), and
- Lack of collision avoidance and injury mitigation technology (section 2.4).

As a result of its investigation, the NTSB established that the following factors did not cause or contribute to the crash:

- *Weather:* The weather was cloudy, and the roadway was dry; there was no precipitation at the time of the crash.
- *Roadway and Lighting:* In the area of the crash, SH 23/33 was a straight, two-lane undivided highway with one lane in each direction. There were no sight obstructions for at least 900 feet (from the intersection of SH 23/33 and Northwoods Drive to the impact area). The posted speed limit was 55 mph. All highway markings, signage, and rumble strips complied with state and federal guidance. It was daylight at the time of the crash.
- *Actions of the students waiting to board the school bus:* The fatally injured student pedestrian stood off the travel lane, on a private driveway. A second student was also on the driveway but was farther away from the bus.
- *Mechanical condition of the vehicles:* The WSP did not find any evidence of precrash mechanical defects during its postcrash inspection of the school bus or the pickup truck. The school bus's flashing amber warning lights, flashing red stop lights, and stop arm were operational.

- *School district policies:* The Reedsburg School District had safety and operational policies in place as required by state and federal laws and applicable guidance. Although the bus stop was on a high-speed roadway, which increased student exposure to high-speed vehicles, the students' risk was reduced because they were not required to cross the road to board the bus.[35]

- *The school bus driver licensing, training, fatigue, medical condition, cell phone use, or use of alcohol or other drugs:* The school bus driver was licensed to drive a school bus and had completed training offered by the school district. He had a regular sleeping schedule and had about 7 hours of sleep opportunity before the morning of the crash. The driver held a medical certificate and had no reported health issues or medications. The driver was not using a cell phone and did not appear otherwise distracted at the time of the crash. Postcrash toxicological test results were negative for alcohol and other drugs.

- *The pickup truck driver's licensing or use of alcohol or other drugs:* The pickup truck driver had a probationary license. Postcrash toxicological testing was negative for alcohol and other drugs.

The NTSB concludes that none of the following were factors in this crash: (1) weather; (2) roadway and lighting; (3) actions of the students waiting to board the school bus; (4) mechanical condition of the vehicles; (5) school district policies; (6) school bus driver licensing, training, fatigue, medical condition, cell phone use, or use of alcohol or other drugs; and (7) pickup truck driver's licensing or use of alcohol or other drugs.

First responders arrived at the crash site within 7 minutes of receiving notification of the crash. The RFD assisted the struck student, but she was pronounced dead at the scene. The students from the bus were transported back to school on another bus to reunite with their parents. The roadway was reopened 5 hours after the crash. The NTSB concludes that the emergency response to the crash was timely and adequate.

2.2 Crash Analysis

On the day of the crash, the school bus driver arrived at the garage around 6:45 a.m., conducted a pretrip bus inspection, and departed on his route. The pickup

[35] For more information regarding student fatalities at school bus stops on high-speed roadways, see NTSB 2020b, *Vehicle Collision with Student Pedestrians Crossing High Speed Roadway to Board School Bus, Rochester, Indiana*.

truck driver said he left his house around 7:08 or 7:09 a.m. The school bus stopped at stop 7 for about 14 seconds. The bus driver recalled the pickup truck was stopped behind the bus, and onboard video footage showed the pickup truck behind the bus during that time. As the bus pulled away from stop 7, the pickup truck was not visible again in the video footage until about 1 second before the crash.

The bus driver's statements, as well as evidence from the onboard video system, showed that the school bus reached a maximum speed of 39.2 mph between stops 7 and 8 and then gradually slowed as the bus approached stop 8. The driver stated that he turned on the bus's flashing amber lights around Northwoods Drive as the bus slowed, and witnesses indicated they began to slow down when they saw the bus's "flashing" or "yellow" lights. The video footage showed that the driver activated the flashing red lights and extended the stop arm as the bus came to a full stop in the right travel lane to load students.[36] Based on the driver's statement, the speed of the bus shown on the video footage, and the location of Northwoods Drive, the amber lights would have been on for about 15 seconds before the red lights were activated. The NTSB concludes that the school bus driver turned on the bus's flashing amber and flashing red lights and extended the stop arm, which provided sufficient warning to attentive drivers that the school bus was stopping to load students onto the bus.

In his interview with law enforcement, the pickup truck driver indicated he did not "remember much" before the crash. He said he looked up, saw the school bus lights and saw that the bus was stopped, and braked and swerved to avoid the bus. Friction marks for about 61 feet before impact confirm that the driver applied the brakes and then swerved out of the travel lane onto the right shoulder. The pickup truck's estimated speed in the last second before swerving to the right and striking the bus was about 54 mph.

In his initial statement to law enforcement, the pickup truck driver stated that he was either looking down at his radio or looking at the field to his left before looking up and seeing the stopped bus. In his second interview, he said he was looking out his window to the left and then his eyes returned to the road, seeing the lights and recognizing the stopped bus.

Although the pickup truck driver could have been looking out the window or inside the vehicle cab, resulting in his unawareness of the amber or red lights as the school bus began to slow, it is unlikely that either of these activities would have accounted for the 15 seconds that the amber lights were activated. Research has found that the maximum glance duration when tuning the radio ranges from 0.96 seconds to 2.20 seconds (Sodhi and others 2002, Perez and others 2013). In a

[36] Wisconsin Statutes 300.16 requires school buses to stop in the farthest right travel lane.

study of car-following behavior, NHTSA found that drivers' eye glances away from the road averaged 0.6 seconds when behind another car (Tijerina and others 2004).

The pickup truck driver's phone activity, shown in figure 7, indicates that he was actively involved in a texting conversation in the minutes and final seconds before the crash. About 4 minutes before the crash, the pickup truck driver sent two text messages and soon received two text messages, including one with attached pictures. In the minute before the crash, the pickup truck driver engaged in additional texting activity, which would have occurred as the school bus and the pickup truck were traveling between stops 7 and 8. During this final minute, the school bus began slowing for stop 8 from its maximum speed of 39.2 mph at 7:20:32, and the amber lights were activated. The pickup truck driver sent a text at 7:20:40, received a text at 7:20:50, and opened the message texting box and inserted a photo at 7:20:55 a.m. The SCSO stated that the photo appeared unrelated to the conversation and the message was not sent. Four seconds later, at 7:20:59, the school bus came to a complete stop. The pickup truck collided with the right-rear of the bus 0.2 seconds after the bus stopped, and the pickup truck then struck and overran the student 0.6 seconds after the collision with the bus.

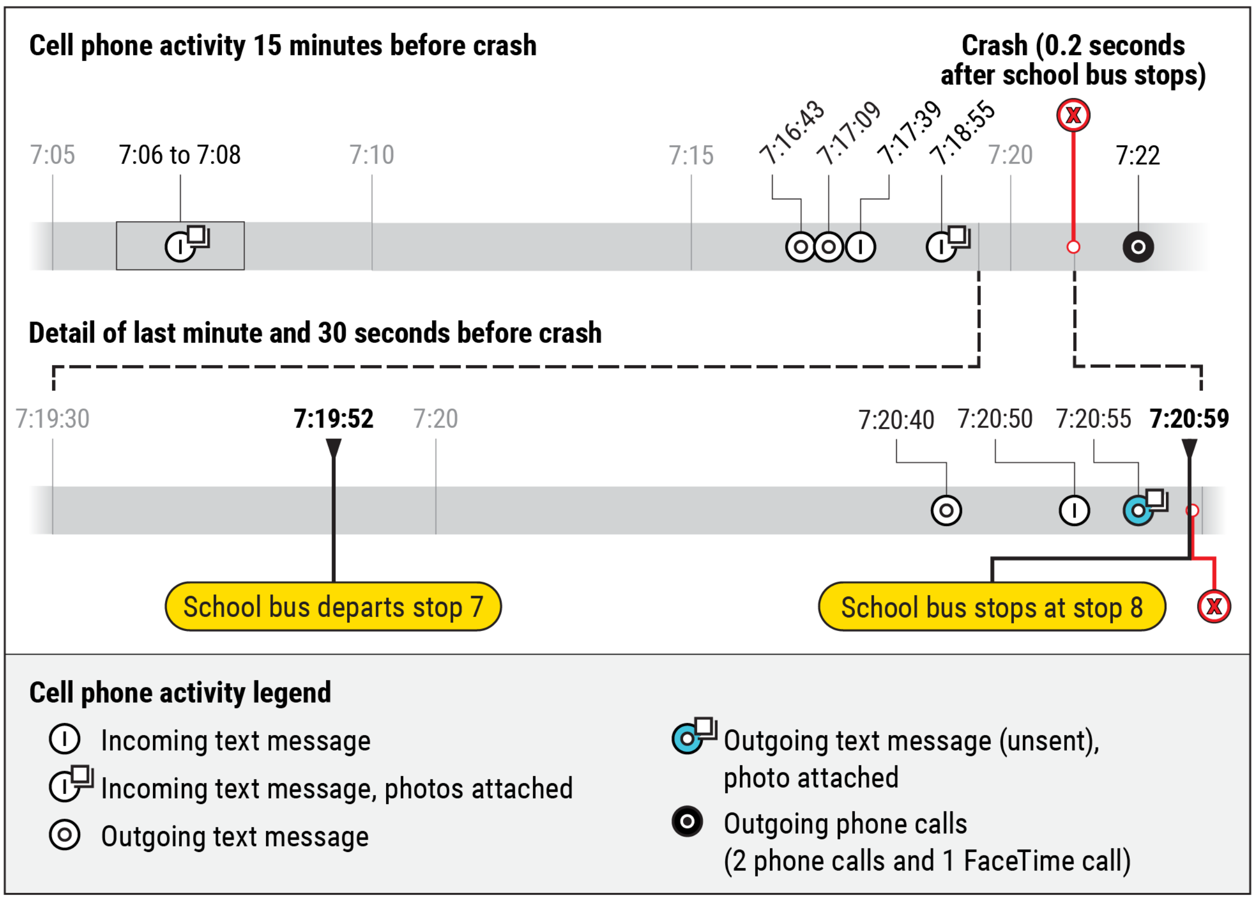

Figure 7. Pickup truck driver's cell phone activity.

The pickup truck driver's cell phone activity included responding to text messages with attached photos, viewing the messages and attached photos, and sending outgoing text messages. Four seconds before the crash, he inserted a photo into a text. The actions of opening and responding to text messages drew his attention away from the driving task. He failed to attend to several cues that the school bus was preparing to stop: the bus was slowing from its maximum speed of 39.2 mph, and the flashing amber and red lights were activated. The NTSB concludes that the pickup truck driver's response to the slowing and stopped school bus was delayed because he was distracted by his cell phone texting activity, causing him to brake and swerve in an attempt to avoid a collision.

2.3 Driver Distraction from Cell Phone Use

2.3.1 Introduction

Distracted driving—including cell phone use while driving—is a recognized safety issue. Drivers are distracted when they perform activities that take their attention away from the driving task such as eating and drinking, talking with passengers, or talking or texting on a cell phone. In 2023, an estimated 781,958 crashes (fatal, injury, and property damage) involved distraction; of these, 64,979 involved cell phone use (NHTSA 2025).

Texting while driving is particularly dangerous because it involves three types of distraction: it requires drivers to take their eyes off the road (visual distraction), manipulate the phone (manual distraction), and focus attention on a non-driving task (cognitive distraction) (NHTSA 2010). Several research studies based on data from a naturalistic study of over 3,000 drivers found that the risk of a crash was 2 to 6 times greater when drivers were manipulating a cell phone (when sending, receiving, or reading a text message) compared to no distraction (Dingus and others 2016, Kidd and McCartt 2015, and Owen and others 2018). Visual-manual cell phone interactions, such as texting, have been found to triple a driver's odds of involvement in a road-departure crash and increase a driver's odds of rear-ending the vehicle ahead by more than a multiple of seven (Owen and others 2018). In general, visual-manual cell phone tasks increase the crash risk for all age groups, but cognitive distraction may have a larger impact on drivers under age 30 (Guo and others 2017). Even a notification of a text or phone call can be distracting and divert attention from the driving task (Stothart and others 2015). Although voice recognition systems can minimize the visual-manual distraction from texting, using these systems is still more distracting than driving without any cell phone use (Simmons and others 2017, Strayer and others 2015, Mehler and others 2015).

Over the past two decades, the NTSB has investigated several crashes involving vehicle operators using a cell phone while driving. In 2002, the NTSB investigated a multivehicle collision near Largo, Maryland, that resulted in five fatalities (NTSB 2002). The driver who lost control of her vehicle was a new driver and was distracted by her use of a handheld cell phone. In 2004, the NTSB investigated a bus crash with a low-clearance bridge overpass in Alexandria, Virginia, and determined the cause of the collision was the bus driver's failure to notice and respond to posted low-clearance warning signs and the bridge because he was talking on a hands-free cell phone (NTSB 2006). In 2010, the NTSB investigated a multivehicle collision in Gray Summit, Missouri, resulting in 38 injuries and 2 fatalities. One of the involved drivers was found to be distracted due to a texting conversation (NTSB 2011). More recently, the NTSB investigated a collision between a sport utility vehicle (SUV) operating with partial driving automation and a crash attenuator in Mountain View, California (NTSB 2020a). The driver was distracted, likely from a cell phone game application. In 2019, the NTSB investigated a collision between an SUV and a medium-size bus transporting adult passengers with disabilities and special needs in Belton, South Carolina (NTSB 2021). The SUV driver lost control of her vehicle due to distraction from cell phone use, crossed over the center line, and collided with the bus. The driver of the SUV and a passenger on the bus were fatally injured.

Over the years, the NTSB has issued several recommendations focused on education, enforcement, and engineering countermeasures to prevent driver distraction from cell phone use and maintain driver engagement with the driving task. Some of these safety recommendations are summarized below.

2.3.2 Countermeasures

2.3.2.1 Enforcement and Education

In 2011, as a result of our investigation of the multivehicle collision in Gray Summit, Missouri, we issued Safety Recommendation H-11-39 to the 50 states and the District of Columbia:

> (1) Ban the nonemergency use of portable electronic devices (other than those designed to support the driving task) for all drivers; (2) use the National Highway Traffic Safety Administration model of high visibility enforcement to support these bans; and (3) implement targeted communication campaigns to inform motorists of the new law and enforcement, and to warn them of the dangers associated with the nonemergency use of portable electronic devices while driving. (H-11-39)

According to the Governors Highway Safety Association, as of December 2024, all states except Montana prohibit texting while driving, 31 states prohibit all drivers from using handheld cell phones while driving, but no state bans all cell phone use. However, 36 states, including Wisconsin, ban all cell phone use by novice drivers and 25 states ban cell phone use for school bus drivers.[37]

Wisconsin prohibits texting by all drivers and all cell phone use by drivers holding a probationary license or an instruction permit. All drivers are banned from using a handheld cell phone in work zones. In 2021, Wisconsin Senate Bill 348 and Assembly Bill 338 were introduced to ban the handheld use of portable wireless devices by all drivers. Senate Bill 830, which sought to ban cell phone use in active school zones, was introduced in 2023. None of these bills passed.[38]

Wisconsin has conducted media campaigns such as "Buckle Up Phone Down" to encourage businesses, schools, and other organizations to take a pledge to wear seat belts and refrain from using a cell phone while driving.[39] Wisconsin has also developed TV ads focused on the prevention of distracted driving.[40] The *Wisconsin Motorists' Handbook* summarizes the state's cell phone laws, and the Wisconsin Department of Transportation also publishes them on its webpage.[41] NTSB classified Safety Recommendation H-11-39 Open—Acceptable Alternate Response for the state of Wisconsin in October 2022 because Wisconsin law prohibits texting while driving and because bills to prohibit cell phone use while driving were introduced but did not pass.[42]

Despite Wisconsin's efforts to enact laws to prohibit texting by drivers and conduct education and enforcement campaigns on the dangers and consequences of using a cell phone while driving, drivers continue to use cell phones. The next sections discuss technological countermeasures to prevent cell phone use while driving.

2.3.2.2 Cell Phone Technology

According to the AAA Foundation for Traffic Safety's 2023 Traffic Safety Culture Index survey, about 93% of drivers identify texting, emailing, or reading on a handheld cell phone while driving as being very or extremely dangerous (AAA Foundation 2024). The same survey revealed that 37% of respondents said they drove while reading a text/email, and 27% drove while manually typing or sending a

[37] For details, see the Governors Highway Safety Association issues page on distracted driving.

[38] For details, see the text of Senate Bill 348; Assembly Bill 338; and Senate Bill 830.

[39] See Wisconsin's Buckle Up Phone Down website.

[40] See Wisconsin's Distracted Driving website.

[41] See the *Wisconsin Motorists' Handbook* and a summary of Wisconsin's cell phone laws.

[42] The overall classification for H-11-39 is Open—Acceptable Alternate Response.

text/email on a phone at least once in the past 30 days. Based on observational data, an estimated 6.4% of drivers were using some type of phone, either handheld or hands-free, at a typical daylight moment in 2022 (NHTSA 2024). A recent study by the Insurance Institute for Highway Safety (IIHS) using telematics data showed that 3.5% of trips included at least one handheld phone call (Reagan and others 2024).

Lock-out technology has been developed to prevent the driver's use of cell phones while the vehicle is in motion. These systems are intended to "lock out" the use of any features that are not related to the driving task or that can be distracting to the driver. In the NTSB's investigation of the Mountain View, California, crash, the NTSB concluded that an effective countermeasure for eliminating distraction from portable electronic devices while driving would be a lock-out function or application that automatically disables highly distracting features of cell phones while driving (NTSB 2020a).

As a result of that investigation, the NTSB issued Safety Recommendation H-20-8 to Apple, Inc.; Google, Inc.; HTC Corporation; Lenovo; LG Electronics; Motorola; Nokia; Samsung Group; and Sony Corporation:

> Develop a distracted driving lock-out mechanism or application for portable electronic devices that will automatically disable any driver-distracting functions when a vehicle is in motion, but that allows the device to be used in an emergency; install the mechanism as a default setting on all new devices and apply it to existing commercially available devices during major software updates. (H-20-8)

In 2021, the NTSB reiterated Safety Recommendation H-20-8 to the cell phone manufacturers in our investigation of a collision between an SUV and medium-size bus in Belton, South Carolina (NTSB 2021).

In this recommendation, the NTSB specified that the lock-out mechanism should automatically disable the driver-distracting features and should be installed in the default setting. Apple, Inc., and Google, Inc., both offer lock-out mechanisms on their cell phones as options but require the user to activate the system. A 2020 study by the IIHS found that only about 20% of surveyed cell phone users had the lock-out feature set to activate automatically when they drive (Reagan and Cicchino 2020). Designing the lock-out mechanism to automatically engage as a default setting would increase the feature's use.

Apple, Inc., first responded to this recommendation in June 2020 indicating its phones had a lock-out feature, but it was not enabled by default. Apple, Inc., also said it was developing other systems such as Siri Eyes Free and CarPlay that increase voice interaction and limit touching of the cell phone. The NTSB classified Safety Recommendation H-20-8 to Apple, Inc., Open—Acceptable Response in December

2020 because, although disappointed that Apple's lock-out system was not automatically engaged, we were pleased with Apple's actions to develop other features.

In its most recent response in March 2022, Apple, Inc., wrote that its Driving Focus Mode is installed on all iPhones running iOS 11 or later. It also stated that Driving Focus Mode must be turned on by the phone's user and does not engage by default because there is not a reliable way to determine that the device is being used by the vehicle's driver and not a passenger. However, as explained in the NTSB's response to Apple, Inc., a proactive approach to safety is to install the system as a default feature on all new iPhones and during operating system updates and to require occupants in moving vehicles to opt out of the Driving Focus Mode when they are not the driver. Therefore, in 2022, Safety Recommendation H-20-8 to Apple, Inc., was classified Open—Unacceptable Response.

In June 2020, Google, Inc., responded to Safety Recommendation H-20-8 and stated it had developed a Do Not Disturb feature for voluntary use on Android devices. In December 2020, the NTSB classified Safety Recommendation H-20-8 to Google, Inc., Open—Acceptable Response and urged Google, Inc., to install the Do Not Disturb feature as a default setting. It is our understanding that Do Not Disturb continues to be a voluntary feature of Google devices; the feature is not installed as the default setting, so users are required to activate it.

In July 2022, the NTSB classified Safety Recommendation H-20-8 to Nokia Closed—Reconsidered because Nokia had stopped manufacturing personal electronic devices before the NTSB issued this recommendation and because neither Nokia nor its brand licensee, HMD Global Oy, could alter the installed operating configuration, which controls how the lock-out mechanism is enabled, on either new phones or during subsequent updates.

The other cell phone manufacturers, HTC, Lenovo, LG, Motorola, Samsung, and Sony, have not responded to Safety Recommendation H-20-8. It has been 5 years since this recommendation was originally issued and 4 years since it was reiterated, with no response from these manufacturers.

The dangers of cell phone use—particularly texting—while driving are well established. Although Wisconsin bans texting while driving for all drivers and prohibits probationary licensees from any cell phone use, the pickup truck driver in this crash still engaged in this risky behavior. Technology-based countermeasures are needed in addition to legislation because drivers continue to use their cell phones while driving and continue to risk lives by using their cell phones while driving.

The NTSB concludes that a well-designed cell phone lock-out system that automatically engages and disables the use of features that are not related to the driving task can reduce cell phone–related distracted driving crashes by preventing a driver from engaging in distracting behaviors, such as reading and sending text messages or making or receiving calls. Because the Excelsior crash involves yet another fatal crash caused by distraction from portable electronic devices while driving, and because the cell phone manufacturers have failed to implement or respond to this recommendation, the NTSB reiterates Safety Recommendation H-20-8 to Apple, Inc., Google, Inc., HTC, Lenovo, LG, Motorola, Samsung, and Sony. Further, the NTSB classifies Safety Recommendation H-20-8 Open—Unacceptable Response to Google, Inc., HTC, Lenovo, LG, Motorola, Samsung, and Sony.

2.3.2.3 Driver Monitoring Systems

Driver monitoring systems (DMS) are camera-based systems designed to track driver behaviors (for example, eye glance or head movement) for signs of unsafe driving, such as distraction, inattentiveness, or drowsiness. If these behaviors are detected, the system sends an alert (visual, auditory, or haptic, or a combination of those) to bring the driver's attention back to the driving task.

In the United States, federal standards do not require vehicles to be equipped with DMSs, and DMSs are not rated in NHTSA's New Car Assessment Program (NCAP).[43] This is not the case in other countries. For example, Europe's New Car Assessment Programme (Euro NCAP) added occupant status monitoring (which includes DMS, called advanced driver distraction warning [ADDW]) to its program in 2023.[44] Euro NCAP evaluates how well ADDW technologies can identify and react to driver behaviors including distraction, drowsiness, and unresponsiveness with an alert or other vehicle responses, such as short-duration brake activations, to return the driver's attention to the roadway. Specific to distraction, Euro NCAP evaluates an ADDW's ability to detect long gazes away from the road (≥ 3 seconds), short distractions involving repeated glances away from the forward road view, and phone use.

Further, the European Union has mandated that by July 7, 2026, all new passenger and commercial vehicles must be equipped with ADDW systems.[45] Among other requirements, a warning must be provided when a driver's attention is

[43] NHTSA's NCAP consists of 5-star ratings that provide consumers with information on new passenger vehicle crashworthiness and rollover safety. In addition, it provides information on advanced driver technologies.

[44] For details, see the Euro NCAP report *Assessment Protocol – Safety Assist: Safe Driving*.

[45] European Union Regulation 2019/2144 states that as of July 7, 2024, all new types or designs of passenger cars and goods vehicles must be equipped with an advanced driver distraction warning system. As of July 7, 2026, this requirement applies to all new passenger cars and goods vehicles, even existing vehicle models that are newly produced.

away from the road for more than 3.5 seconds when a vehicle's speed is 50 km/h (about 31 mph) or greater.[46]

China's NCAP includes assessment of DMSs that specifically evaluate a driver's level of alertness and attention to the driving task. Eye movement and head movement are evaluated as part of a driver attention monitoring system.[47]

In March 2022, NHTSA published a request for comments asking for feedback on proposed changes to its NCAP.[48] In that request, NHTSA said it considered DMSs as an emerging technology and requested general information on DMSs as well as more specific information on technologies to detect distracted and drowsy driving. The NTSB noted in its May 2022 response that these technologies are ready for deployment and cited Europe's mandate for installation of ADDW systems on vehicles and Euro NCAP's ADDW testing protocols.[49]

NHTSA included distracted driving and drowsy driving in a January 2024 advance notice of proposed rulemaking titled "Advanced Impaired Driving Prevention Technology."[50] NHTSA did so because of the safety problem posed by distracted or drowsy driving and because the DMS technologies that can detect alcohol impairment may also have the potential to detect distracted or drowsy driving. In its March 2024 response, the NTSB acknowledged the complexity of DMSs to properly address alcohol impairment and distracted and drowsy driving but also urged NHTSA to take an iterative approach to NCAP to move forward with technologies such as DMSs that are available and already incorporated into other countries' NCAP and then update over time as technologies strengthen.[51] The NTSB again urged NHTSA to move forward with incorporating DMSs into the NCAP.

In December 2024, NHTSA published a final decision notice updating the NCAP; although it included four advanced driver assistance systems, it did not

[46] The European Union road safety initiative for driver distraction warning systems contains the requirements for these systems, such as monitoring driver eye movements.

[47] For details, see C-NCAP Management Regulation - Appendix L Active Safety ADAS Test Protocol | SafetyWissen.

[48] See "New Car Assessment Program," request for comments, March 9, 2022 (87 *Federal Register* 13452, Docket No. NHTSA-2021-0002).

[49] See NTSB's response to NHTSA's New Car Assessment Program.

[50] See "Advanced Impaired Driving Prevention Technology," advance notice of proposed rulemaking, January 5, 2024 (89 *Federal Register* 27665, Docket No. NHTSA–2022–0079).

[51] See https://www.regulations.gov/comment/NHTSA-2022-0079-8656 for the NTSB's response to the advance notice of proposed rulemaking.

include DMSs.[52] However, the notice contains a roadmap for the long-term upgrades to NCAP and includes DMSs for distraction and drowsy driving. According to the roadmap, the final decision stage for DMSs is proposed for 2029 with an implementation date of 2032.

A DMS, particularly one that can detect distracted driving, could have played a critical role in preventing this crash by detecting the pickup truck driver's inattention due to his cell phone use and alerting him to return his attention to the roadway. The NTSB concludes that driver monitoring systems that detect and alert a distracted driver (such as the pickup truck driver in the Excelsior crash and bring their attention back to the driving task can improve safety. The NTSB recognizes that NHTSA has added DMS for distracted and drowsy driving to its NCAP roadmap. However, the NTSB is disappointed that NHTSA anticipates it will be another 7 years before implementation. Even if distracted and drowsy driving DMSs are added to NCAP in 2032, it will take several more years before DMS penetrates the market considering that the average age of a vehicle on the road is 12.6 years old.[53]

The NTSB will monitor NHTSA's progress to implement DMS according to its roadmap timeline as we continue ongoing investigations involving this technology.[54]

2.3.2.4 NHTSA's Voluntary Driver Distraction Guidelines

A vehicle can contain several electronic devices. Some of these, such as a radio or infotainment center, are original equipment when the vehicle is built. Other electronic devices are portable, such as cell phones or tablets, and are temporarily brought into the vehicle. Some electronic devices may be installed or integrated into the vehicle after manufacture; such devices are referred to as aftermarket devices. Many of these devices can be distracting for a driver.

In 2010, NHTSA introduced its plan to develop nonbinding, voluntary guidelines to minimize driver distraction from in-vehicle, portable, and aftermarket devices (NHTSA 2010). The guidelines were to be developed in three phases to address:

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[52] See "New Car Assessment Program Final Decision Notice-Advanced Driver Assistance Systems and Roadmap," final decision notice, December 3, 2024 (89 *Federal Register* 95916, Docket No. NHTSA–2024–0077).

[53] For more information, see Average Age of Vehicles Hits New Record in 2024 | S&P Global Mobility.

[54] See Rear-End Collision Between a Sport Utility Vehicle Operating With Partial Driving Automation and Two Stationary Passenger Vehicles, Philadelphia, Pennsylvania, and Rear-End Collision Between a Sport Utility Vehicle Operating With Partial Driving Automation and a Stationary Sport Utility Vehicle, San Antonio, Texas.

- Visual-manual interfaces of devices installed in light vehicles as original equipment (Phase 1);
- Visual-manual interfaces of portable and aftermarket devices (Phase 2); and
- Auditory–vocal interfaces (Phase 3).

The Phase 1 guidelines, published in 2013, serve as a voluntary aid for manufacturers in designing in-vehicle electronic devices. The goal is to reduce visual-manual distraction from the primary driving task while performing secondary tasks involving the use of an in-vehicle electronic device.[55] NHTSA's Phase 1 guidelines contain a list of secondary tasks that interfere with or distract the driver, such as entering a text message or displaying video not related to the driving task, and NHTSA recommends that in-vehicle systems be "locked out" or "designed so that they cannot be used by the driver to perform these inherently distracting secondary tasks while driving." For other visual-manual secondary tasks, such as those related to navigation, the guidelines specify applicable test methods that focus on the amount of visual attention needed to complete the task and set time-based acceptance criteria.

In 2016, NHTSA proposed Phase 2 guidelines addressing visual-manual interfaces of portable and aftermarket devices.[56] NHTSA incorporated Phase 1 guidelines into the proposed Phase 2 guidelines. The guidelines proposed that either (a) portable electronic devices be able to be paired with in-vehicle devices or (b) devices unable to be paired have a driver mode so the device conforms with Phase 1 guidelines. NHTSA did not finalize the proposed Phase 2 guidelines. The third phase was to expand the guidelines to include auditory–vocal interfaces, but a proposal for these guidelines had not been developed at the time of this report's publication.

The NTSB commented on the Phase 1 guidelines and expressed concern about the voluntary nature of the guidelines and the underemphasis of the role of cognitive distraction.[57] We reiterated our concern about the lack of focus on the role

[55] See "Visual-Manual NHTSA Driver Distraction Guidelines for In-Vehicle Electronic Devices," notice of federal guidelines, April 26, 2013 (78 *Federal Register* 24818, Docket No. NHTSA–2010–0053).

[56] See the notice in the *Federal Register* for the proposed contents of the second phase of NHTSA's Driver Distraction Guidelines, "Visual–Manual NHTSA Driver Distraction Guidelines for Portable and Aftermarket Devices," notice of proposed federal guidelines, December 5, 2016 (81 *Federal Register* 87656, Docket No. NHTSA–2013–0137).

[57] See NTSB's response to NHTSA's proposed Phase 2 guidelines.

of cognitive distraction in our comments on the proposed Phase 2 guidelines.[58] We also stated that we did not support the pairing of personal smartphones, tablets, or music devices with original equipment unless the devices supported driving-related tasks.

In January 2022, the US Department of Transportation (USDOT) released its National Roadway Safety Strategy and put forward a comprehensive plan to reach its goal of zero traffic deaths.[59] The USDOT developed the plan using the principles of the Safe System Approach to achieve its objectives of safer people, safer roads, safer vehicles, safer speeds, and postcrash care.[60] In a 2024 update to the strategy, the USDOT included two new action items specifically addressing distracted driving:[61]

> New Action: Revise distracted driving prevention campaign materials to reflect the evolution of distraction dangers associated with hand-held devices and use updated content during high visibility enforcement activities.
>
> New Action: Develop a distraction research roadmap, informed by diverse expertise and public comment, that could support future updates such as Visual-Manual Driver Distraction Guidelines for In-Vehicle Electronic Devices.

In the minutes and seconds before the pickup truck collided with the school bus and student pedestrian, the pickup truck driver was using a cell phone while driving and was involved in a texting conversation in which he was sending and receiving text messages and photos. The pickup truck did not have an in-vehicle display to use with a cell phone, meaning that he had to physically manipulate the cell phone to text and insert a photo into a message. Although NHTSA's proposed Phase 2 Guidelines covered portable devices including cell phones, they were not finalized. The proposed Phase 2 Guidelines would have required a cell phone, even if not paired with the vehicle, to have a driver mode that locked out nondriving-related tasks such as texting and viewing nondriving-related information.

Furthermore, original equipment in-vehicle electronic devices, portable electronic devices, and aftermarket electronic devices have advanced over the past

[58] The NTSB's comments can be found in the docket for Visual-Manual Driver Distraction Guidelines for Portable and Aftermarket Devices, NHTSA docket no. 2013-0137. See the document titled "Comment from Christopher A. Hart" [former NTSB Chairman], February 3, 2017.

[59] See the US Department of Transportation's 2022 National Roadway Safety Strategy, version 1.1 (January 2022).

[60] See What Is a Safe System Approach? | US Department of Transportation.

[61] See the US Department of Transportation's 2024 Progress Report on the National Roadway Safety Strategy.

decade since the Phase 1 Guidelines were published. For example, auditory and voice capabilities as well as the use of larger interface screens have been introduced for original equipment in-vehicle systems.[62] According to data from a recent industry survey, consumers prefer touchscreens when given a choice between button, rotary dials, touch screens, or voice commands for controlling center screen content.[63] However, touch screens rely on visual cues. Recognizing that overuse of touchscreens in vehicles increases the risk of driver distraction, Euro NCAP is introducing new protocols that will encourage physical controls for certain vehicle functions.[64] The use of vocal commands has also become more prevalent with cell phones.

Additionally, new applications for use of original equipment in-vehicle as well as portable and aftermarket electronic devices have been created and continue to be developed, potentially affecting how people interact with the vehicle interfaces and with their phones while driving. These applications and devices add opportunities for distraction from the primary driving task. Some of these new features may reduce driver workload, but other features may increase cognitive demands on the driver. For example, using voice commands may reduce the time a driver's eyes are off the road compared to using a visual-manual action, but they can still distract a driver (Strayer and others 2015, Mehler and others 2015). The NTSB concludes that NHTSA's 2013 Phase 1 Driver Distraction Guidelines, which focused on the visual-manual distraction of in-vehicle technology, are outdated due to advances in technology in the past 12 years and because NHTSA did not implement Phases 2 and 3; thus, the guidance necessary for preventing distracted driving crashes is lacking and such crashes will remain prevalent without leadership and guidance at the federal level to minimize driver distraction. Therefore, the NTSB recommends that NHTSA develop and publish Driver Distraction Guidelines that address the design of current original equipment in-vehicle electronic devices, portable electronic devices, and aftermarket electronic devices to prevent driver distraction.

2.4 Lack of Collision Avoidance and Injury Mitigation Technology

2.4.1 Introduction

This crash involved two collisions: the first occurred when the pickup truck braked, swerved, and struck the right-rear corner of the school bus, and the second occurred when the pickup truck struck the student pedestrian waiting to board the

[62] For example, see a survey from Topspeed.com, "19 Cars With The Largest Touchscreens" | Topspeed.

[63] See the AutoPacific insights page "AutoPacific Study Says Big Infotainment Screens & Functionality Appeal to Young Families and In-Vehicle Multi-Taskers" | AutoPacific.

[64] See Car Industry Told To Dial Back Use of Touchscreens | *The Times* (UK).

bus. In this section, the NTSB discusses collision avoidance systems that are designed to prevent or mitigate crashes with vehicles and pedestrians such as the collisions of the pickup truck with the school bus and the student pedestrian. This section also discusses passive vehicle design systems, such as modified hoods or pliable bumpers, designed to reduce injuries to pedestrians in the event of a crash.

2.4.2 Collision Avoidance Technology

Collision avoidance technologies such as forward collision warning (FCW) and automatic emergency braking (AEB) are driver assistance systems that can prevent or reduce the severity of rear-end collisions such as the crash in the Town of Excelsior, Wisconsin, in which the pickup truck driver, distracted by his cell phone use, failed to act in time to avoid a collision with the school bus as it stopped to load students. FCW and AEB systems use radar, cameras, or a combination of these tools to detect and classify objects in front of the vehicle to identify a potential hazard such as the rear of a slowing or stopped vehicle. If the equipped vehicle gets too close to a lead vehicle, the FCW system alerts the driver of an impending collision. The alert can be audible, visual, haptic, or a combination of these.[65] If the driver does not take action, AEB systems can apply the vehicle's brakes to reduce the vehicle's speed and avoid a crash or mitigate the severity of a crash. AEB systems can also assist with braking if the driver does not apply enough braking force. Pedestrian automatic emergency braking (PAEB) systems likewise use sensors to detect pedestrians and can alert drivers to a pedestrian in their path or can apply the vehicle's brakes to avoid contact between the vehicle and a pedestrian or to reduce the speed of the vehicle to mitigate injury severity in the event of a crash.

The NTSB has a long history of recommending FCW, AEB, and PAEB systems to be installed in vehicles (see section 2.4.4 for additional information on NTSB recommendations and responses from NHTSA and the vehicle manufacturers). Many manufacturers began to offer collision avoidance systems, including AEB, on their passenger vehicles as standard equipment as a result of a 2015 voluntary agreement among the manufacturers, IIHS, and NHTSA (see section 2.4.4.2).[66]

On May 9, 2024, NHTSA published a final rule, "Automatic Emergency Braking for Light Vehicles," establishing a new federal motor vehicle safety standard (FMVSS No. 127) that requires newly manufactured light vehicles to be equipped with FCW, AEB, and PAEB systems that meet minimum performance specifications.[67] The

[65] Haptic alerts provide a tactile sensation like vibration to signal an event.

[66] See "U.S. DOT and IIHS announce historic commitment from 10 automakers to include automatic emergency braking on all new vehicles" | IIHS.

[67] See "Federal Motor Vehicle Safety Standards; Automatic Emergency Braking Systems for Light Vehicles," final rule, May 9, 2024 (89 *Federal Register* 39686, Docket No. NHTSA-2023-0021).

standard specifies that the FCW and AEB systems need to detect lead vehicles (moving or stopped) when the equipped vehicle is traveling at speeds between 6.2 mph and 90.1 mph. The FCW system must provide visual or auditory warnings and for the AEB system to engage early enough, at speeds up to 62 mph, by either initiating braking or supplementing driver-applied braking to avoid the crash.[68] The AEB system must engage, but not necessarily avoid a crash, at speeds up to 90.1 mph.[69] PAEB systems also must initiate automatic braking after detecting a pedestrian when the subject vehicle is traveling at speeds greater than 6.2 and up to 45.4 mph to avoid a crash with pedestrians. The PAEB requirements address both daylight and nighttime conditions. The 2010 pickup truck involved in this crash was manufactured before NHTSA established this standard and also before the 2015 voluntary agreement; therefore, it was not equipped (and was not required to be equipped) with FCW, AEB, and PAEB systems.

As noted earlier, FMVSS No. 127 requires the AEB system to initiate or supplement braking early enough to avoid a crash at speeds up to 50 mph or 62 mph, depending on whether the driver is braking. Under the Excelsior crash circumstances, given the pickup truck's estimated speed (about 54 mph) a second before the crash, as well as the pickup truck driver's estimate that he was traveling between 55 and 60 mph, an AEB system meeting the new standards would have been able to reduce the pickup truck's speed before impact, thereby potentially avoiding or mitigating the collision with the school bus. An AEB system that could stop the pickup truck before the collision with the rear of the slowing school bus would have also prevented the subsequent collision with the student pedestrian. Even a reduction in the pickup truck's speed before striking the school bus would have mitigated the severity of the collision with the student pedestrian and would have increased her chances of survival.[70]

The PAEB performance standard in FMVSS No.127 requires a vehicle to avoid a collision with a pedestrian by applying the brakes automatically under certain test conditions during daylight and darkness. The speed range for PAEB (6.2 to 45.4 mph) is lower than that of AEB. Like AEB, PAEB uses sensors to detect an object (a pedestrian) in the vehicle's forward travel path. The vehicle's travel path, as well as

[68] The AEB system must avoid the collision up to speeds of 62 mph when the driver has applied the brakes. If the driver does not apply the brakes, the AEB system must avoid the crash up to speeds of 50 mph.

[69] At speeds between 62 and 90 mph, brake timing, braking force, and collision avoidance are at the discretion of the manufacturer. FMVSS No. 127 requires that an FCW is provided and that the vehicle automatically applies the brakes, but it does not require any particular speed reduction in that speed range.

[70] A pedestrian's risk of death increases as impact speed increases. In a study of US pedestrian crashes, the average risk of death increased from 10% at 24 mph to 25% at 33 mph, 50% at 41 mph, 75% at 48 mph, and 90% at 55 mph (Tefft 2013).

anything potentially obstructing the pedestrian, are considered in the PAEB performance criteria.

In the Excelsior sequence of events, because of the pickup truck's initial collision with the rear of the school bus, combined with the pickup truck's speed and the student's location out of the pickup truck's direct line of approach on the roadway, a PAEB system alone, even one that met new standards, likely would not have been effective at reducing the impact speed with the pedestrian. However, an AEB system meeting FMVSS No. 127 would have reduced the pickup truck's speed before impact with the school bus, avoiding or mitigating the collision with the bus and the student pedestrian. The NTSB concludes that had the pickup truck been equipped with an AEB system meeting the minimum performance requirements set in FMVSS No. 127, the collision with the school bus could have been avoided or at least mitigated, which would also have prevented or mitigated the collision with the student pedestrian.

2.4.3 Injury Mitigation Technology

In the event of a crash, vehicle design plays a critical role in a pedestrian's ability to survive a collision. The 13-year-old student pedestrian was struck by the pickup truck's 47-inch-tall, blunt front end along the truck's centerline.[71] She was accelerated in the direction the pickup truck was traveling (northwest) and downward toward the ground and was then overrun, resulting in fatal injuries. The pickup truck's speed was estimated to be about 54 mph the second before the pickup truck swerved to the right and collided with the school bus; the impact with the bus and the pickup truck driver's braking slowed the truck slightly before the impact with the student pedestrian, which occurred only 0.6 seconds after the bus was struck.

As noted earlier, a pedestrian's risk of death increases as impact speed increases; the average risk of death increases from 10% at an impact speed of 24 mph to 90% at 55 mph (Tefft 2013). Similar results were found in a recent IIHS study (Monfort and Mueller 2024): pedestrians struck at 20 mph had a 1% chance of sustaining a fatal injury; however, at 35 mph, the risk was 19%, and at 50 mph, the chance of a fatal injury exceeded 80%.

In addition to impact speeds, the severity of injuries to a struck pedestrian is affected by the impacting vehicle's size and front-end shape. Larger vehicles such as SUVs and pickup trucks are more dangerous for pedestrians than smaller cars (Hu and others 2024). The danger from these larger vehicles comes from the way in which their tall front ends strike pedestrians higher up on their bodies, injuring more sensitive body parts such as the torso and head (Monfort and Mueller 2024). Being

[71] A vehicle with a blunt hood design has a more vertical, less sloped front end.

struck higher on the body also increases injury due to the likelihood that after the initial impact, a person will be struck to the ground and overrun rather than thrown onto the hood (Edwards and Leonard 2022). Another IIHS study found that vehicles with hoods more than 40 inches off the ground were about 45% more likely to cause pedestrian fatalities than vehicles with hood heights lower than 30 inches and sloped front ends. In addition, medium-height vehicles with blunt front ends were 26% more likely to kill a pedestrian (Hu and others 2024). Additionally, higher vehicle height combined with vehicle speed increases the likelihood of moderate and serious pedestrian injuries when a crash does occur. According to the IIHS research, at 27 mph, a medium-height pickup had an 83% chance of causing moderate injuries and a 62% chance of causing serious injuries compared with a medium-height car, which had a 60% chance of causing moderate injuries and a 30% chance of causing serious injuries.[72]

The 13-year-old student pedestrian in this crash was struck by a pickup truck with a high (47 inches) and blunt front end, a profile with a proven high risk of injury or fatality. Although the pickup truck driver braked and struck the school bus before striking the student, the reduction in the vehicle's estimated speed of 54 mph in the second before swerving to the right was likely minimal because the impact with the bus was glancing and the impact with the student occurred only 0.6 seconds after impact with the bus. Thus, as indicated in the Monfort and Mueller research findings, the impact speed between the pickup truck with a high front end and the student pedestrian was likely near the range resulting in an 80% chance of a fatal injury. In addition, as the pickup truck collided with the pedestrian, she was struck to the ground and then overrun, further increasing her risk of death. The NTSB concludes that the pickup truck's high and blunt hood design combined with its speed at the time of impact with the student pedestrian contributed to her fatal injuries.

2.4.4 Safety Recommendations for Collision Avoidance and Injury Mitigation Technology

2.4.4.1 Safety Recommendations to NHTSA for Testing Protocols for Collision Avoidance Systems

For more than two decades, the NTSB has recommended that FCW, AEB, and PAEB systems be installed in vehicles. In 2001, the NTSB published a special investigative report, *Vehicle- and Infrastructure-Based Technology for the Prevention of Rear-End Collisions*, and issued Safety Recommendation H-01-8 to the USDOT (later reassigned to NHTSA) to complete rulemaking on adaptive cruise control and collision warning system performance standards for new passenger vehicles (NTSB

[72] The front end of a medium-height pickup truck was 13 inches higher than that of a medium-height car.

2001). Safety Recommendation H-01-8 was classified Closed—Acceptable Alternate Action in the NTSB's 2015 special investigation report *The Use of Forward Collision Avoidance Systems to Prevent and Mitigate Rear-End Crashes*, based on NHTSA's research and development of partial performance standards and assessment protocols (NTSB 2015). In that report, the NTSB also concluded that NHTSA's testing scenarios and protocols for assessing forward collision avoidance systems in passenger vehicles did not adequately represent the wide range of speeds seen in crashes and recommended that NHTSA

> Develop and apply testing protocols to assess the performance of forward collision avoidance systems in passenger vehicles at various velocities, including high speed and high velocity-differential. (H-15-4)

In correspondence to NHTSA in June 2016 and November 2017, the NTSB stated that it was unclear how NHTSA's research on collision avoidance technology would lead to protocols that could assess the performance of such systems, and Safety Recommendation H-15-4 was therefore classified Open—Unacceptable Response.

In 2018, the NTSB published a special investigation report that examined many aspects of pedestrian safety (NTSB 2018). That report describes various technologies manufacturers were developing and concluded that a set of test conditions was needed to rate the performance of pedestrian collision avoidance systems. We asked NHTSA to:

> Develop performance test criteria for manufacturers to use in evaluating the extent to which automated pedestrian safety systems in light vehicles will prevent or mitigate pedestrian injury. (H-18-42)

In June 2019, the NTSB classified Safety Recommendation H-18-42 Open—Acceptable Response because NHTSA had conducted PAEB research to develop objective vehicle pedestrian test procedures.

As noted earlier, in May 2024, NHTSA published a final rule, "Automatic Emergency Braking for Light Vehicles," establishing a new federal motor vehicle safety standard (FMVSS No. 127) that requires newly manufactured light vehicles to be equipped with FCW, AEB, and PAEB systems that meet minimum performance specifications.[73] The federal safety standard addressed a statutory mandate from the Infrastructure Investment and Jobs Act to direct the Secretary of Transportation to establish a rule requiring that all passenger vehicles manufactured for sale in the

[73] See "Federal Motor Vehicle Safety Standards; Automatic Emergency Braking Systems for Light Vehicles," final rule. May 9, 2024 (89 *Federal Register* 39686, Docket No. NHTSA-2023-0021).

United States be equipped with an FCW system and an AEB system.[74] The compliance date for manufacturers to equip light vehicles with FCW, AEB, and PAEB systems is September 1, 2029.

On November 26, 2024, NHTSA published a response to petitions for reconsideration of the FMVSS No. 127 final rule; petitioners included the Alliance for Automotive Innovation, Toyota Motor North America, Volkswagen Group of America, Scuderia Cameron Glickenhaus, LLC, and Autotalks.[75] In its November response, NHTSA partially granted the petitions for reconsideration and clarified the requirements applicable to FCW signals, corrected an error in one of the test scenarios, and simplified some of the language.[76] On January 17, 2025, the Alliance for Automotive Innovation petitioned the United States Court of Appeals for the District of Columbia Circuit for a repeal of the final rule.[77]

Separate from the rulemaking activity on FMVSS No. 127, NHTSA also published a final decision notice in December 2024 stating it was adding four new advanced driver assistance system technologies to NCAP: blind spot warning, blind spot intervention, lane keeping assist, and PAEB.[78] NHTSA also updated the procedures it uses to test AEB systems.[79] NHTSA's final decision on AEB and PAEB for NCAP established similar testing speeds and avoidance criteria to the FMVSS No. 127 standard.

FMVSS No. 127 specifies testing procedures for forward collision avoidance systems including FCW, AEB, and PAEB at a range of speeds as recommended in the NTSB Safety Recommendations H-15-4 and H-18-42. In addition, NHTSA's December 2024 final decision on NCAP established testing protocols and criteria for light vehicle forward collision avoidance systems starting with model year 2026 vehicles

[74] For details, see the Infrastructure Investment and Jobs Act.

[75] See "Federal Motor Vehicle Safety Standards; Automatic Emergency Braking Systems for Light Vehicles," November 26, 2024, final rule; response to petitions for reconsideration (89 *Federal Register* 93199, docket no. NHTSA-2023-0021).

[76] On January 27, 2025, NHTSA announced that the effective date of the rule amending FMVSS No. 127 with clarification changes was delayed until March 20, 2025. See "Federal Motor Vehicle Safety Standards; Automatic Emergency Braking Systems for Light Vehicles," final rule; delay of effective date, January 27, 2025 (90 *Federal Register* 8179, docket no. NHTSA-2023-0021).

[77] See the full text of the complaint, USCA case no. 25-1026.

[78] (a) "New Car Assessment Program Final Decision Notice–Advanced Driver Assistance Systems and Roadmap," final decision notice, December 3, 2024 (89 *Federal Register* 95916, Docket No. NHTSA–2024–0077). (b) NHTSA published a series of regulatory documents, consisting of requests for comments in 2015 and 2022, and an advance notice of proposed rulemaking in 2020.

[79] Dynamic brake support and crash imminent braking are AEB systems. Dynamic brake support automatically assists the driver's braking to avoid a crash. If the driver does not respond, the crash imminent braking system automatically applies the brakes to avoid the crash.

that are similar to performance levels in FMVSS No. 127. NHTSA's final rule requiring light vehicles to be equipped with FCW, AEB, and PAEB systems, and NHTSA's December 2024 final decision to update NCAP, include performance testing protocols and criteria for collision avoidance systems and meet the intent of Safety Recommendations H-15-4 and H-18-42. Therefore, Safety Recommendations H-15-4 and H-18-42 are classified Closed—Acceptable Action.

2.4.4.2 Safety Recommendations for Vehicle Manufacturers to Install Collision Avoidance Systems

In addition to recommending that NHTSA develop performance testing protocols for FCW, AEB, and PAEB, the NTSB also issued recommendations to the passenger vehicle, truck-tractor, motorcoach, and single-unit truck manufacturers in its 2015 special investigation report (NTSB 2015). In that report, we concluded that forward collision avoidance systems installed in light and heavy vehicles would reduce the frequency and severity of rear-end crashes, such as the rear-end collision between the pickup truck and the school bus in this crash. We asked vehicle manufacturers to:

> Install forward collision avoidance systems that include, at a minimum, a forward collision warning component, as standard equipment on all new vehicles. (H-15-8)
>
> Once the National Highway Traffic Safety Administration publishes performance standards for autonomous emergency braking, install systems meeting those standards on all new vehicles. (H-15-9)

The overall status of Safety Recommendations H-15-8 and -9 is Open—Acceptable Response.

As noted previously, as a result of a 2015 voluntary agreement among the manufacturers, IIHS, and NHTSA, manufacturers began offering AEB as a standard feature on new light vehicles. The agreement urged auto manufacturers to make AEB a standard feature on new light vehicles no later than September 1, 2022 and on trucks under 10,000 pounds no later than September 1, 2023.[80] In 2023, all 20 participating automakers, representing 99% of the US auto market, fulfilled their pledge.[81] To meet the agreement, the AEB system had to either be able to slow the

[80] For details, see "U.S. DOT and IIHS announce historic commitment of 20 automakers to make automatic emergency braking standard on new vehicles."

[81] See "Automakers fulfill autobrake pledge for light-duty vehicles."

vehicle by at least 10 mph in one of two tests conducted at 12 and 25 mph or by 5 mph at both speeds.[82]

In January 2016, the NTSB classified Safety Recommendations H-15-8 and -9 for Ford Motor Company, the manufacturer of the 2010 pickup truck, Open—Acceptable Response because Ford offered FCW and AEB as optional equipment on some models and had committed to the 2015 voluntary agreement to make AEB a standard feature on all new vehicles.

In 2018, Ford's Pre-Collision Assist system was upgraded to include FCW, brake support, AEB, and PAEB. The FCW provides visual and auditory alerts and the AEB either engages the brakes to mitigate crashes or provides supplemental braking force (i.e., brake support) when the driver's braking is less than maximum if a potential rear-end collision is detected. Although the system can detect pedestrians, it has limitations.[83] Pre-Collision Assist with AEB is now offered as standard equipment on all Ford vehicles, including the F-150. According to Ford's 2024 annual submission to NHTSA on the number of vehicles offering AEB, 98% of its light vehicles up to 8,500 pounds GVWR for sale in the United States are shipped with AEB.[84] Ford also reported that 96% of light-duty vehicles and trucks up to 10,000 pounds GVWR are equipped with AEB as a standard safety system.

As of October 28, 2024, nearly all the light-duty Ford vehicles sold in the United States to the public are equipped with AEB as a standard safety system. Therefore, NTSB classifies Safety Recommendation H-15-8 Closed—Acceptable Action to Ford Motor Company. Until FMVSS No. 127 requiring manufacturers to meet FCW, AEB, and PAEB standards goes into effect in 2029 (or when testing of Ford's 2026+ model year vehicles shows they meet the updated NCAP criteria), Safety Recommendation H-15-9 remains classified Open—Acceptable Response for Ford Motor Company.

2.4.4.3 Safety Recommendations to NHTSA to Update NCAP with Collision Avoidance Systems

To incentivize automobile manufacturers to install FCW, AEB, and PAEB on vehicles, the NTSB recommended that NHTSA expand NCAP to include these systems. In its 2015 special investigation on forward collision avoidance systems, the NTSB said the rating system would be an incentive to consumers to purchase a

[82] This performance achieves an advanced rating in IIHS's front crash prevention evaluation.

[83] See Ford's Pre-Collision Assist with Automatic Emergency Braking for additional information. Under certain conditions, such as if the pedestrian is running, the system may not detect the pedestrian.

[84] The report covered vehicles manufactured after September 1, 2023, and before August 31, 2024. The remaining 2% were police or emergency vehicles. See NHTSA Docket 2015-0101-0130.

vehicle with such systems and encourage passenger vehicle manufacturers to include the systems as standard equipment (NTSB 2015). We also said that a graded system (as opposed to a pass/fail system) comparing collision avoidance systems across manufacturers' vehicles would enable consumers to differentiate and evaluate the systems. We issued safety recommendations to NHTSA to expand NCAP to include a scale that rates the performance of forward collision avoidance systems (H-15-6) and to include these ratings on the Monroney label, the label placed on new vehicles with consumer information (H-15-7). In its 2018 special investigation report on pedestrian safety, the NTSB also issued Safety Recommendation H-18-43 to NHTSA to incorporate PAEB in the NCAP; this recommendation is discussed in section 2.4.4.4.

> Expand the New Car Assessment Program 5-star rating system to include a scale that rates the performance of forward collision avoidance systems. (H-15-6)

> Once the rating scale, described in Safety Recommendation H-15-6, is established, include the ratings of forward collision avoidance systems on the vehicle Monroney labels. (H-15-7)

Safety Recommendations H-15-6 and H-15-7 were classified Open—Unacceptable Response in April 2021 because NHTSA had not incorporated a rating system for collision avoidance systems into NCAP. The current NCAP is only pass/fail for forward collision avoidance systems and information regarding the pass/fail performance is not included on the Monroney label.

As discussed earlier, NHTSA published a final decision notice in December 2024 updating NCAP and addressed FCW, AEB, and PAEB. The December 2024 final decision does not include a rating system for collision avoidance technologies. Instead, NHTSA plans to use checkmarks on the NCAP webpage to identify vehicles that are equipped with the collision avoidance technologies that meet the updated test criteria. However, the implementation of a rating system is part of NHTSA's roadmap for NCAP. NHTSA's target date for implementing this rating system for collision avoidance technologies is 2027. Also in the final decision, NHTSA states it is researching how to display vehicle ratings on the Monroney label and plans to complete rulemaking to update the Monroney label in 2026. NHTSA has initiated research by publishing a notice and request for comments for the collection of consumer information related to the 5-Star Safety Ratings section of the Monroney label.[85] The target date to include the crash avoidance ratings as well as other vehicle ratings on the Monroney label is fourth quarter 2027 for model year 2028 vehicles.

[85] "Agency Information Collection Activities; Notice and Request for Comment; 5-Star Safety Ratings Label Qualitative Concept Testing" notice and request for comments, March 7, 2025 (90 *Federal Register* 11579 Docket No. NHTSA-2024-0041).

NHTSA's December 2024 decision to update the testing protocols for FCW and AEB and its plans to include a rating scale for collision avoidance technologies at a later date partially meet the intent of Safety Recommendation H-15-6. Therefore, the NTSB classifies Safety Recommendation H-15-6 Open—Acceptable Response to NHTSA. The final decision on the addition of the ratings of the crash avoidance technologies to the Monroney label is projected with a target implementation date of 2027; therefore, due to the continued delay in updating the Monroney label, Safety Recommendation H-15-7 remains classified Open—Unacceptable Response.

2.4.4.4 Safety Recommendations to NHTSA for Injury Mitigation and Pedestrian Safety Technology

Collision avoidance systems are designed to reduce a vehicle's speed to avoid a crash or reduce the speed at impact. If a collision occurs, the impact will occur at a reduced speed and a passive vehicle design can further prevent injury. In this crash, a 13-year-old student pedestrian was struck by a pickup truck with a high, blunt front end at a relatively high speed. Even if the pickup truck had been equipped with an AEB system that reduced the vehicle's speed at impact, the high, blunt front end of the pickup truck still posed a danger.

In our 2018 special investigation report on pedestrian safety, we found that incorporating pedestrian injury mitigation into vehicle hood and bumper designs would improve pedestrian safety, and issued Safety Recommendation H-18-41 to NHTSA to:

> Develop performance test criteria for vehicle designs that reduce injuries to pedestrians. (H-18-41)

Safety Recommendation H-18-41 was classified Open—Unacceptable Response in June 2019. The NTSB acknowledged that NHTSA was conducting research on PAEB but not on vehicle designs as requested in H-18-41.

In that 2018 special investigation report, we further recognized that effective passive vehicle design countermeasures are more effective when combined with active collision avoidance and mitigation technologies. Even with a passive vehicle design that reduces pedestrian injuries in the event of a crash, high impact speeds can still result in pedestrian injuries and fatalities. The purpose of PAEB is to prevent a collision or reduce the speed of the impact with a pedestrian. If a pedestrian collision still occurs, the PAEB should reduce the impact speed such that passive vehicle designs can further prevent serious injuries and fatalities. We asked NHTSA to:

> Incorporate pedestrian safety systems, including pedestrian collision avoidance systems and other more-passive safety systems, into the New Car Assessment Program. (H-18-43)

In April 2021, the NTSB classified Safety Recommendation H-18-43 Open–Unacceptable Response (along with H-15-6 and -7) because NCAP still did not address pedestrian safety systems, including PAEB or passive vehicle design features for pedestrian safety.

On September 19, 2024, NHTSA published a notice of proposed rulemaking (NPRM) titled "Federal Motor Vehicle Safety Standards; Pedestrian Head Protection, Global Technical Regulation No. 9."[86] In this notice, NHTSA proposed a new FMVSS to ensure new passenger vehicles incorporate passive designs to mitigate risk of severe and fatal head injury in child and adult pedestrian crashes. The proposed standard includes test procedures simulating a head-to-hood impact and specifies performance requirements to minimize the risk of head injury for vehicle speeds up to 25 mph. The proposed rule is based on a Global Technical Regulation (GTR) on pedestrian protection.

The NTSB responded to the NPRM indicating its support for harmonizing testing protocols with those used around the world.[87] We encouraged NHTSA to adopt an approach that determines the test area based on where head impacts would occur in the real world and incorporate testing protocols that also evaluate large vehicles such as pickup trucks. We urged NHTSA to expedite the rulemaking process on these passive pedestrian protection requirements.

NHTSA also published a final decision notice, "New Car Assessment Program Final Decision Notice–Crashworthiness Pedestrian Protection," on November 24, 2024.[88] NHTSA stated that it will identify new model year vehicles that meet minimum thresholds for pedestrian safety. Similar to the method used in the Euro NCAP, the assessment method will simulate a pedestrian being struck by a vehicle traveling at 40 km/h (25 mph) and will evaluate the potential risk of injury to a pedestrian's head, upper leg, and lower leg. NHTSA indicated that although the proposed NCAP crashworthiness pedestrian program implements a pass/fail approach, it intends to eventually use a comparative rating system. According to the NCAP roadmap, the rating system is targeted for implementation in 2027.

[86] "Federal Motor Vehicle Safety Standards; Pedestrian Head Protection, Global Technical Regulation No. 9; Incorporation by Reference," notice of proposed rulemaking, September 19, 2024 (89 *Federal Register* 76922, Docket No. NHTSA-2024-0057). Global Technical Regulations are an effort to develop technical regulations for cars and other motor vehicles that can be coordinated, or *harmonized*, worldwide.

[87] See NTSB's response to the notice of proposed rulemaking.

[88] See "New Car Assessment Program Final Decision Notice–Crashworthiness Pedestrian Protection," final decision notice, November 25, 2024 (89 *Federal Register* 93000, Docket No. NHTSA–2024–0078).

The November 2024 NCAP final decision on pedestrian crashworthiness aligns with GTR No. 9 and in some cases exceeds the requirements of GTR No. 9. For example, in NCAP, the pedestrian crashworthiness tests simulate a pedestrian being struck at a higher speed. Additionally, although NHTSA's NPRM included head protection for adults and children, it did not include leg protection criteria which are addressed in the November 2024 NCAP crashworthiness final decision. The publication of the November 2024 final decision to add to NCAP performance test criteria for vehicle designs to ensure pedestrian crashworthiness fulfills the intent of Safety Recommendation H-18-41. Therefore, the NTSB classifies Safety Recommendation H-18-41 Closed—Acceptable Action.

Safety Recommendation H-18-43 asked NHTSA to incorporate vehicle design and pedestrian collision avoidance systems in NCAP. Both PAEB and improved vehicle crashworthiness designs are needed to improve pedestrian safety. PAEB will help prevent collisions or reduce the vehicle speed so that a vehicle's pedestrian crashworthy design measures can reduce pedestrian injuries when a crash does occur. NHTSA's December 2024 final decision to add PAEB to NCAP and its November 2024 final decision to add pedestrian crashworthiness measures fulfills the intent of Safety Recommendation H-18-43. Therefore, the NTSB classifies Safety Recommendation H-18-43 Closed—Acceptable Action.

3 Conclusions

3.1 Findings

1. None of the following were factors in this crash: (1) weather; (2) roadway and lighting; (3) actions of the students waiting to board the school bus; (4) mechanical condition of the vehicles; (5) school district policies; (6) school bus driver licensing, training, fatigue, medical condition, cell phone use, or use of alcohol or other drugs; and (7) pickup truck driver's licensing or use of alcohol or other drugs.

2. The emergency response to the crash was timely and adequate.

3. The school bus driver turned on the bus's flashing amber and flashing red lights and extended the stop arm, which provided sufficient warning to attentive drivers that the school bus was stopping to load students onto the bus.

4. The pickup truck driver's response to the slowing and stopped school bus was delayed because he was distracted by his cell phone texting activity, causing him to brake and swerve in an attempt to avoid a collision.

5. A well-designed cell phone lock-out system that automatically engages and disables the use of features that are not related to the driving task can reduce cell phone–related distracted driving crashes by preventing a driver from engaging in distracting behaviors, such as reading and sending text messages or making or receiving calls.

6. Driver monitoring systems that detect and alert a distracted driver (such as the pickup truck driver in the crash in the Town of Excelsior, Wisconsin) and bring their attention back to the driving task can improve safety.

7. The National Highway Traffic Safety Administration (NHTSA) 2013 Phase 1 Driver Distraction Guidelines, which focused on the visual-manual distraction of in-vehicle technology, are outdated due to advances in technology in the past 12 years and because NHTSA did not implement Phases 2 and 3; thus, the guidance necessary for preventing distracted driving crashes is lacking and such crashes will remain prevalent without leadership and guidance at the federal level to minimize driver distraction.

8. Had the pickup truck been equipped with an automatic emergency braking system meeting the minimum performance requirements set in Federal Motor Vehicle Safety Standard No. 127, the collision with the school bus could have

been avoided or at least mitigated, which would also have prevented or mitigated the collision with the student pedestrian.

9. The pickup truck's high and blunt hood design combined with its speed at the time of impact with the student pedestrian contributed to her fatal injuries.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the fatal crash in the Town of Excelsior, Wisconsin, was the pickup truck driver's distracted driving due to his texting, resulting in his collision with the right-rear corner of the school bus and with the student pedestrian waiting to board the school bus. Contributing to the severity of the injuries to the student pedestrian was the pickup truck's speed, as well as its height and the shape of its front end.

4 Recommendations

4.1 New Recommendation

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendation.

To the National Highway Traffic Safety Administration:

> Develop and publish Driver Distraction Guidelines that address the design of current original equipment in-vehicle electronic devices, portable electronic devices, and aftermarket electronic devices to prevent driver distraction.
> (H-25-16)

4.2 Previously Issued Recommendations Reiterated in This Report

As a result of its investigation, the National Transportation Safety Board reiterates the following safety recommendation.

To Apple, Inc., Google, Inc., HTC Corporation, Lenovo, LG Electronics, Motorola, Samsung Group, Sony Corporation:

> Develop a distracted driving lock-out mechanism or application for portable electronic devices that will automatically disable any driver-distracting functions when a vehicle is in motion, but that allows the device to be used in an emergency; install the mechanism as a default setting on all new devices and apply it to existing commercially available devices during major software updates.
> (H-20-8)

Safety Recommendation H-20-8 is reiterated to eight recipients in section 2.3.2.2 of this report.

4.3 Previously Issued Recommendations Classified in This Report

As a result of its investigation, the National Transportation Safety Board classifies the following safety recommendations.

To the National Highway Traffic Safety Administration:

> Develop and apply testing protocols to assess the performance of forward collision avoidance systems in passenger vehicles at various

velocities, including high speed and high velocity-differential. (H-15-4)

Expand the New Car Assessment Program 5-star rating system to include a scale that rates the performance of forward collision avoidance systems. (H-15-6)

Develop performance test criteria for vehicle designs that reduce injuries to pedestrians. (H-18-41)

Develop performance test criteria for manufacturers to use in evaluating the extent to which automated pedestrian safety systems in light vehicles will prevent or mitigate pedestrian injury. (H-18-42)

Incorporate pedestrian safety systems, including pedestrian collision avoidance systems and other more-passive safety systems, into the New Car Assessment Program. (H-18-43)

Safety Recommendations H-15-4 and H-18-42 are classified Closed—Acceptable Action in section 2.4.4.1 of this report. Safety Recommendation H-15-6 is classified Open—Acceptable Response in section 2.4.4.3 of this report. Safety Recommendations H-18-41 and H-18-43 are classified Closed—Acceptable Action in section 2.4.4.4 of this report.

To Ford Motor Company:

Install forward collision avoidance systems that include, at a minimum, a forward collision warning component, as standard equipment on all new vehicles. (H-15-8)

Safety Recommendation H-15-8 is classified Closed—Acceptable Action to Ford Motor Company in section 2.4.4.2.

To Google, Inc., HTC Corporation, Lenovo, LG Electronics, Motorola, Samsung Group, Sony Corporation:

Develop a distracted driving lock-out mechanism or application for portable electronic devices that will automatically disable any driver-distracting functions when a vehicle is in motion, but that allows the device to be used in an emergency; install the mechanism as a default setting on all new devices and apply it to existing commercially available devices during major software updates. (H-20-8)

Safety Recommendation H-20-8 is classified Open—Unacceptable Response for seven recipients in section 2.3.2.2 of this report.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JENNIFER L. HOMENDY
Chairwoman

MICHAEL GRAHAM
Member

THOMAS CHAPMAN
Member

J. TODD INMAN
Member

Appendixes

Appendix A: Investigation

The National Transportation Safety Board was notified of this crash on May 12, 2023, and dispatched a partial investigative team consisting of the investigator-in-charge and motor carrier investigator. Groups were established to investigate human performance; motor carrier operations; and highway, vehicle, and survival factors. The on-scene investigative staff was supported by the Office of Research and Engineering and the Transportation Disaster Assistance Division.

Parties to the investigation were the Wisconsin Department of Transportation, Sauk County Sheriff's Office, and Sauk County Highway Department.

Appendix B: Consolidated Recommendation Information

Title 49 *United States Code* 1117(b) requires the following information on the recommendations in this report.

For each recommendation—

(1) a brief summary of the Board's collection and analysis of the specific accident investigation information most relevant to the recommendation;

(2) a description of the Board's use of external information, including studies, reports, and experts, other than the findings of a specific accident investigation, if any were used to inform or support the recommendation, including a brief summary of the specific safety benefits and other effects identified by each study, report, or expert; and

(3) a brief summary of any examples of actions taken by regulated entities before the publication of the safety recommendation, to the extent such actions are known to the Board, that were consistent with the recommendation.

To the National Highway Traffic Safety Administration:

H-25-16

Develop and publish Driver Distraction Guidelines that address the design of current original equipment in-vehicle electronic devices, portable electronic devices, and aftermarket electronic devices to prevent driver distraction.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3.2.4, NHTSA's Voluntary Driver Distraction Guidelines. Information supporting (b)(1), (b)(2), and (b)(3) can be found on pages 27–30.

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