

Integrated Vehicle-Based Safety System

Heavy Truck Driver Vehicle Interface (DVI)

Stage 1 Jury Drive Protocol

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16. Abstract <p>The Integrated Vehicle-Based Safety Systems (IVBSS) program is a four-year, two phase cooperative research program conducted by an industry team led by the University of Michigan Transportation Research Institute (UMTRI). The program goal is to integrate several collision warning systems into one vehicle in a way that alerts drivers to potential collision threats with an effective driver vehicle interface (DVI), while minimizing the number of excessive warnings presented to the driver. Basic program strategies for meeting this objective include systematically managing and prioritizing all information presented to the driver, minimizing the number of system false alarms, and restricting auditory alarms to higher urgency collision conditions.</p> <p>This report describes two separate jury drive evaluation stages that will be conducted as part of the heavy-truck IVBSS development process. Also provided are stage 1 jury drive activities and materials, system orientation and demonstration instructions, public roadway drive instructions and materials, test-track drive and debriefing materials, IVBSS warnings and alerts review, and a self-administered driver questionnaire.</p>			
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List of Acronyms and Abbreviations

CDL.....	Commercial Driving License
DIU.....	Driver Interface Unit
DVI.....	Driver Vehicle Interface
FCW.....	Forward Collision Warning
FOT.....	Field Operational Test
IVBSS.....	Integrated Vehicle-based Safety Systems
HT.....	Heavy Truck
LCM.....	Lane Change Merge
LDU.....	Lateral Display Unit
LDW.....	Lateral Drift Warning
POV.....	Principal Other Vehicle
SV.....	Subject Vehicle
TBD.....	To Be Determined

Introduction and Overview

Two separate jury drive evaluation stages will be conducted as part of the Heavy Truck (HT) Integrated Vehicle-Based Safety System (IVBSS) development process, as summarized below. To the extent possible, findings from Stage 1 will be implemented as changes to the Driver Vehicle Interface (DVI) used in Stage 2. In addition, findings from the jury drive activities (Stages 1 & 2) – particularly those that can be implemented as software changes within the IVBSS system – will be implemented as changes to the DVI in time for the Final Verification Tests scheduled to be completed during the Late-August through end-of-September timeframe.

1 Stage 1 Jury Drive Overview

1.1. *Timeframe*

Mid-late July, 2007

1.2. *Vehicle*

Older International 8600 with an extended cab (“Bronze Vehicle”).

1.3. *Expected Status of the IVBSS/DVI*

Consistent with current design specifications (no less IVBSS content than is on the current Suburban). IVBSS installation may be at a prototype level during the jury drive, including relatively crude packaging, fit, and finish. Some functions may have optional settings or parameters, allowing for adjustment during or following the jury drive.

1.4. *Drivers*

IVBSS team members or related organizational staff with Commercial Driving Licenses (CDLs) will serve as drivers during the Stage 1 Jury Drive. Preference in selecting drivers will be given to those with recent real-world commercial driving experience. Drivers should not be directly involved in IVBSS HT development. Between 6 and 7 drivers will participate as Stage 1 jury drivers.

1.5. *Anticipated Length of Each Jury Drive*

One 3-hour session followed by a second 90-minute session.

1.6. *Key Activities during Each Jury Drive*

Each drive will have five (5) activities, with the first two activities completed by each driver on one day and the final three activities completed on the second day. The first-day activities will include: (1) a brief orientation and demonstration of the IVBSS system; and (2) a public roadway drive and debrief with a focus on making sure that the drivers experience lower-priority threats and warnings. The second-day activities will include: (1) a test track drive and debrief using a subset of the scenarios excerpted from the current IVBSS Heavy Truck Objective Test Procedures, with a focus on exposing the drivers to high-priority threats and warnings (e.g., Forward Collision Warning (FCW)-4B, -5, -6, -7 and Lane Change Merge (LCM)-3); (2) a comprehensive IVBSS warnings and alerts review; and (3) a brief self-administered driver

survey. Drive debrief, system review, and questionnaire items contain a mix of scaled responses, yes/no questions, and open-ended questions.

Each drive will have an observer seated in the passenger seat who will provide the initial system orientation and demonstration, note his/her observations about the driver's response to the system during the public roadway and test track drives, ask the driver specific questions about the system during the debriefings, and administer the comprehensive system review.

2 Stage 2 Jury Drive Overview

2.1. Timeframe

Late July through mid-August, 2007

2.2. Vehicle

New 8600 with day cab ("Gold Vehicle").

2.3. Expected Status of the IVBSS/DVI

Consistent with current design specifications (no less IVBSS content than is on the current Suburban). IVBSS installation may be at a prototype level during the jury drive, including relatively crude packaging, fit, and finish. Some functions may have optional settings or parameters, allowing for adjustment during or following the jury drive.

2.4. Drivers

All Stage 2 jury drivers will be professional Conway drivers with CDLs. Between 8 and 10 drivers are anticipated. The drivers will be representative of the Field Operational Test (FOT) driver population, in terms of company affiliation, driving experience, types of routes driven, and experience with in-vehicle electronic and advanced safety system operation.

2.5. Anticipated Length of Each Jury Drive

Approximately 4 hours total

2.6. Key Activities During Each Jury Drive

Stage 2 Jury Drive activities will be refined on the basis of Stage 1 findings; as well as Stage 2 objectives and constraints. As currently planned, each Stage 2 Jury Drive will have five (5) parts: (1) a system orientation and demonstration (since these drivers may not have had any previous experience with the IVBSS system or its technologies, this part of the drive may take longer than it will in Stage 1); (2) a test track drive and debrief using a subset of the scenarios included in the current Objective Test Procedures, with a focus on exposing the drivers to high-priority threats and warnings (e.g., FCW-4B, 5, -6, -7 and LCM-3); (3) a public roadway drive and debrief with a focus on making sure that the drivers experience lower-priority threats and warnings; (4) a comprehensive IVBSS warnings and alerts review; and (5) a brief self-administered driver survey. Drive debrief, system review, and questionnaire items will contain a mix of scaled responses, yes/no questions, and open-ended questions.

Each drive will have an observer seated in the passenger seat who will provide the initial system orientation and demonstration, note his/her observations about the driver's response to the

system during the public roadway and test track drives, ask the driver specific questions about the system during the debriefings, and administer the comprehensive system review.

3 Stage 1 Jury Drive Activities and Materials Overview

This protocol has been prepared to support the planning and execution of the Stage 1 Jury Drives. As outlined above, each Stage 1 Jury Drive will consist of five activities: (1) System Orientation and Demonstration; (2) Public Roadway Drive and Debriefing; (3) Test Track Drive and Debriefing; (4) Comprehensive IVBSS Warnings and Alerts Review; and (5) a brief Self-Administered Driver Questionnaire. Table 1 below provides a summary of the approximate duration of each of these six activities and identifies the materials that are available to support observers in conducting these activities.

Table 1. Summary of Stage 1 Jury Drive activity, duration, and supporting materials.

Stage 1 Jury Drive Activity	Approximate Duration	Supporting Materials
System Orientation and Demonstration	30 minutes	System Orientation and Demonstration Instructions (Attachment 1) Laptop with IVBSS HT DVI audio and video messages installed
Public Roadway Drive and Debriefing	120 minutes	Public Roadway Drive Instructions and Observer Worksheets (in Attachment 2)
	30 minutes	Public Roadway Drive Debriefing Materials (in Attachment 2)
Test Track Drive and Debriefings	60 minutes	IVBSS HT System Verification Plan Test Track Drive Instructions, Observer Worksheets (in Attachment 3) Test Track Drive Debriefing Materials (in Attachment 3)
Comprehensive IVBSS Warnings and Alerts Review	20 minutes	Laptop with IVBSS HT DVI audio and video system messages installed Comprehensive Review of IVBSS Warnings and Alerts (in Attachment 4)
Self-Administered Driver Questionnaire	10 minutes	Self-Administered Driver Questionnaire (Attachment 5)

3.1. System Orientation and Demonstration

The purpose of this 30-minute activity is to ensure that all drivers have an adequate level of familiarity with the prototype IVBSS system to support their operation of the system and their understanding of the basic meanings of the system messages, warnings, and alerts. Attachment 1, *System Orientation and Demonstration Instructions*, provides a protocol that can be used in conducting this activity. Following is an outline of the specific steps to be completed during this activity.

1. If appropriate, introduce yourself to the driver.
2. As required, describe the objectives of the system and the Stage 1 Jury Drive.

3. Provide the orientation and demonstration, following the script in the *System Orientation and Demonstration Instructions*, as appropriate.

3.2. Public Roadway Drive and Debrief

The two and one-half hour public roadway drive and debrief is conducted to expose the driver to relatively common threats and warnings in a naturalistic setting, to observe the drivers' responses to these conditions, and to obtain the drivers' comments during the subsequent post-drive debrief regarding noteworthy driver reactions and driver opinions regarding their experience frequency of warnings and alerts. Attachment 2, *Public Roadway Drive Instructions and Materials*, provides a protocol that can be used in conducting this activity. Following is an outline of the specific steps to be completed during this activity.

Begin the public roadway drive by providing the driver an overview of the objectives for this activity (provided in Attachment 2), then prompt the driver to initiate targeted situations and take notes on the appropriate work sheets, as summarized below.

1. Provide prompts to the driver if targeted driving situations are not being encountered as anticipated.
2. Provide prompts to the driver to take appropriate action (i.e., signal when another vehicle is along side) to initiate desired system responses if such targeted conditions are not being encountered as anticipated.
3. Observe the driving conditions and driver actions per the public roadway driving activity worksheet and complete the form, per the instructions.
4. Near the end of the established public roadway driving time (2 hours), direct the driver to return to the vehicle parking lot and commence with the public roadway drive debriefing.
5. Following the public roadway drive, a 30-minute debrief is conducted to obtain driver input regarding potential DVI issues observed during the public roadway drive.

3.3. Test Track Drive and Debrief

The purpose of this 60-minute activity is to expose the driver to high-priority threats in a relatively safe setting and to observe the drivers' responses to the system warnings and alerts. Five driving scenarios designed to result in specific high-priority threats have been adapted from the *Draft IVBSS HT System Verification Plan* (February, 2007) to provide the driving scenarios for this activity. The test track drive will provide a basis for the driver's inputs during post-test track drive interviews immediately following each driving scenario; as well as during post-drive questionnaire completions. Attachment 3, *Test Track Drive and Debriefing Materials*, provides a draft protocol that can be used in conducting test track drive scenarios and debriefings. Following is an outline of the specific steps to be completed during each driving scenario.

Begin the test track driving activity by providing the driver with an overview of the test track driving activity objectives (provided in Attachment 3), then follow the appropriate instructions for each driving scenario as summarized below.

1. Review the upcoming scenario events, cues, communications, and default safety responses with the driver and verify his/her understanding and agreement.
2. Verify through the established communications protocol that all other parties on the test track are prepared to initiate the upcoming scenario.

3. Begin the scenario per the agreed-upon scenario protocol.
4. Observe the driving conditions and driver actions per the established test track driving observer form and document observations per the form protocol.
5. At the end of each test track drive scenario, complete a debriefing with the driver, using the Test Track Drive Debriefing Materials, which are included in Attachment 3.

3.4. *IVBSS Warnings and Alerts Review*

Using the set of IVBSS warnings and alerts demonstration files installed on a laptop, the observer will conduct a comprehensive review of the driver's evaluation of IVBSS warnings and alerts immediately following the final test drive and debriefing, using the instructions and materials provided in Attachment 4. Each drive will have an observer seated in the passenger seat who will provide the initial system orientation and demonstration, note his/her observations about the driver's response to the system during the public roadway and test track drives, ask the driver specific questions about the system during the debriefings, and administer the comprehensive system review.

3.5. *Self-Administered Driver Questionnaire*

The purpose of this 15-minute activity is to obtain driver input regarding general DVI issues that can most efficiently be obtained through a self-administered questionnaire. Attachment 5, *Self-Administered Driver Questionnaire*, provides a questionnaire that can be completed by drivers during this final activity.

Attachment 1 System Orientation and Demonstration Instructions

Instructions

Stage 1 Jury Drive Observers should ensure that each driver is adequately familiar with the current status of the IVBSS HT system prior to commencing with the Test Track Driving activity. Please review this attachment prior to the jury drive session, then use the following script in providing the driver their orientation and instructions.

NOTE: Completion of the driver orientation and post-drive interview activities require the use of a laptop computer with each of the FCW, LCM, and LDW visual and auditory warnings and alerts available for presentation to the driver.

NOTE: Throughout the attachments in this document, *italic font* indicates Driver Observer scripts that can be read verbatim to the jury driver, or paraphrased as appropriate.

Driver Orientation Script

The prototype Integrated Vehicle Based Safety System, or IVBSS, installed in this truck has been designed to provide warnings and alerts to drivers that will help them to avoid three types of accidents: rear-end collisions, lane change/merge collisions, and run-off-the-road accidents.

The IVBSS is comprised of a set of sensors that detect conditions corresponding to each of these three types of crashes, and then provides warning and alerts through the main Driver Interface Unit, or DIU, and the two Lateral Display Units, or LDUs.

Let's start-up the system and ensure that it is operable, then adjust a few basic system settings.

Turn on system and verify that the “All warnings OK” message appears.

Select “Volume” from the main menu

*This display lets you set the volume of the audio alerts by pressing the up and down arrows. I am going to set a standard volume level (**TBD**) for the drive today, which I adjust with the up and down arrows, then set by pressing the “OK” button.*

Select “Brightness” from the main menu

*This display lets you set the display brightness by pressing the up and down arrows. . I am going to set a standard brightness level (**TBD**) for the drive today, which I adjust with the up and down arrows, then set by pressing the “OK” button.*

Laptop Demonstration Displays and Script

Before we begin with the today's driving, I'd like to show you the different warnings and alerts that are designed to help drivers avoid rear-end collisions, lane change/merge collisions, and lane departure accidents.

I'll be using a laptop to show these warnings and alerts to you. I'll show you each one, describe it, and ask you if you have any questions about it.

Table 2. IVBSS warnings and alerts laptop demonstration script.

<i>Present This:</i>	<i>Then Read This:</i>
FCW-0 No Forward Object Detected	<i>Here is the warning that is displayed on the DIU when both the lane departure warning system and the forward collision warning systems are operable and there is no forward object detected. Do you have any questions about this message?</i>
FCW-1 Forward Object Detected	<i>Here is the message that is displayed on the DIU when there is a forward object detected within 350 feet. Do you have any questions about this message?</i>
FCW-2 3-Second Headway Warning	<i>Here is the warning that is displayed on the DIU when there is a forward vehicle or object that is 3 seconds ahead of your vehicle, given your current speed. Do you have any questions about this warning?</i>
FCW-3V 2-Second Headway Visual Warning	<i>Here is the warning that is displayed on the DIU when there is a forward object with less than 2 seconds of headway from your vehicle. Do you have any questions about this warning?</i>
FCW-3A 2-Second Headway Auditory Warning	<i>Here is the auditory warning that accompanies the visual 2-second warning when the headway distance between vehicles is closing. Do you have any questions about this auditory warning?</i>
FCW-4V 1-Second Headway Visual Warning	<i>Here is the warning that is displayed on the DIU when there is a forward object with less than one second, but more than 1/2 second of headway from your vehicle. Do you have any questions about this visual warning?</i>
FCW-4 1-Second Headway Auditory Warning	<i>Here is the auditory alert that will be presented at the onset of the 1-second warning if the headway between the other vehicle and your truck is closing. Do you have any questions about this auditory alert?</i>

<i>Present This:</i>	<i>Then Read This:</i>
FCW-5, 6, 7 Visual Collision Alert	<i>Here is the alert that is displayed on the DIU when there is a forward object with less than ½ second of headway from your vehicle. This alert will be displayed if any of the following conditions are met: (1) There is a moving forward object within ½ second with an opening, closing, or constant distance; (2) There is a stationary forward object within 220 feet with less than 3 seconds headway; or (3) There is a slow moving vehicle ahead that is moving 20 percent slower than your vehicle and is within 220 feet.</i> <i>Do you have any questions about this visual alert?</i>
FCW-5, 6, 7 Collision Alert Auditory Warning	<i>Here is the auditory alert that will be presented at the onset of the collision alert.</i> <i>Do you have any questions about this auditory warning?</i>
LDW-0 No Forward Object Detected Lane Departure Warning System Operable	<i>Again, Here is the warning that is displayed on the DIU when both the lane departure warning system and the forward collision warning systems are operable and there is no forward object detected.</i> <i>Note that the two [TBD icons] in the lower-left of the display indicate that both sides of the lane departure warning system are operable.</i> <i>Do you have any questions about this display?</i>
LDW-L Left Drift Visual Warning	<i>Here is the warning that is displayed when the system has detected that your truck has drifted to the <u>left</u> of your current lane.</i> <i>Do you have any questions about this visual warning?</i>
LDW-R Right Drift Visual Warning	<i>Here is the warning that is displayed when the system has detected that your truck has drifted to the <u>right</u> of your current lane.</i> <i>Do you have any questions about this visual warning?</i>
LDW-R/L Lane Drift Auditory Warning	<i>Here is the auditory warning that will be presented when the system has detected that your truck has drifted out of your current lane.</i> <i>Do you have any questions about this auditory warning?</i>
LCM-0 No Vehicle Detected	<i>Now, I'll show you the warnings and alerts that can be displayed on the lateral display units.</i> <i>When none of the three lights are activated, that indicates that there is not a vehicle detected in the zone adjacent to your truck.</i> <i>Do you have any questions about this display?</i>
LCM-1 Vehicle Detected	<i>One yellow light is lit on the LDU when a vehicle is detected in the adjacent zone.</i> <i>Do you have any questions about this display?</i>

<i>Present This:</i>	<i>Then Read This:</i>
LCM-2 Vehicle + Signal Detected	<p><i>One red light is lit on the LDU when a vehicle is detected in the adjacent zone <u>and</u> the turn signal on that side is active <u>and</u> the system has determined that the truck driver <u>has not</u> begun to move into the adjacent lane.</i></p> <p><i>Do you have any questions about this display?</i></p>
LCM-3 Auditory Alert Vehicle + Signal + Lateral Drift Detected	<p><i>This is the auditory warning that will be presented when a vehicle is detected in the adjacent zone <u>and</u> the turn signal on that side is active <u>and</u> the system has determined that the truck driver <u>has</u> begun to change lanes <u>or</u> the system is not able to determine the truck driver's intentions based on available lateral data.</i></p> <p><i>Do you have any questions about this auditory warning?</i></p>

Attachment 2 Public Roadway Drive Instructions and Materials

Introduction

During the public roadway drive and debriefing, Driver Observers are responsible for:

- Defining the IVBSS warnings that drivers should be trying to trigger during the public roadway drive;
- Tracking the frequency with which each warning is triggered during the drive;
- Observing and documenting noteworthy driver behaviors in response to those warnings; and then
- Conducting a debriefing with the driver following the drive.

Two hours and 30 minutes are allocated for this activity, including initial driver instructions, driving onto the roadway, completing the public roadway drive, returning to the vehicle storage area, and conducting the debriefing.

Driver Instructions

We will next begin your drive on public roads for approximately two hours. During this drive, I would like you to find safe opportunities to trigger the following 9 IVBSS warnings.

1. *Forward object detected within 350 feet*
2. *Forward object detected with less than a 3-second headway*
3. *Forward object detected with less than a 2-second opening or constant headway*
4. *Lateral lane drift to the left*
5. *Lateral lane drift to the right*
6. *Vehicle detected in the left adjacent zone*
7. *Vehicle detected in the left adjacent zone and left turn signal is activated*
8. *Vehicle detected in the right adjacent zone*
9. *Vehicle detected in the right adjacent zone and right turn signal is activated*

Let's review how you can safely trigger each of these warnings on the roadway.

Forward Object Detected within 350 Feet of Your Truck

For the 'forward object detected within 350 feet' condition, you have two alternative strategies:

1. *You can approach another vehicle that is moving slower than your truck until you are within 350 feet of that other vehicle, or*
2. *You can pull behind another vehicle that is traveling close to the speed of your truck and is no more than 350 feet ahead.*

Forward Object Detected with Less than a 3-second Headway

For the ‘forward object detected with less than a 3-second headway’ condition, you have basically the same two alternative strategies:

- 1. You can continue to approach another vehicle that is moving slower than your truck until you are within a 3-second headway, or*
- 2. You can merge behind another vehicle that is within a 3-second headway.*

Forward Object Detected with Less than a 2-second Opening or Closing Headway

For the ‘forward object detected with less than a 2-second opening or closing headway’ conditions, you want to get behind another vehicle that is either at the same speed as your truck or is traveling faster than your truck. So, if the opportunity presents itself, you can merge behind another vehicle that is traveling the same speed as your vehicle or slightly faster within a 2-second headway.

Lateral Lane Drift to the Left

For the ‘lateral lane drift to the left’ condition, I want you to find a safe location to drive the truck over the left lane marker without signaling with your left turn signal.

Lateral Lane Drift to the Right

For the ‘lateral lane drift to the right’ condition, you are to find a safe location to drive the truck over the right lane marker without signaling with your right turn signal.

Vehicle Detected in the Left Adjacent Zone

For the ‘vehicle detected in the left adjacent zone’ condition, I am simply asking you to position your truck with another vehicle in your left detection zone.

Vehicle Detected in the Left Adjacent Zone and Left Turn Signal is Activated

*For the ‘vehicle detected in the left adjacent zone and left turn signal activated’ condition, once you have positioned your truck with another vehicle in your left detection zone; you are to signal with your left turn signal but **DO NOT** initiate a merge into the left lane.*

Vehicle Detected in the Right Adjacent Zone

For the ‘vehicle detected in the right adjacent zone’ condition, you are to position your truck with another vehicle in your right detection zone.

Vehicle Detected in the Right Adjacent Zone and Right Turn Signal is Activated

*For the ‘vehicle detected in the right adjacent zone and right turn signal activated’ condition, once you have positioned your truck with another vehicle in your right detection zone; you are to signal with your right turn signal but **DO NOT** initiate a merge into the right lane.*

Safety Warning

Of course, your primary concern at all times should be the safety of you and others on the roadway. If at any time you think that you are putting yourself or others at risk by executing any of these procedures, please take appropriate action and indicate your concerns to me.

Observer Instructions and Worksheets

Three forms are provided for use by the Driver Observer in conducting Public Roadway Drive and Debrief: the *Driver Exposure Tracking Worksheet*, *Public Roadway Jury Drive Observer Log Sheet and Debriefing Script*, and the *Nuisance and False Alarm Debriefing Form*.

Instructions for use of each form are provided below:

Driver Exposure Tracking Worksheet

This worksheet, shown below in Figure 1 that can be used to track and record the frequency of driver exposures to each of the nine (9) targeted warnings that occur during the public roadway drive. Simply check a box each time that a driver is exposed to the specific warning. The objective during the public roadway drive is to expose the driver to a comparable number of each of the nine targeted warnings during the drive.

Public Roadway Jury Drive Observer Log Sheet and Debriefing Script

This form, shown below Figure 2 in is used by the Observer to record both (1) the general conditions under which a targeted warning is triggered and (2) any noteworthy Driver behaviors during the drive; then to record the comments by the Driver during the debrief concerning any observed noteworthy behaviors.

In recording the **General Conditions**, the objective is for Observers to record the following information to the extent that this information can be recorded while still attending to the Driver's behavior:

- The time that the warning was triggered;
- The roadway being traveled;
- The direction of travel; and
- The description of the other involved vehicle (if there was one).

The **Warning Triggered** can be recorded by checking the appropriate box from among the nine alternatives.

The **Observed Behavior** can be recorded by checking any appropriate boxes from among the four alternatives and writing a brief note, as appropriate, to describe the driver's behavior. In general, you should be looking for the following conditions during the warning exposure.

- **Excessive Glance at Display (> 0.5 sec):** The driver glances for more than approx. 0.5 sec at the DIU or LDU at any time immediately after an IVBSS warning during the test drive.
- **Startle Response:** An auditory alert evokes an apparent startle response by the driver (quick, involuntary movement or glance).

- **Untimely or Inappropriate Response:** The driver does not respond to a warning in what appears to be a safe and timely manner and/or does not respond in the most appropriate manner.
- **Other Noteworthy Behavior:** The Observer notes some other behavior that appears to reflect a response or reaction to the IVBSS that is not consistent with the basic design objective of aiding the driver in identifying and responding to unsafe conditions.

The **Observed Behavior Debriefing** section of this sheet is to be used immediately following the public roadway drive to solicit and record Driver comments regarding observed noteworthy behaviors, if any were observed.

For each noteworthy Driver Behavior, the Observer should review the recorded conditions with the Driver and determine the **Driver’s Memory Confidence** in recalling those events, the warning, and his response, asking the question provided in the form, indicating the response alternatives to the Driver, and recording the alternative that best reflects the Driver’s confidence level.

Once, the Driver’s memory confidence is determined, the Observer should ask the appropriate question in the final portion of the debriefing form, referring to (as appropriate) any **Excessive Glance, Startle Response, Delayed Driving Response, or Other Noteworthy Behavior**; and record the Driver’s response in the form.

Nuisance and False Alarm Debriefing Form

The final form provided for the Public Roadway Debriefing is the *Nuisance and False Alarm Debriefing Form*, shown below in Figure 3. This form has a series of questions for the FCW, Lane Departure Warning (LDW), and LCM warnings, addressing the Driver’s view of:

Warning Frequency (*Too Many, About the Right Frequency, Too Few*);

Unnecessary Warning Conditions as described by the Driver; and

Unnecessary Warning Reaction (*Strongly Negative, Somewhat Negative, Neutral, Somewhat Positive, Strongly Positive*).

Driver Exposure Tracking Worksheet				
Warning Condition	Exposure Repetitions Observed			
	1	2	3	4
1. FCW-1: Forward object detected within 350 feet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. FCW-2: Forward object -- 3-second headway	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. FCW-3: Forward object -- 2-second headway	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. LDW-L: Left Lateral lane drift	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. LDW-R: Right Lateral lane drift	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. LCM-1-L: vehicle detected -- Left	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. LCM-2-L: vehicle detected -- Left PLUS signal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. LCM-1-R: vehicle detected -- Right	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. LCM-2-R: vehicle detected -- Right PLUS signal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 1. Driver Exposure Tracking Worksheet.

Public Roadway Jury Drive Observer Log Sheet and Debriefing Script				
General Conditions				
Time:				
Roadway:				
Direction of Travel:				
Other Vehicle Description:				
Warning Triggered				
<input type="checkbox"/> FCW-1: Forward object detected within 350 feet				
<input type="checkbox"/> FCW-2: Forward object -- 3-second headway				
<input type="checkbox"/> FCW-3: Forward object -- 2-second headway				
<input type="checkbox"/> LDW-L: Left Lateral lane drift				
<input type="checkbox"/> LDW-R: Right Lateral lane drift				
<input type="checkbox"/> LCM-1-L: vehicle detected -- Left				
<input type="checkbox"/> LCM-2-L: vehicle detected -- Left PLUS signal				
<input type="checkbox"/> LCM-1-R: vehicle detected -- Right				
<input type="checkbox"/> LCM-2-R: vehicle detected -- Right PLUS signal				
Observed Behavior				
<input type="checkbox"/> Excessive Glance at Display (> 0.5 sec) If Checked, describe:				
<input type="checkbox"/> Startle Response If Checked, describe:				
<input type="checkbox"/> Untimely or Inappropriate Response If Checked, describe:				
<input type="checkbox"/> Other Noteworthy Behavior If Checked, describe:				
Observed Behavior Debriefing				
Driver Memory Confidence: After reviewing the specific conditions at the time of the warning... <i>How confident are you that you recall the events I've outlined, the specific warning, and your response to the warning:</i>				
Very High Confidence	Moderately High Confidence	Moderate Confidence	Moderately Low Confidence	Low Confidence
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Excessive Glance				
<i>Was there anything about this warning that drew your attention away from the roadway for an extended period?</i>				
Startle Response				
<i>Did this warning startle you? If you were startled, why?</i>				
Delayed Driving Response				
<i>Was there anything in particular about this alert that required your extended attention to interpret?</i>				

Figure 2. Public Roadway Jury Drive Observer Log Sheet and Debriefing Script.

Nuisance and False Alarm Debriefing Form				
Forward Collision Warnings				
Warning Frequency: <i>How would you characterize the number of Forward Collision Warnings during the on-road test drive?</i>				
Too Many Warnings <input type="checkbox"/>	About the Right Number of Warnings <input type="checkbox"/>	Too Few Warnings <input type="checkbox"/>		
Unnecessary Warning Conditions: <i>If you indicated that you thought that there were too many Forward Collision warnings, under what conditions do you think that warnings occurred unnecessarily?</i>				
Unnecessary Warning Reaction: <i>How would you generally characterize your reaction to unnecessary warnings?</i>				
Strongly Negative <input type="checkbox"/>	Somewhat Negative <input type="checkbox"/>	Neutral <input type="checkbox"/>	Somewhat Positive <input type="checkbox"/>	Strongly Positive <input type="checkbox"/>
Lateral Departure Warnings				
Warning Frequency: <i>How would you characterize the number of Lateral Departure Warnings during the on-road test drive?</i>				
Too Many Warnings <input type="checkbox"/>	About the Right Number of Warnings <input type="checkbox"/>	Too Few Warnings <input type="checkbox"/>		
Unnecessary Warning Conditions: <i>If you indicated that you thought that there were too many Lateral Departure warnings, under what conditions do you think that warnings occurred unnecessarily?</i>				
Unnecessary Warning Reaction: <i>How would you generally characterize your reaction to unnecessary warnings?</i>				
Strongly Negative <input type="checkbox"/>	Somewhat Negative <input type="checkbox"/>	Neutral <input type="checkbox"/>	Somewhat Positive <input type="checkbox"/>	Strongly Positive <input type="checkbox"/>
Lane Change/Merge Warnings				
Warning Frequency: <i>How would you characterize the number of Lane Change/Merge Warnings during the on-road test drive?</i>				
Too Many Warnings <input type="checkbox"/>	About the Right Number of Warnings <input type="checkbox"/>	Too Few Warnings <input type="checkbox"/>		
Unnecessary Warning Conditions: <i>If you indicated that you thought that there were too many Lane Change/Merge warnings, under what conditions do you think that warnings occurred unnecessarily?</i>				
Unnecessary Warning Reaction: <i>How would you generally characterize your reaction to unnecessary warnings?</i>				
Strongly Negative <input type="checkbox"/>	Somewhat Negative <input type="checkbox"/>	Neutral <input type="checkbox"/>	Somewhat Positive <input type="checkbox"/>	Strongly Positive <input type="checkbox"/>

Figure 3. Nuisance and False Alarm Debriefing Form.

Attachment 3 Test Track Drive and Debriefing Materials

Instructions

The test track driving activity is based on selected driving scenarios from the Objective Test Plan. Execution of each scenario requires coordination with test track personnel, observation, and recording of driving conditions and driver actions during each driving scenario, and a completion of a driver debriefing at the end of each scenario. The following Objective driving scenarios have been selected for the test track portion of the Stage 1 Jury Drive. At a minimum, the first three of these scenarios should be completed, with the final two scenarios to be completed as time is available for completing the test track drive.

FCW-5: RE-1 – Rear-end conflict with a constant speed Other Vehicle

LCM-3: LC-1 – Lane-change conflict with adjacent Other Vehicle (right)

FCW-4B: RE-7 – Rear-end conflict with Other Vehicle after cut-in by Other Vehicle

FCW-6: RE-3 – Rear-end conflict with a stopped Other Vehicle

FCW-7: RE-2 – Rear-end conflict with a slowing Other Vehicle

This attachment provides a draft general instruction script (*in italics*); as well as draft Driver instruction scripts and worksheets for each of the five test track scenarios.

General Driver Instruction Script

You are now going to follow between three and five separate driving scenarios on the test track in an effort to exercise the IVBSS and obtain some of the alerts corresponding to the most dangerous conditions for which this system is designed to help drivers in avoiding accidents. The five driving scenarios are:

- Rear-end conflict with a constant speed Other Vehicle*
- Lane-change conflict with adjacent Other Vehicle (right)*
- Rear-end conflict with Other Vehicle after cut-in by Other Vehicle*
- Rear-end conflict with a stopped Other Vehicle*
- Rear-end conflict with a slowing Other Vehicle*

You will definitely complete the first three of these scenarios; and you will complete the one or both of the last two scenarios if time allows. For each scenario, we will review the “scenario concept”, including the initial, transitional, warning conditions, and conflict resolution; then review your driving instructions. Once you are confident that you understand the scenario, we will begin the specific driving scenario. Upon completing each scenario, I will ask a few questions regarding the IVBSS warnings you experienced during that scenario.

FCW-5: RE-1 – Rear-end Conflict with a Constant Speed Other Vehicle

We'll begin with the first test track scenario, the rear-end conflict with a constant speed Other Vehicle.

Scenario Concept

Let's review the concept for this scenario. This scenario is intended to result in a FCW alert when your truck approaches, from behind, a slower moving other vehicle in the center of the same lane. In this scenario, your truck is traveling at least 20 mph faster than the other vehicle that you are approaching.

Initial, Transitional, and Final Conditions

Figure 4 shows the initial, transitional, and final conditions for this scenario.

The initial conditions are in the top third of the figure and show your truck at a constant speed approaching a slower-moving constant-speed Other Vehicle at a closing rate that exceeds 20 mph.

The center of the figure shows that a warning should occur when your truck gets close enough to the slower-moving vehicle to trigger the forward collision warning.

Finally, the bottom of the figure shows that the conflict should be resolved when you slow your truck and drive to the left while the other vehicle accelerates and moves to the right to avoid a crash.

If a forward collision warning is not presented by the system at the appropriate time, or if you sense that a crash is imminent at any time, then you should abort this scenario.

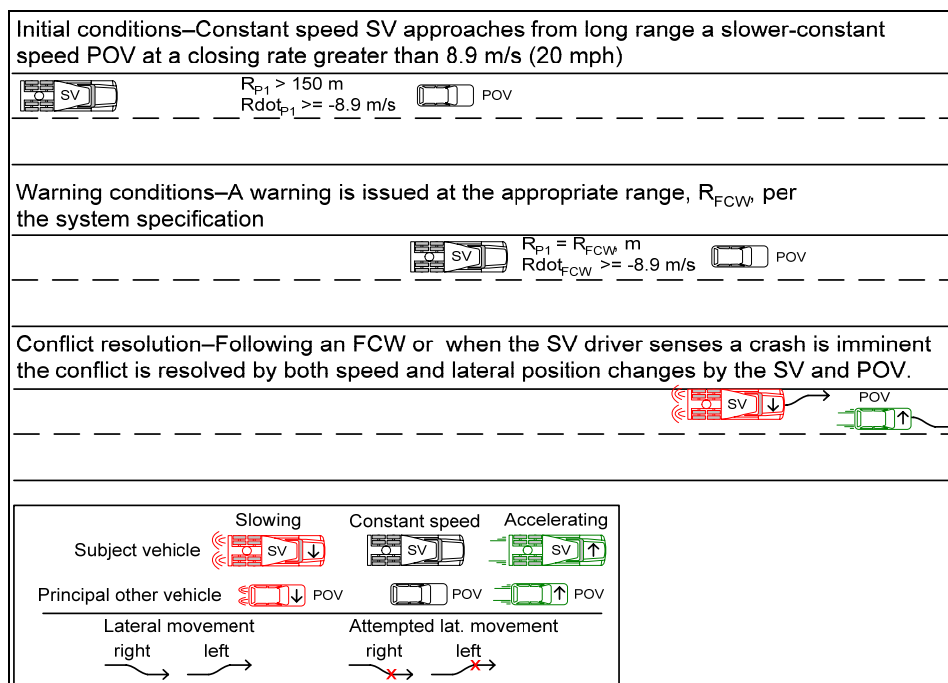


Figure 4. Initial and final conditions for Rear-end Conflict with a Constant Speed Other Vehicle.

Test Track Preparation and Special Equipment

Let's review the test track set-up for this scenario.

The initial conditions for this scenario will be staged using a set of cones. The placement of the cones, relative to the start of the straight section of track for this scenario is shown in the table below. (Please note that a negative distance means the cone is placed before the straight section of track). The cones are labeled to indicate their purpose. The general procedure for executing the scenario is:

- Your truck travels around the track at the (TBD) speed in the center of the designated lane.
- The Other Vehicle is stopped at cone 2.
- When your truck passes cone 1, I will instruct the Other Vehicle to start.
- The Other Vehicle driver accelerates at a constant rate of 1.5 m/s² for 9 seconds to reach the desired speed in the space between cones 2 and 3 while staying in the center of the designated lane.
- If staged correctly the Other Vehicle will reach cone 3 simultaneously with your truck entering the straight section of the track with the desired initial conditions.

Table 3. Cone location for Rear-end with a Constant Speed Other Vehicle.

Cone	Distance, m	Label/Purpose
1	-220	Observer commands Other Vehicle to start
2	90	From a stop the Other Vehicle accelerates at 1.5 m/s ²
3	150	Other Vehicle at specified speed in 9 seconds

Driving Instructions

Let's review your driving instructions.

1. You accelerate, in the center of the (TBD) lane, to the (TBD) speed and engage the cruise control. If necessary, you should use the cruise-control speed-adjustment buttons to attain the desired speed.
2. At the (TBD) speed, and upon passing cone 1, I will command the driver of the other vehicle to start driving.
3. You then continue along the center of the (TBD) lane at the (TBD) speed closing on the Other Vehicle in a straight section of the test track.
4. When there is a collision warning or if you sense a crash is imminent, you should abort the scenario by braking appropriately while steering to the left to avoid the Other Vehicle.

When the scenario is aborted and you brake and steer to the left, the driver of the other vehicle will accelerate while steering to the right to clear a path for your truck.

Observer Instructions and Worksheet

Below is the worksheet that should be used by the Driver Observer during the FCW-5 Test Track Drive. Please check each box to indicate the status of the test drive and provide explanations when any of the following occur: (1) the driver disengages the cruise control before FCW-5; (2) the driver glances for more than approx. 0.5 sec at the DIU at any time during the test drive; (3) the auditory alert evokes an apparent startle response (quick, involuntary movement or glance) from the driver; or (4) the driver does not respond to FCW-5 with the correct timely response – braking and steering left.

FCW-5 Test Track Drive Worksheet

FCW Warning/Alert	Expected Driver Response	Observations
FCW-1	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-2	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-3	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-4	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-5	Brake and Steer to Left	Startle Response to Auditory Alert? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
		Timely Braking and Steering Left? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, describe below</i>
<u>OBSERVER NOTES:</u>		

FCW-5 Debriefing Materials

Instructions

Immediately after the completion of the FCW-5 test track driving scenario, use the following materials to complete a debriefing if any noteworthy driver behaviors were observed.

Test Track Debriefing Script

Introduce each debrief question using the general format and options provided, and then ask the specific debrief question from the right-hand column of **Error! Reference source not found.**the worksheet below.

During that driving scenario, I observed that you [Behavior] at the onset of the [warning/alert]

Behavior Descriptors: Excessive Glance: *Glanced for an extended period*
 Startle Response: *Appeared to be startled*
 Delayed Driving: *Appeared to have a delayed response*

Warning/Alert Titles: FCW-1: *Forward Object Detected Message*
 FCW-2: *3-Second Headway Warning*
 FCW-3: *2-Second Headway Warning*
 FCW-4: *1-Second Headway Warning*
 FCW-5: *Collision Alert*

FCW-5 Test Track Debriefing Worksheet

Driving Scenario	Warning/Alert	Observed Driver Behavior	Debrief Question
FCW-5	FCW-1	Excessive Glance	<i>Was there anything about this warning that drew your attention away from the roadway for an extended period?</i>
	FCW-2	Excessive Glance	
	FCW-3	Excessive Glance	
	FCW-4	Excessive Glance	
	FCW-5	Excessive Glance	
		Startle Response	<i>Did this warning startle you? If you were startled, why?</i>
		Delayed Driving Response	<i>Was there anything in particular about this alert that required your extended attention to interpret?</i>
Driving Scenario	Warning/Alert	Observed Driver Behavior	Driver Comment

LCM-3: LC-1 – Lane-change Conflict with Adjacent Other Vehicle (Right)

Now let's begin the second test track scenario, the lane-change conflict with an adjacent primary other vehicle on the right

Scenario Concept

Let's review the concept for this scenario, shown below in Figure 5. This scenario is intended to result in a lane change/merge warning when your truck signals a right turn and you begin to change lanes to the right while the adjacent lane is occupied by another vehicle that is located in your foremost blind-spot. In this scenario both vehicles are traveling at the same forward speed. The figure below shows the initial, transitional, and final conditions for this scenario.

Initial, Transitional, and Final Conditions

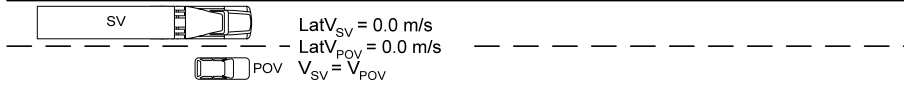
The scenario begins with both your truck and the other vehicle traveling nominally at the same speed in the center of their designated lanes with the front bumper of the other vehicle aligned with the front bumper of your vehicle.

The conflict is initiated when you engage the turn signal and move to the right.

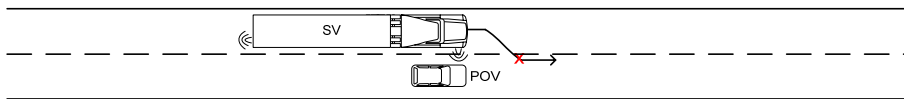
The scenario ends when a lane change merge warning is issued or you sense that a crash is imminent.

If a lane change merge warning is not presented by the system at the appropriate time, or if you sense that a crash is imminent at any time, then you should abort this scenario by steering to the left to avoid the other vehicle.

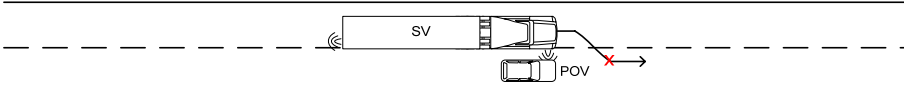
Initial conditions—Both the SV and POV are traveling nominally at the same speed in the center of their designated lanes with the front bumper of the POV aligned with the front bumper of the SV



Conflict transition—SV driver signals and moves to the right with a lateral velocity, $LatV_{SV}$, between 0.15 and 0.4 m/s



Warning conditions—A LCM warning is issued at the appropriate range, $LatDist_{LCW}$, per the system specification



Conflict resolution—Following the LCM warning or if the SV driver senses a crash is imminent the conflict is resolved by lateral position changes by the SV

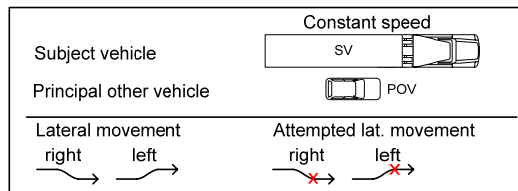
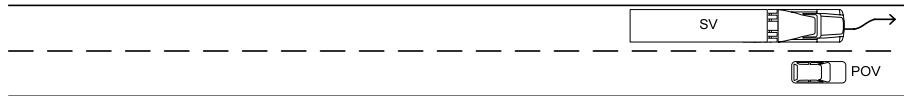


Figure 5. Initial and final conditions for Lane-change Conflict with Adjacent Other Vehicle (Right).

Driving Instructions

Let's review your driving instructions.

1. You accelerate, in the center of the selected lane, to the desired speed and engage the cruise control. If necessary, you should use the cruise-control speed-adjustment buttons to attain the desired speed.
2. When you pass cone 1, I will command the driver of the other vehicle to come into position next to your front-right bumper.
3. When I tell you, please turn-on your right turn signal, perform your usual scan, and then begin moving the truck to the right.
4. Upon a warning by the lane change merge system or if you sense a crash is imminent abort the scenario by steering to the left to avoid the other vehicle.

When the scenario is aborted and you steer to the left, the driver of the other vehicle will steer to the right to ensure that no collision occurs.

Observer Instructions and Worksheet

Below is the worksheet that should be used by the Driver Observer during the LCM-3 Test Track Drive. Please check each box to indicate the status of the test drive and provide explanations when any of the following occur: (1) the driver disengages the cruise control before LCM-3; (2) the driver glances for more than approx. 0.5 sec at the LDU at any time during the test drive; (3) the auditory alert evokes an apparent startle response (quick, involuntary movement or glance) from the driver; or (4) the driver does not respond to LCM-3 alert with the correct timely response – steering left.

FCW-5 Test Track Drive Worksheet

LCM Warning/ Alert	Expected Driver Response	Observations
LCM-1	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at LDU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
LCM-2	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at LDU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
LCM-3	Steer to Left	Startle Response to Auditory Alert? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, explain below</i>
		Excessive Glance (0.5 sec) at LDU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
		Timely Steering to Left? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, describe below</i>
<u>OBSERVER NOTES:</u>		

LCM-3 Debriefing Materials

Instructions

Immediately after the completion of the LCM-3 test track driving scenario, use the following materials to complete a debriefing if any noteworthy driver behaviors were observed.

Test Track Debrief Script

Introduce each debrief question using the general format and options provided below, and then ask the specific debrief question from the right-hand column of the worksheet below.

During that driving scenario, I observed that you [Behavior] at the onset of the [warning/alert]

Behavior Descriptors: Excessive Glance: *Glanced for an extended period*
 Startle Response: *Appeared to be startled*
 Delayed Driving: *Appeared to have a delayed response*

Warning/Alert Titles: LCM-1: *Adjacent Vehicle Detected*
 LCM-2: *Adjacent Vehicle plus Signal Detected*
 LCM-3: *Adjacent Vehicle plus Signal plus Lateral Drift Detected*

LCM-3 Test Track Debriefing Worksheet

Driving Scenario	Warning/Alert	Observed Driver Behavior	Debrief Question
LCM-3	LCM-1	Excessive Glance	<i>Was there anything about this warning that drew your attention away from the roadway for an extended period?</i>
	LCM-2	Excessive Glance	
	LCM-3	Excessive Glance	
			Startle Response
		Delayed Driving Response	<i>Was there anything in particular about this alert that required your extended attention to interpret?</i>
Driving Scenario	Warning/Alert	Observed Driver Behavior	Driver Comment

FCW-4B: RE-7 – Rear-end Conflict with Other Vehicle after Cut-in by Other Vehicle

Now we begin the third test track scenario, the rear-end conflict with an Other Vehicle after a cut-in by that vehicle.

Scenario Concept

Let's review the concept for this scenario. This scenario is intended to result in a forward collision alert when a slower moving vehicle changes lanes in front of your vehicle.

Initial, Transitional, and Final Conditions

Figure 6 below shows the initial, conflict transition, warning condition, and conflict resolution conditions for this scenario.

The initial conditions are in the top portion of the figure and show your truck at a constant speed approaching a slower constant-speed vehicle that is traveling in an adjacent lane to the left of your truck.

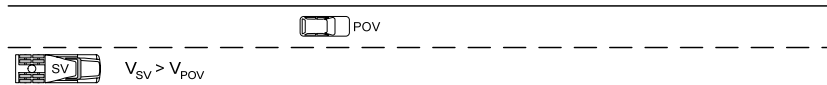
Then, at a predetermined distance from your truck, the driver of the Other Vehicle changes lanes to the right in front of your truck.

The third area of the figure shows that a warning should occur when your truck gets close enough to the merged vehicle to trigger the forward collision warning.

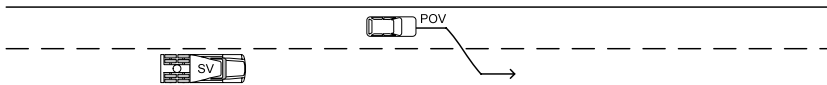
Finally, the bottom of the figure shows that upon a warning or if you sense that a crash is imminent, the conflict is resolved by you slowing and driving to the left.

If a forward collision warning is not presented by the system at the appropriate time, or if you sense that a crash is imminent at any time, then you should abort this scenario by braking appropriately and steering to the left to avoid the other vehicle.

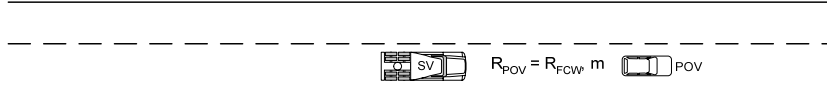
Initial conditions—Constant speed SV approaches from long range a slower-constant speed POV in an adjacent lane.



Conflict transition—POV changes lanes to the right in front of the SV at the designated range.



Warning conditions—A warning is issued at the appropriate range, R_{FCW} , per the system specification



Conflict resolution—Following an FCW or when the SV driver senses a crash is imminent the conflict is resolved by both speed and lateral position changes by the SV and POV.

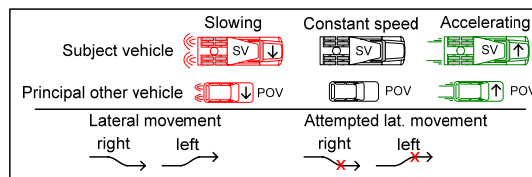
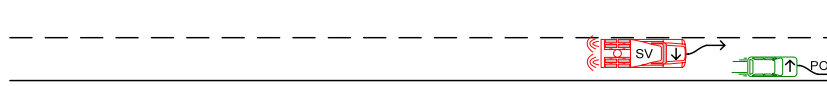


Figure 6. Initial and final conditions for Rear-end Conflict with Other Vehicle after Cut-in.

Test Track Preparation and Special Equipment

Let's review the test track set-up for this scenario.

The initial conditions for the scenario will be staged using a set of cones. The placement of the cones, relative to the start of the straight section of track is shown in Table 4 below (a negative distance means the cone is placed before the straight section of track). The cones are labeled to indicate their purpose. The general procedure for executing the scenario is:

- Your truck travels around the track at the desired speed in the center of the right-most of the two adjacent lanes.
- The Other Vehicle is stopped at cone 2.
- When you pass cone 1, the driver of the other vehicle will be instructed to start his vehicle.
- The Other Vehicle will accelerate at an established rate while staying in the center of the left-most of the two designated adjacent lanes.
- If staged correctly the Other Vehicle will reach cone 3 at the same time that your truck enters the straight section of the track.
- At cone 4 the Other Vehicle will begin to change lanes to the right entering the same lane as your truck.
- At cone 5 the Other Vehicle lane change should be complete. It should be noted that, given the initial conditions of this scenario, a forward collision warning should be issued before the Other Vehicle's driver completes the lane change at cone 5.

Table 4. Cone location for Rear-end Conflict after a Cut-in by Other Vehicle.

Cone	Distance, m	Label/Purpose
1	-240	SV commands POV to start
2	-77	From a stop the POV accelerates at 1.5 m/s ²
3	30	POV at specified speed in 12.0 second
4	50	POV starts lane change
5	193	POV lane change is complete (assumes an 8 sec lane-change duration)

Driving Instructions

Let's review your driving instructions.

1. *You accelerate in the center of the center lane to the (TBD) speed and engage the cruise control. If necessary, you should use the cruise-control speed-adjustment buttons to attain the desired speed.*
2. *At the (TBD) speed, and upon passing cone 1, the driver of the Other Vehicle will be instructed to start driving.*
3. *You will continue along the center of the center lane at the (TBD) speed closing on the Other Vehicle which is in the center of the adjacent lane to the left.*
4. *Upon a warning by the forward collision system or if you sense that a crash is imminent the scenario is aborted.*
5. *You should abort the scenario by braking appropriately while steering to the left to avoid the Other Vehicle.*

When the scenario is aborted and you brake and steer to the left, the driver of the other vehicle will accelerate while steering to the right to clear a path for your truck

Observer Instructions and Worksheet

Error! Reference source not found. below is the worksheet that should be used by the Driver Observer during the FCW-4B Test Track Drive. Please check each box to indicate the status of the driver's behavior and to provide explanations when any of the following occur: (1) the driver disengages the cruise control before FCW-5; (2) the driver glances for more than approx. 0.5 sec at the DIU at any time during the test drive; (3) the auditory alert evokes an apparent startle response (quick, involuntary movement or glance) from the driver; or (4) the driver does not respond to FCW-4B alert with the correct timely response – braking and steering left.

FCW-5 Test Track Drive Worksheet

FCW Warning/Alert	Expected Driver Response	Observations
FCW-4B	Brake and Steer to Left	Startle Response to Auditory Alert? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
		Timely Braking and Steering Left? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, describe below</i>
<u>OBSERVER NOTES:</u>		

FCW-4B Debriefing Materials

Instructions

Immediately after the completion of the FCW-4B test track driving scenario, use the following materials to complete a debriefing if any noteworthy driver behaviors were observed.

Test Track Debrief Script

Introduce each debrief question using the general format and options provided below, and then ask the specific debrief question from the right-hand column of the worksheet below.

During that driving scenario, I observed that you [Behavior] at the onset of the [warning/alert]

Behavior Descriptors:	Excessive Glance:	<i>Glanced for an extended period</i>
	Startle Response:	<i>Appeared to be startled</i>
	Delayed Driving:	<i>Appeared to have a delayed response</i>

Warning/Alert Titles:	FCW-4:	<i>1-Second Headway Warning</i>
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FCW-4B Test Track Debriefing Worksheet

Driving Scenario	Warning/ Alert	Observed Driver Behavior	Debrief Question
	FCW-4B	Excessive Glance	<i>Was there anything about this warning that drew your attention away from the roadway for an extended period?</i>
		Startle Response	<i>Did this warning startle you? If you were startled, why?</i>
		Delayed Driving Response	<i>Was there anything in particular about this alert that required your extended attention to interpret?</i>
Driving Scenario	Warning/ Alert	Observed Driver Behavior	Driver Comment

FCW-6: RE-3 – Rear-end Conflict with a Stopped Other Vehicle

If time allows...

We'll now begin the fourth test drive scenario, the rear-end conflict with a stopped other vehicle.

Scenario Concept

Let's review the concept for this scenario. This scenario is intended to result in a FCW alert when your truck approaches, from behind and at a moderate speed, a stopped other vehicle from a long range in the same lane on a straight segment of roadway with both vehicles in the center of the designated lane.

Initial, Transitional, and Final Conditions

Figure 7 below shows the initial, transitional, and final conditions for this scenario.

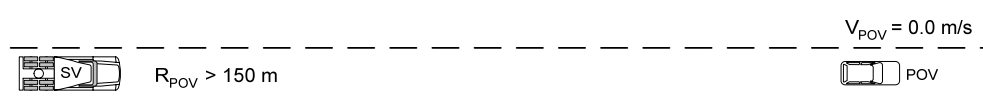
The initial conditions are in the top third of the figure and show your truck at a constant speed approaching from a long range a stopped other vehicle.

The center of the figure shows that a warning should occur when your truck gets close enough to the stopped vehicle to trigger the forward collision warning.

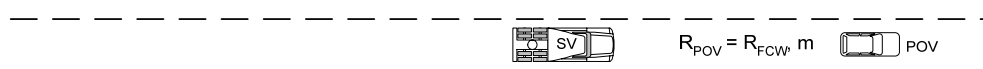
Finally, the bottom of the figure shows that upon a warning or if you sense that a crash is imminent, the conflict is resolved by you slowing and driving to the left.

If a forward collision warning is not presented by the system at the appropriate time, or if you sense that a crash is imminent, then you should abort this scenario.

Initial conditions—Constant speed SV approaches from long range a stopped POV in the center of the designated lane



Warning conditions—A warning is issued at the appropriate range, R_{FCW} , per the system specification



Conflict resolution—Following an FCW or when the SV driver senses a crash is imminent the conflict is resolved by both speed and lateral position changes by the SV and POV.

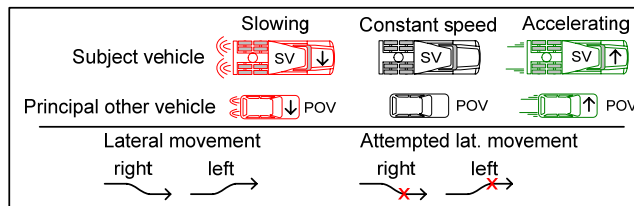
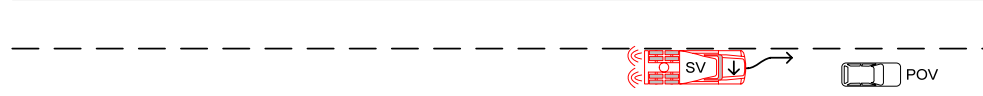


Figure 7. Initial and final conditions for Rear-end Conflict with a Stopped Other Vehicle.

Test Track Preparation and Special Equipment

Let's review the track set-up for this scenario.

For this scenario, the other vehicle will be parked in the center of the designated lane with at least 650 feet of straight track available for the approach of your truck. You will be approaching the other vehicle in the same lane with your truck at a constant speed prior to entering the straight portion of the track.

Driving Instructions

Let's review your driving instructions.

1. You accelerate, in the center of the selected lane, to the desired speed (TBD mph) and engage the cruise control. If necessary, the you should use the cruise-control speed-adjustment buttons to attain the desired speed.
2. You then continue along the center of the selected lane at the desired speed closing on the other vehicle in a straight section of the test track.
3. Upon a warning by the FCW system or if you sense that a crash is imminent the scenario is aborted by you braking appropriately while steering left to avoid the Other Vehicle.

When the scenario is aborted you should brake and steer to the left.

Observer Instructions and Worksheet

Error! Reference source not found.below is the worksheet that should be used by the Driver Observer during the FCW-6 Test Track Drive. Please check each box to indicate the status of the

test drive and provide explanations when any of the following occur: (1) the driver disengages the cruise control before FCW-6; (2) the driver glances for more than approx. 0.5 sec at the DIU at any time during the test drive; (3) the auditory alert evokes an apparent startle response (quick, involuntary movement or glance) from the driver; or (4) the driver does not respond to FCW-6 with the correct timely response – braking and steering left.

FCW-6 Test Track Drive Worksheet

FCW Warning/Alert	Expected Driver Response	Observations
FCW-1	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-6	Brake and Steer to Left	Startle Response to Auditory Alert? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
		Timely Braking and Steering Left? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, describe below</i>
<u>OBSERVER NOTES:</u>		

FCW-6 Debriefing Materials

Instructions

Immediately after the completion of the FCW-6 test track driving scenario, use the following materials to complete a debriefing if any noteworthy driver behaviors were observed.

Test Track Debrief Script

Introduce each debrief question using the general format and options provided below, and then ask the specific debrief question from the right-hand column of the worksheet below.

During that driving scenario, I observed that you [Behavior] at the onset of the [warning/alert]

Behavior Descriptors:	Excessive Glance:	<i>Glanced for an extended period</i>
	Startle Response:	<i>Appeared to be startled</i>
	Delayed Driving:	<i>Appeared to have a delayed response</i>

Warning/Alert Titles:	FCW-1:	<i>Forward Object Detected Message</i>
	FCW-6:	<i>Collision Alert</i>

FCW-6 Test Track Debriefing Worksheet

Driving Scenario	Warning/ Alert	Observed Driver Behavior	Debrief Question
FCW-6	FCW-1	Excessive Glance	<i>Was there anything about this warning that drew your attention away from the roadway for an extended period?</i>
	FCW-6	Excessive Glance	
			Startle Response
		Delayed Driving Response	<i>Was there anything in particular about this alert that required your extended attention to interpret?</i>
Driving Scenario	Warning/ Alert	Observed Driver Behavior	Driver Comment

FCW-7: RE-2 – Rear-end Conflict with a Modestly-slowng Other Vehicle

If time allows...This last scenario is the rear-end conflict with a slowing other vehicle.

1.1.1 Scenario Concept

Let's review the concept for this scenario. This scenario is intended to result in a FCW alert when your truck approaches, from behind, a modestly slowing other vehicle in the center of the same lane.

1.1.2 Initial, Transitional, and Final Conditions

Figure 8 below shows the initial, transitional, and final conditions for this scenario.

The initial conditions are in the top third of the figure and show your truck at a constant speed approaching a same-speed Other Vehicle at a (TBD) range.

The conflict transition shows the other vehicle slowing at a steady-state rate of less than 6.5 feet/s².

The next segment of the figure shows that a warning should occur when your truck gets close enough to the slower-moving vehicle to trigger the forward collision warning.

Finally, the bottom of the figure shows that the conflict should be resolved when you slow your truck and drive to the left while the other vehicle accelerates and moves to the right to avoid a crash.

If a forward collision warning is not presented by the system at the appropriate time, or if you sense that a crash is imminent, then you should abort this scenario by braking and steering to the left.

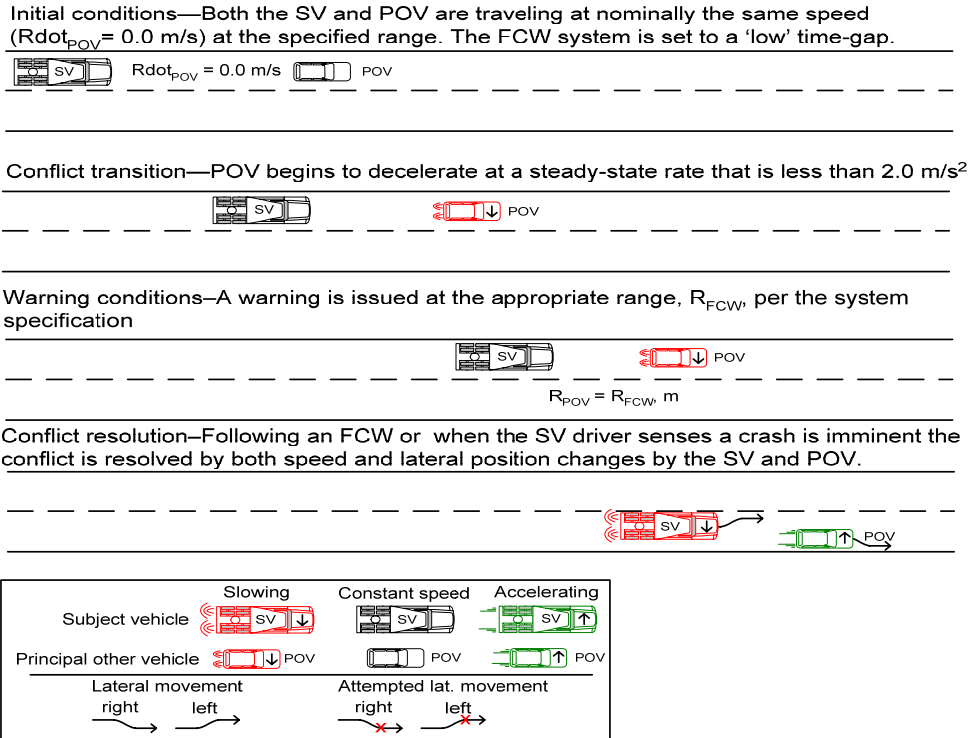


Figure 8. Initial and final conditions for Rear-end Conflict with a Modestly Slowing Other Vehicle.

Test Track Preparation and Special Equipment

Let's review the test track set-up for this scenario.

The initial conditions for this scenario will be staged using a set of cones. The placement of the cones, for this scenario is shown in Table 5 below (a negative distance means the cone is placed before the straight section of track). The cones are labeled to indicate their purpose. The general procedure for executing the scenario is:

- Your truck travels around the track at the (TBD) speed in the center of the designated lane.
- The other vehicle is stopped at cone 2.
- When you pass cone 1, test track personnel will instruct the driver of the other vehicle to start.
- You then accelerate at the prescribed rate (you will be assisted by a windshield mounted accelerometer) for 12 seconds to reach the (TBD) speed in the space between cones 2 and 3 while staying in the center of the designated lane.
- If staged correctly the other vehicle will reach cone 3 simultaneously with your truck entering the straight section of the track with the desired initial conditions.
- At cone 4 the other vehicle begins the transitional event by slowing at the desired deceleration level.
- At cone 5 the other vehicle should be at the desired lower speed. Note: it is expected that an FCW will be issued prior to reaching this desired lower speed by the Other Vehicle.

Table 5. Cone location for Rear-end with a Slowing Other Vehicle and a Short Time-gap.

Cone	Distance, m	Label/Purpose
1	-213	I will command the Other Vehicle to start
2	-68	From a stop the Other Vehicle accelerates at 1.5 m/s ²
3	40	Other Vehicle at specified speed in 12 seconds
4	60	Other Vehicle begins deceleration
5	140	Other Vehicle reaches target transition speed

Driving instructions

Let's review your driving instructions.

1. *You accelerate, in the center of the selected lane, to the (TBD) speed and engage the cruise control. If necessary, you should use the cruise-control speed-adjustment buttons to attain the desired speed.*
2. *When you pass cone 1, test track personnel will command the other vehicle driver to start driving.*
3. *At cone 4 prepare for the other vehicle to begin a transition event.*
4. *Upon a warning by the forward collision system or if you sense that a crash is imminent abort the scenario by braking appropriately while steering to the left to avoid the other vehicle.*

When the scenario is aborted and you brake and steer to the left, the driver of the other vehicle will accelerate while steering to the right to clear a path for your truck.

Observer Instructions and Worksheet

Below is the worksheet that should be used by the Driver Observer during the FCW-7 Test Track Drive. Please check each box to indicate the status of the test drive and provide explanations when any of the following occur: (1) the driver disengages the cruise control before FCW-7; (2) the driver glances for more than approx. 0.5 sec at the DIU at any time during the test drive; (3) the auditory alert evokes an apparent startle response (quick, involuntary movement or glance) from the driver; or (4) the driver does not respond to FCW-7 with the correct timely response – braking and steering left.

FCW-7 Test Track Drive Worksheet

FCW Warning/Alert	Expected Driver Response	Observations
FCW-1	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-2	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-3 (Expected?)	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-4 (Expected?)	Continue on Cruise Control	Continue on Cruise Control? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
FCW-7	Brake and Steer to Left	Startle Response to Auditory Alert? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, explain below</i>
		Excessive Glance (0.5 sec) at DIU? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If Yes, describe below</i>
		Timely Braking and Steering Left? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, describe below</i>
<u>OBSERVER NOTES:</u>		

FCW-7 Debriefing Materials

Instructions

Immediately after the completion of the FCW-7 test track driving scenario, use the following materials to complete a debriefing if any noteworthy driver behaviors were observed.

Test Track Debrief Script

Introduce each debrief question using the general format and options provided below, and then ask the specific debrief question from the right-hand column of the worksheet below.

During that driving scenario, I observed that you [Behavior] at the onset of the [warning/alert]

Behavior Descriptors: Excessive Glance: *Glanced for an extended period*
 Startle Response: *Appeared to be startled*
 Delayed Driving: *Appeared to have a delayed response*

Warning/Alert Titles: FCW-1: *Forward Object Detected Message*
 FCW-2: *3-Second Headway Warning*
 FCW-7: *Collision Alert*

FCW-7 Test Track Debriefing Worksheet

Driving Scenario	Warning/Alert	Observed Driver Behavior	Debrief Question
FCW-7	FCW-1	Excessive Glance	<i>Was there anything about this warning that drew your attention away from the roadway for an extended period?</i>
	FCW-2	Excessive Glance	
	FCW-7	Excessive Glance	
			Startle Response
		Delayed Driving Response	<i>Was there anything in particular about this alert that required your extended attention to interpret?</i>
Driving Scenario	Warning/Alert	Observed Driver Behavior	Driver Comment

Attachment 4 IVBSS Warnings and Alerts Review

Overview

Using the set of laptop IVBSS warnings and alerts demonstration files, use the following script and response forms to conduct a comprehensive review of the driver’s evaluation of all major IVBSS warnings and alerts.

<i>Present This:</i>	<i>Then Read This:</i>
FCW-0 No Forward Object Detected	<i>Here is the message that is displayed on the DIU when both the lane departure warning system and the forward collision warning systems are operable and there is no forward object detected.</i>

FCW-0 Q1 *To what extent do you understand this message?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function</i>
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<i>Present This:</i>	<i>Then Read This:</i>
FCW-1 Forward Object Detected	<i>Here is the message that is displayed on the DIU when there is a forward object detected within 350 feet.</i>

FCW-1 Q1 *To what extent do you understand this message?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function</i>
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FCW-1 Q2 *How appropriately does this message convey the actual urgency of the situation?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency</i>
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FCW-1 Q3 *How appropriate is the timing of the onset of this message in providing you a timely warning and sufficient time to assess and respond to the situation?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing</i>
----------------------	--

<i>Present This:</i>	<i>Then Read This:</i>
-----------------------------	-------------------------------

FCW-2 3-Second Headway Warning	<i>Here is the warning that is displayed on the DIU when there is a forward object with less than 3 seconds of headway from your vehicle</i>
--------------------------------------	--

FCW-2 Q1 *To what extent do you understand this message?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
----------------------	--

FCW-2 Q2 *How appropriately does this message convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
----------------------	---

FCW-2 Q3 *How appropriate is the timing of the onset of this warning in providing you a timely warning and sufficient time to assess and respond to the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing
----------------------	---

<i>Present This:</i>	<i>Then Read This:</i>
-----------------------------	-------------------------------

FCW-3V 2-Second Headway Visual Warning	<i>Here is the warning that is displayed on the DIU when there is a forward object with less than 2 seconds of headway from your vehicle.</i>
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FCW-3V Q1 *To what extent do you understand this message?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
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FCW-3V Q2 *How appropriately does this message convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
----------------------	---

FCW-3V Q3 *How appropriate is the timing of the onset of this warning in providing you a timely warning and sufficient time to assess and respond to the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing
----------------------	---

Present This:**Then Read This:**

FCW-3A
2-Second Headway
Auditory Warning

Here is the auditory warning that accompanies the visual 2-second warning when the headway distance between vehicles is closing.

FCW-3A Q1 *How readily do you associate this audio alert with its intended meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No initial association between the signal and the intended meaning 100 = Initial association was exactly the intended meaning of the signal
----------------------	---

FCW-3A Q2 *To what extent do the characteristics of this audio alert help you in learning to quickly identify its meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No help in learning to identify warning 100 = Extremely helpful in learning to identify warning
----------------------	---

FCW-3A Q3 *To what extent do you understand the meaning of this audio alert?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
----------------------	--

FCW-3A Q4 *How appropriately does this audio alert convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
----------------------	---

FCW-3A Q5 *To what extent do the particular sound characteristics of this audio alert result in you feeling annoyed at its onset?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Warning sound characteristics never make me feel annoyed at its onset 100 = Warning sound characteristics always make me feel annoyed and distracted at its onset
----------------------	---

FCW-3A Q6 *To what extent does this audio alert complement the visual alert to help you understand and respond promptly to the warning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No value of having both visual and auditory warnings 100 = Much greater value in having both visual and auditory warnings
----------------------	---

<i>Present This:</i>	<i>Then Read This:</i>
FCW-4V 1-Second Headway Visual Warning	<i>Here is the visual warning that is displayed on the DIU when there is a forward object with less than one second, but more than ½ second of headway from your vehicle.</i>

FCW-4V Q1 *Is this warning distinct from the '2 second headway' visual warning?*

- Yes**
 No

FCW-4V Q2 *To what extent do you understand this message?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function</i>
----------------------	---

FCW-4V Q3 *How appropriately does this message convey the actual urgency of the situation?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency</i>
----------------------	--

FCW-4V Q4 *How appropriate is the timing of the onset of this warning in providing you a timely warning and sufficient time to assess and respond to the situation?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing</i>
----------------------	--

Present This:**Then Read This:**

FCW-4A

1-Second Headway
Auditory Warning*Here is the auditory alert that will be presented at the onset of the 1-second warning if the headway between the other vehicle and your truck is closing.*FCW-4A Q1 *Is this warning distinct from the '2 second headway' auditory warning?* **Yes** **No**FCW-4A Q2 *How readily do you associate this audio alert with its intended meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No initial association between the signal and the intended meaning 100 = Initial association was exactly the intended meaning of the signal
----------------------	---

FCW-4A Q3 *To what extent do the characteristics of this audio alert help you in learning to quickly identify its meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No help in learning to identify warning 100 = Extremely helpful in learning to identify warning
----------------------	---

FCW-4A Q4 *To what extent do you understand this audio alert?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
----------------------	--

FCW-4A Q5 *How appropriately does this audio alert convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
----------------------	---

FCW-4A Q6 *To what extent do the particular sound characteristics of this audio alert result in you feeling annoyed at its onset?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Warning sound characteristics never make me feel annoyed at its onset 100 = Warning sound characteristics always make me feel annoyed and distracted at its onset
----------------------	---

FCW-4A Q7 *To what extent does this audio alert complement the visual alert to help you understand and respond promptly to the warning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No value of having both visual and auditory warnings 100 = Much greater value in having both visual and auditory warnings
----------------------	---

<i>Present This:</i>	<i>Then Read This:</i>
FCW-5, 6, 7 Visual Collision Alert	<i>Here is the visual alert that is displayed on the DIU when there is a forward object with less than ½ second of headway from your vehicle. This alert will be displayed if any of the following conditions are met: (1) There is a moving forward object within ½ second with an opening, closing, or constant distance; (2) There is a stationary forward object within 220 feet with less than 3 seconds headway; or (3) There is a slow moving vehicle ahead that is moving 20 percent slower than your vehicle and is within 220 feet.</i>

FCW-5V Q1 *Is this visual alert distinct from the '1 second headway' visual warning?*

- Yes**
 No

FCW-5V Q2 *To what extent do you understand this message?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function</i>
----------------------	---

FCW-5V Q3 *How appropriately does this message convey the actual urgency of the situation?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency</i>
----------------------	--

FCW-5V Q4 *How appropriate is the timing of the onset of this warning in providing you a timely warning and sufficient time to assess and respond to the situation?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing</i>
----------------------	--

Present This:**Then Read This:**

FCW-5, 6, 7

Collision Alert

Auditory Warning

*Here is the auditory alert that will be presented at the onset of the collision alert.*FCW-5A Q1 *Is this audio alert distinct from the '1 second headway' auditory alert?* **Yes** **No**FCW-5A Q2 *How readily do you associate this audio alert with its intended meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No initial association between the signal and the intended meaning 100 = Initial association was exactly the intended meaning of the signal
----------------------	---

FCW-5A Q3 *To what extent do the characteristics of this audio alert help you in learning to quickly identify its meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No help in learning to identify warning 100 = Extremely helpful in learning to identify warning
----------------------	---

FCW-5A Q4 *To what extent do you understand this audio alert?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
----------------------	--

FCW-5A Q5 *How appropriately does this audio alert convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
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FCW-5A Q6 *To what extent do the particular sound characteristics of this audio alert result in you feeling annoyed at its onset?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Warning sound characteristics never make me feel annoyed at its onset 100 = Warning sound characteristics always make me feel annoyed and distracted at its onset
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FCW-5A Q7 *To what extent does this audio alert complement the visual alert to help you understand and respond promptly to the warning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No value of having both visual and auditory warnings 100 = Much greater value in having both visual and auditory warnings
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Present This:	Then Read This:
LDW-0 No Forward Object Detected	<i>Here is the message that is displayed on the DIU when both the lane departure warning system and the forward collision warning systems are operable and there is no forward object detected.</i>
Lane Departure Warning System Operable	<i>Note that the two [TBD icons] in the lower-left of the display indicate that both sides of the lane departure warning system are operable. Do you have any questions about this display?</i>

LDW-0 Q1 To what extent do you understand the “No Forward Object Detected” message?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the message at all 100 = Completely understand the message
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LDW-0 Q2 To what extent do you understand the “Lane Departure System Availability” icons?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the icons at all 100 = Completely understand the icons
----------------------	--

Present This:	Then Read This:
LDW-L Left Drift Visual Warning	<i>Here is the visual warning that is displayed when the system has detected that your truck has drifted to the <u>left</u> of your current lane</i>

LDW-LV Q1 To what extent do you understand this message?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
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LDW-LV Q2 How appropriately does this message convey the actual urgency of the situation?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
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LDW-LV Q3 How appropriate is the timing of the onset of this warning in providing you a timely warning and sufficient time to assess and respond to the situation?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing
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<i>Present This:</i>	<i>Then Read This:</i>
LDW-R Right Drift Visual Warning	<i>Here is the warning that is displayed when the system has detected that your truck has drifted to the <u>right</u> of your current lane</i>

LDW-RV Q1 *To what extent do you understand this message?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
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LDW-RV Q2 *How appropriately does this message convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
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LDW-RV Q3 *How appropriate is the timing of the onset of this warning in providing you a timely warning and sufficient time to assess and respond to the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing
----------------------	---

Present This:**Then Read This:**

LDW-R/L

Right/Left Drift

Auditory Warning

Here is the auditory warning that will be presented when the system has detected that your truck has drifted out of your current lane

LDW-A Q1 *Is this auditory alert distinct from other auditory alerts?*

Yes

No

LDW-A Q2 *How readily do you associate this audio alert with its intended meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No initial association between the signal and the intended meaning 100 = Initial association was exactly the intended meaning of the signal
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LDW-A Q3 *To what extent do the characteristics of this audio alert help you in learning to quickly identify its meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No help in learning to identify warning 100 = Extremely helpful in learning to identify warning
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LDW-A Q4 *To what extent do you understand this audio alert?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
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LDW-A Q5 *How appropriately does this audio alert convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
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LDW-A Q6 *To what extent do the particular sound characteristics of this audio alert result in you feeling annoyed at its onset?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Warning sound characteristics never make me feel annoyed at its onset 100 = Warning sound characteristics always make me feel annoyed and distracted at its onset
----------------------	---

LDW-A Q7 *To what extent does this audio alert complement the visual alert to help you understand and respond promptly to the warning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No value of having both visual and auditory warnings 100 = Much greater value in having both visual and auditory warnings
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<i>Present This:</i>	<i>Then Read This:</i>
LCM-0 No Vehicle Detected	<i>Now, I'll show you the warnings and alerts that can be displayed on the lateral display units</i> <i>When none of the three lights are activated, that indicates that there is not a vehicle detected in the zone adjacent to your truck</i>

LCM-0 Q1 *To what extent do you understand this message?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function</i>
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<i>Present This:</i>	<i>Then Read This:</i>
LCM-1 Vehicle Detected	<i>One yellow light is lit on the LDU when a vehicle is detected in the adjacent zone.</i>

LCM-1 Q1 *To what extent do you understand this message?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function</i>
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LCM-1 Q2 *How appropriately does this message convey the actual urgency of the situation?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency</i>
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LCM-1 Q4 *How appropriate is the timing of the onset of this warning in providing you a timely warning and sufficient time to assess and respond to the situation?*

Driver Rating	<i>Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing</i>
----------------------	--

<i>Present This:</i>	<i>Then Read This:</i>
LCM-2 Vehicle + Signal Detected	<i>One red light is lit on the LDU when a vehicle is detected in the adjacent zone <u>and</u> the turn signal on that side is active <u>and</u> the system has determined that the truck driver <u>has not</u> begun to move into the adjacent lane.</i>

LCM-2 Q1 *To what extent do you understand this message?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
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LCM-2 Q2 *How appropriately does this message convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
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LCM-2 Q4 *How appropriate is the timing of the onset of this warning in providing you a timely warning and sufficient time to assess and respond to the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very inappropriate timing 100 = Highly appropriate timing
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<i>Present This:</i>	<i>Then Read This:</i>
LCM-3 Auditory Alert Vehicle + Signal + Lateral Drift Detected	<i>This is the auditory warning that will be presented when a vehicle is detected in the adjacent zone <u>and</u> the turn signal on that side is active <u>and</u> the system has determined that the truck driver <u>has</u> begun to move into the adjacent lane <u>or</u> the system is not able to determine the truck driver's intentions based on available lateral data</i>

LCM-A Q1 *Is this auditory alert distinct from other auditory alerts?*

- Yes**
 No

LCM-A Q2 *How readily do you associate this audio alert with its intended meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No initial association between the signal and the intended meaning 100 = Initial association was exactly the intended meaning of the signal
----------------------	---

LCM-A Q3 *To what extent do the characteristics of this audio alert help you in learning to quickly identify its meaning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No help in learning to identify warning 100 = Extremely helpful in learning to identify warning
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LCM-A Q4 *To what extent do you understand this audio alert?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
----------------------	--

LCM-A Q5 *How appropriately does this audio alert convey the actual urgency of the situation?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor match with actual urgency 100 = Very high match with actual urgency
----------------------	---

LCM-A Q6 *To what extent do the particular sound characteristics of this audio alert result in you feeling annoyed at its onset?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Warning sound characteristics never make me feel annoyed at its onset 100 = Warning sound characteristics always make me feel annoyed and distracted at its onset
----------------------	---

LCM-A Q7 *To what extent does this audio alert complement the visual alert to help you understand and respond promptly to the warning?*

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No value of having both visual and auditory warnings 100 = Much greater value in having both visual and auditory warnings
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Attachment 5 Self-Administered Driver Questionnaire

General Instructions

This is the final activity during your participation in the IVBSS jury drive. Please review each of the questions below and provide a response.

Section B. Background Information Data Collection

B.1 Corrected Visual Acuity: Indicate your approximate (corrected) visual acuity

- 20/20 (normal)
- 20/40 (modestly near-sighted)
- Worse than 20/40

B.2 Type of Visual Correction: Indicate the type of visual correction used during the evaluation

- None
- Near-sighted correction only
- Far-sighted correction only
- Multiple corrections without limited fields of focus
- Multiple corrections with limited fields of focus

B.3 Auditory Acuity: To the best of your knowledge, do you have a hearing impairment?
(check the most appropriate response)

- No
- Yes, I have a very slight hearing impairment
- Yes, I have a modest hearing impairment
- Yes, I have a significant hearing impairment

Section 1: Display Unit Finish and Placement

General Instructions: Please provide a rating from 0-100 in the left-hand **Driver Rating** column following each of the questions in the remainder of this questionnaire.

- 1.1 DIU Fit and Finish:** To what extent does the fit between the components and the finish of the materials of the Driver Interface Unit on the dash represent superior quality?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor fit and finish quality 100 = Superior fit and finish quality
----------------------	--

- 1.2 LDU Fit and Finish:** To what extent does the fit between the components and the finish of the materials of the Lateral Display Unit on the side pillars represent superior quality?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very poor fit and finish quality 100 = Superior fit and finish quality
----------------------	--

- 1.3 1.3 DIU Display Visibility:** During operation of the system, to what extent do you have a direct, unobstructed, and normal line of sight to the Driver Interface Unit on the dash?

(Provide your rating from 0-100 in the left-hand **Driver Rating** column below)

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No line of sight blockage, and location is consistent with normal scanning pattern 100 = Extensive line of sight blockage and/or normal scanning pattern is substantially disrupted
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- 1.4 DIU Line of Sight Interference:** During operation of the system, to what extent is your forward line of sight blocked by the location of the Driver Interface Unit on the dash?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No line of sight blockage 100 = Extensive and disruptive line of sight blockage
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- 1.5 LDU Display Visibility:** During operation of the system, to what extent do you have a direct, unobstructed, and normal line of sight to the Lateral Display Unit on the side pillars?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No line of sight blockage, and location is consistent with normal scanning pattern 100 = Extensive line of sight blockage and/or normal scanning pattern is substantially disrupted
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- 1.6 LDU Line of Sight Interference:** During operation of the system, to what extent is your lateral line of sight blocked by the location of the Lateral Display Unit on the side pillars?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No line of sight blockage 100 = Extensive and disruptive line of sight blockage
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- 1.7 DIU Reach:** During operation of the system, to what extent do you need to stretch and/or adjust your posture from your normal driving position to operate the controls on the Driver Interface Unit on the dash?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = No need to stretch or adjust posture 100 = Very substantial need to stretch and adjust posture
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Section 2: Visual Display Contrast and Legibility

- 2.1 **DIU LED Contrast Adequacy:** How adequately does contrast of the light emitting diodes in the Driver Interface Unit on the dash allow you to identify the number and color of the yellow and red warning bars under various lighting conditions?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very low adequacy 100 = Very high adequacy
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- 2.2 **DIU LCD Legibility Adequacy:** How adequately does the size and design of image components and symbols in the Driver Interface Unit on the dash allow you to easily identify them from a normal viewing distance?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very low adequacy 100 = Very high adequacy
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- 2.3 **LDU LED Contrast Adequacy:** How adequately does contrast of the lights in the Lateral Display Unit on the side pillars allow you to identify the color and location of the warning lights under various lighting conditions?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very low adequacy 100 = Very high adequacy
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Section 3: Audio Display Characteristics

- 3.1 **Forward Auditory Display Loudness Adequacy:** How adequately does the loudness of the forward auditory display allow you to clearly hear its auditory warnings (both FCW and LDW) under the range of noise conditions you experience in this truck cab?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very low adequacy 100 = Very high adequacy
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- 3.2 **Left Auditory Display Loudness Adequacy:** How adequately does the loudness of the left auditory display allow you to clearly hear its auditory warnings under the range of noise conditions you experience in this truck cab?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very low adequacy 100 = Very high adequacy
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- 3.3 **Right Auditory Display Loudness Adequacy:** How adequately does the loudness of the right auditory display allow you to clearly hear its auditory warnings under the range of noise conditions you experience in this truck cab?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very low adequacy 100 = Very high adequacy
----------------------	--

Section 4: General User Interface

- 4.1 **Audio Volume Control Menu & Control Function Comprehension:** To what extent do you understand the audio volume control function of the DIU?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
----------------------	--

- 4.2 **Audio Volume Control Menu & Control Ease of Use:** To what extent is the audio volume control easy to use?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very difficult to use 100 = Very easy to use
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- 4.3 **DIU Brightness Control Function Comprehension:** To what extent do you understand the DIU brightness control function of the DIU?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
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- 4.4 **DIU Brightness Control Ease of Use:** To what extent is the DIU brightness control easy to use?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very difficult to use 100 = Very easy to use
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Did you use the 'Temporary Warning Mute Function'?

Yes

No

If you answered Yes, please answer the two final questions below.

- 4.5 **Temporary Warning Mute Function Menu & Control Function Comprehension:** To what extent do you understand the temporary warning mute function of the DIU?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Do not understand the function at all 100 = Completely understand the function
----------------------	--

- 4.6 **Temporary Warning Mute Function Menu & Control Ease of Use:** To what extent is the temporary warning mute function easy to use?

Driver Rating	Please answer using a scale of 0 to 100; where: 0 = Very difficult to use 100 = Very easy to use
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