DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

Docket No. NHTSA-2010-0053

Guidelines for Reducing Visual-Manual Driver Distraction during Interactions with Integrated, In-Vehicle, Electronic Devices

Version 1.01

Changes from V1.00

Version 1.01 differs from Version 1.00 of the NHTSA Driver Distraction Guidelines in that the following subsections have been revised to improve their clarity:

- Subsection III.B – Additional SAE recommended practice added.
- Subsection V.C.7 – Revised to improve clarity.
- Subsection V.C.8 – Revised to improve clarity.
- Subsection VI.E.12 – Revised to caution that including too many tasks in a single session can overwhelm test participants and lead to worse performance by the participant, thereby increasing the likelihood of a task not meeting the acceptance criteria.
- Subsection VI.E.14.a – Revised to improve clarity.
- Subsection VI.G.4.b – Typographical error fixed.
- Subsection VI.G.18 – Inadvertent omission rectified.

No changes have been made to the device interface recommendations contained in these Guidelines.

I. PURPOSE.

The purpose of these Guidelines is to reduce the number of motor vehicle crashes and the resulting deaths and injuries that occur due to a driver being distracted from the primary driving task while performing secondary tasks involving the use of an in-vehicle electronic device. The Guidelines are presented as an aid to manufacturers in designing in-vehicle devices that do not allow the performance of tasks that negatively impact a driver's ability to safely control his or her vehicle. Vehicle and electronic device manufacturers that choose to adhere to these Guidelines do so voluntarily. Compliance with these Guidelines is not required.

A. Driver Responsibilities.

These Guidelines do not alter the driver's primary responsibility to ensure the safe operation of a vehicle as governed by the state laws under which it is being operated, both while driving and when interacting with in-vehicle electronic devices. This includes following all traffic laws, obeying traffic control devices, and driving in a safe manner under all operating conditions.

B. Protection Against Unreasonable Risks to Safety.

The National Highway Traffic Safety Administration (NHTSA) does not evaluate the safety implications of every new device before it is introduced into vehicles. However, the Safety Act authorizes NHTSA to initiate enforcement action when a motor vehicle or item of motor vehicle equipment, including original equipment in-vehicle electronic devices, contains a safety-related defect. (49 U.S.C. §§ 30118–30121).

II. SCOPE.

These Guidelines are applicable to the human-machine interfaces of electronic devices used for performing all non-driving-related tasks[1] as well as for performing some driving-related tasks.

Table 2 contains a non-exhaustive list of the types of non-driving-related tasks and electronic devices to which these Guidelines are applicable.

Table 1 - Non-Driving-Related Tasks/Devices to Which These Guidelines Apply

Type of Task	Task/Device
Communications	Caller Identification Incoming Call Management Initiating and Terminating Phone Calls Conference Phoning Two-Way Radio Communications Paging Address Book Reminders Text-Based Communications Social Media Messaging or Posting
Entertainment	Radio (including but not limited to AM, FM, and Satellite) Pre-recorded Music Players, All Formats Television Video Displays Advertising Internet Browsing News Directory Services
Information	Clock Temperature

These Guidelines are applicable to driving-related tasks that are neither related to the safe operation and control of the vehicle nor involve the use of a system required by law. Examples

[1] Underlined terms are defined in Section IV. Definitions.

of driving-related tasks to which these Guidelines are applicable include interacting with vehicle information centers, emissions controls, fuel economy information displays, trip odometers, and route navigation systems. These Guidelines are **not** applicable to the following general categories of driving-related tasks, which involve activities performed by the driver as part of the safe operation and control of the vehicle or involve systems required by law:

- Operating the driving controls (steering wheel, throttle pedal, brake pedal, etc.) of the vehicle,
- Any task relating to proper use of a driver safety warning system,
- Using any other electronic device that has a function, control, and/or display specified by either a Federal Motor Vehicle Safety Standard, another United States Government law or regulation, or a state or local Government law or regulation.

A non-exhaustive list of driving-related task categories, along with whether these Guidelines apply to each category, is contained in Table 3.

Table 2 - Driving-Related Tasks

Categories of Driving-Related Tasks	Guidelines Applicable?	
	Yes	**No**
Manipulating the steering handwheel		X
Applying the brake, throttle, and clutch pedal (if present)		X
Operating the transmission shift lever		X
Operation of paddle shifters on steering wheel		X
Operation of the parking brake		X
Turning headlights on or off		X
Adjustment of instrument panel brightness		X
Turning turn signals on or off		X
Operation of windshield wipers		X
Operation of the horn		X
Locking and/or unlocking doors		X
Operation of moveable windows		X
Adjustment of moveable mirrors		X
Looking at inside and outside rearview mirrors		X
Turning blind spot detector on or off		X
Operation of moveable seats and headrests		X
Operation of seat belts		X
Checking the speedometer, fuel gauge, engine temperature gauge and any other gauges or digital displays presenting information that is necessary for the safe operation of the vehicle		X
Checking telltale and malfunction indicators		X
Turning electronic stability control and/or traction control on or off		X
Adjustment of climate controls not required by a Federal Motor Vehicle Safety Standard (e.g., temperature and fan adjustment)	X	
Operation of cruise control	X	
Performance of a task via multi-function display interface	X	
Resetting trip odometers and/or trip computers	X	
Navigation of the vehicle – Destination entry	X	
Navigation of the vehicle – Route following	X	
Real-Time Traffic Advisory	X	
Trip Computer Information	X	
Observation of vehicle information centers	X	
Observation of emissions controls	X	
Observation of fuel economy displays	X	
Adjusting vehicle suspension and/or ride	X	

A. Guidelines Intended for Human-Machine Interfaces.

These Guidelines are applicable primarily to human-machine interfaces of in-vehicle electronic devices intended for use by a driver. They are applicable to a limited extent (see Section VII) to devices intended for use by front seat passengers of a vehicle. They are not applicable to devices that are located solely rearward of the front seat of a vehicle.

B. Only Device Interfaces Covered.

These Guidelines are not applicable to any aspect of covered electronic devices other than their interfaces. Specifically, they do not cover a device's electrical characteristics, material properties, or performance.

C. Original Equipment Electronic Devices Covered.

These Guidelines are applicable to the human-machine interfaces of original equipment electronic devices (i.e., those built into a vehicle at the time of manufacture). These Guidelines are applicable to such devices even when linked with aftermarket or portable devices, i.e., original equipment devices should control all aftermarket and portable devices linked to them (i.e., electronically connected with some type of data exchange) in accordance with these principles.

D. Aftermarket and Portable Devices Not Covered.

These Guidelines are currently **not** applicable to the human-machine interfaces of electronic devices that are either installed into a vehicle after it is manufactured (aftermarket devices) or are brought into the vehicle on a temporary basis by the driver or passengers (portable devices).

E. Device Tasks Performed Via Auditory-Vocal Means Not Covered.

These Guidelines are currently **not** applicable to the auditory-vocal portions of human-machine interfaces of electronic devices.

F. Intended Vehicle Types.

These Guidelines are applicable to passenger cars, multipurpose passenger vehicles, and trucks and buses with a Gross Vehicle Weight Rating (GVWR) of not more than 10,000 pounds. However, these guidelines are **not** applicable to:

1. Ambulances or combination ambulance-hearses,
2. Firefighting vehicles,
3. Military vehicles,
4. Vehicles manufactured for use by the United States Government or a State or local government for law enforcement, or
5. Vehicles manufactured for other emergency uses as prescribed by regulation by the Secretary of Transportation.

III. STANDARDS INCLUDED BY REFERENCE.

The following standards and all of their provisions are used in these Guidelines.

A. International Organization for Standardization (ISO) Standards.

ISO 15008:2003, "Road vehicles – Ergonomic aspects of transport information and control systems – Specifications and compliance procedures for in-vehicle visual presentation," March 2003.

ISO 16673:2007(E),"Road vehicles – Ergonomic aspects of transport information and control Systems – Occlusion method to assess visual demand due to the use of in-vehicle systems," April 2007.

B. SAE International (SAE) Standards.

SAE Recommended Practice J670 JAN2008, "Vehicle Dynamics Terminology," revised January 2008.

SAE Recommended Practice J941, "Motor Vehicle Drivers' Eye Locations." Any of the following versions of SAE J941 are acceptable: SAE J941 (June 1992), SAE J941 (June 1997), SAE J941 (September 2002), SAE J941 (October 2008), or SAE J941 (March 2010).

IV. DEFINITIONS.

A. General Definitions.

1. Active Display Area means the portion of a visual display used to present information to the driver in the context of any task that makes use of that display. It excludes unused display surface and any area containing physically-manipulatable controls.
2. Device means all components that a driver uses to perform secondary tasks (i.e., tasks other than the primary task of safe operation and control of the vehicle); whether stand-alone or integrated into another device.
3. Distraction means the diversion of a driver's attention from activities critical for safe operation and control of a vehicle to a competing activity.
4. Downward Viewing Angle means the angle by which a driver has to look down from the horizontal to directly glance at a device's visual display. Both a three-dimensional downward viewing angle and a two-dimensional approximation are used in these Guidelines.

5. Driver's Field of View means the forward view acquired directly through the windshield, rear, and side views acquired through the other vehicle windows, as well as the indirect side and rear views provided by the vehicle's mirrors.

6. Driving means whenever the vehicle's means of propulsion (engine and/or motor) is activated **unless** one of the following conditions is met:

    a. For a vehicle equipped with a transmission with a "Park" position – The vehicle's transmission is in the "Park" position.

    b. For a vehicle equipped with a transmission without a "Park" position – All three of the following conditions are met:

        i. The vehicle's parking brake is engaged, and

        ii. The vehicle's transmission is known (via direct measurement with a sensor) or inferred (by calculating that the rotational speed of the engine divided by the rotational speed of the driven wheels does not equal, allowing for production and measurement tolerances, one of the overall gear ratios of the transmission/vehicle) to be in the neutral position, and

        iii. The vehicle's speed is less than 5 mph.

7. Driving-Related Task means:

    a. Any activity performed by a driver as part of the safe operation and control of the vehicle (not covered by these Guidelines),

    b. Any activity performed by a driver that relates to use of a vehicle system required by Federal or State law or regulation (not covered by these Guidelines), or

c. Any other activity performed by a driver that aids the driver in performing the driving task but is not essential to the safe operation or control of the vehicle (covered by these Guidelines).

8. Function means an individual purpose which the device is designed to fulfill. A device may have one or more functions.

9. Glance means a single ocular fixation by a driver. If the eye glance characterization method being used cannot distinguish between different nearby locations of individual fixations, "glance" may also be used to refer to multiple fixations to a single area that are registered as one ocular fixation.

10. Glance Duration means the time the gaze moves towards a target (the transition time) and the dwell time (the time fixated on a particular point) on the target. Glance duration does **not** include the transition time away from the target. (This is part of the next glance.)

11. Graphical or Photographic Image means any non-video graphical or photographic image. Internationally standardized symbols and icons, as well as Trademark™ and Registered® symbols, are not considered graphical or photographic images.

12. Interaction means an input by a driver to a device, either at the driver's initiative or as a response to displayed information. Interactions include control inputs and data inputs (information that a driver sends or receives from the device that is not intended to control the device). Depending on the type of task and the goal, interactions may be elementary or more complex. For the visual-manual interfaces covered by this version of these Guidelines, interactions are restricted to physical (manual or visual) actions.

13. Lock Out means the disabling of one or more functions or features of a device so that the related task cannot be performed by the driver while driving.

14. Manual Text Entry means manually inputting individual alphanumeric characters into an electronic device. For the purposes of these Guidelines, digit-based phone dialing is not considered manual text entry.

15. Nominal Driver Eye Point means the assumed (for these Guidelines) location of the center of the driver's eyes.

16. Non-Driving-Related Task means any activity performed by a driver **other than** those related to the driving task. A non-exhaustive list of non-driving-related tasks is contained in Table 2. These Guidelines are applicable to all non-driving-related tasks performed using electronic devices.

17. Per Se Lock Out means the lock out of a function or feature due to its inherent interference with a driver's ability to operate and control a vehicle safely.

18. Reading means the driver's act of perceiving visually presented textual information. Reading does not include a driver's perception of auditorily presented text.

19. Subtend means, in a geometrical sense, to be opposite to and delimit (an angle or side).

20. Text-Based Messaging means manually inputting individual alphanumeric characters into, or reading from, an electronic device for the purpose of present or future communication. This action includes, but is not limited to, the composition or reading of messages transmitted via short message service, e-mail, instant

messaging service, internet-based messaging, or social media internet-based applications (including posting). Text-based messaging does not include:

a. Reading, selecting, or entering a phone number, an extension number, or voice-mail retrieval codes and commands into an electronic device for the purpose of initiating or receiving a phone call or using voice commands to initiate or receive a phone call; or

b. Using a device capable of performing fleet management functions (e.g., dispatching services) for a purpose that is not otherwise prohibited by law.

21. Video means full-motion visual information presented through electronic means. This includes entertainment, advertising, and other visual content not related to driving that is obtained from pre-recorded images, live images, video games, broadcasts (such as by television or over the internet), and/or closed-circuit television.

B. Task-Related Definitions.

1. Control Input means a driver action to the human-machine interface of an electronic device that is intended to affect the state of that device. Control inputs may be initiated either by a driver or as a driver's response to displayed information initiated by a device. For the visual-manual interfaces covered by these Guidelines, control inputs are restricted to manual control actions.

2. Dependent Task means a task that cannot be initiated until a prior task (the antecedent task) is first completed. The task's start state is thus dependent upon the end state of the antecedent task.

An antecedent task followed by a dependent task can be distinguished from a single task that contains two subtasks by examining the end states of the two tasks or subtasks. For the antecedent task-dependent task case, both tasks' goals can be achieved (i.e., one goal for the antecedent task and one goal for the dependent task). In contrast, for a task composed of two subtasks, only one goal will be achieved.

An example of an antecedent task-dependent task: after choosing a restaurant from a navigation system's point-of-interest list (antecedent task with goal of choosing a restaurant), a driver is offered an internet function option of making a reservation at the restaurant (dependent task with goal of making reservation). Since there are two goals, this is an antecedent task followed by a dependent task. The dependent task of making a reservation can only be initiated following the task of selecting a restaurant from within the navigation system.

An example of multiple subtasks: entering an address into a route navigation system. The driver enters first the state, then the city, then the street, and finally the street number into the navigation system. However, the driver only has one goal for all of these actions: to enter the complete address. The entry of the state, city, street, and street number are all subtasks since they each form a part of achieving this one goal.

3. End of Data Collection means the time at which a test participant informs the experimenter they have completed a testable task either by speaking the word, "done" or, by a non-verbal means (such as a button press) indicating the same thing. Test participant eye glances are **not** examined after the end of data

collection. If a test participant eye glance was in progress at the end of data collection, only the portion that occurred before the end of data collection is used. Successful task completion requires that the device is in the desired end state at the end of data collection.

4. End State for a Testable Task means the pre-defined device state sought by a test participant to achieve the goal of that testable task.

5. Error means that a test participant has made a significant incorrect input when performing a testable task during a test trial. An error has occurred if the test participant has to backtrack during performance of the task or delete already entered inputs. If the device can accommodate an incorrect entry without requiring backtracking and extra inputs beyond those necessary to reach the desired end state of the task, then no error is deemed to have occurred.

6. Error-Free Trial means a test trial in which no errors are made by the test participant while completing the task.

7. Goal means a device state sought by a driver. Goal achievement is defined as achieving a device state that is the driver's intended state. Goals are frequently independent of the particular device hardware and software being used to execute the task or the method of task execution.

8. Secondary Task means any interaction a driver has with an in-vehicle device that is not directly related to the primary task of the safe operation and control of a vehicle. These tasks may relate to driver comfort, convenience, communications, entertainment, information seeking, or navigation.

9. Start of Data Collection means the time when the experimenter instructs a test participant to begin a task using a verbal cue, "begin" (or issues a non-verbal command indicating the same thing). Test participant eye glances are examined only after the start of data collection. If a test participant eye glance was in progress at the start of data collection, only use the segment after the start of data collection. The start of data collection should occur when the device is at the pre-defined start state for a testable task.

10. Start State for a Testable Task means the pre-defined device state from which testing of a testable task always begins. This is frequently the "home" screen, default visual display state, or other default human-machine interface state from which a driver initiates performance of the testable task. For dependent tasks, the start state would be the end state of the previous testable task.

For a testable task for which there is only one point (e.g., screen, visual prompt, step) from which the task can be initiated, that point would correspond to the start state. For a testable task which can be initiated from more than one point, one of these options is selected as the start state. If it can be determined which start state occurs most often during normal driving, testing should commence from that start state. (The desire here is to reduce the amount of testing needed to ensure adherence with these Guidelines. It is generally not necessary to test all possible transitions into a testable task.)

11. Sub-goal means an intermediate state on the path to the driver's goal. A sub-goal is often distinguishable from a goal in two ways: (1) it is usually not a state at which a driver would be satisfied stopping; and (2) it may vary in its

characteristics and/or sequential order with other sub-goals across hardware/interface functions, and thus is system dependent.

12. Subtask means a sub-sequence of control operations that is part of a larger testable task sequence – and which leads to a sub-goal representing an intermediate state in the path to the larger goal toward which a driver is working.

*Subtasks should **not** be treated as separate dependent tasks. For example, entering the street name as part of navigation destination entry is not a separate task from entering the street number; rather, these are subtasks of the same testable task.*

Data collection should only be undertaken for all subtasks as a group, which comprises a testable task. Separate data collection for individual subtasks is not appropriate.

13. Successful Task Completion means that a test participant has performed a testable task without significant deviations from the correct sequence(s) of inputs (i.e., made an error) and achieved the desired end state. As explained earlier, an error has occurred if the test participant has to backtrack during performance of the task or delete already entered inputs. If the device can accommodate an incorrect entry without requiring backtracking and extra inputs beyond those necessary to reach the desired end state of the task, then no error is deemed to have occurred.

14. Testable Task means a pre-defined sequence of interactions performed using a specific method leading to a goal toward which a driver will normally persist until the goal is reached. A testable task begins with the device at a previously defined start state and proceeds, if successfully completed, until the device attains a

previously defined end state. It is called a testable task because it is a completely defined secondary task that can be tested for adherence with these Guidelines.

C. Task-Related Explanatory Material.

1. Testable tasks should be completely defined prior to any testing to determine whether they are suitable to perform while driving under these Guidelines. The task's goal, start state, end state, specific method to be used, and inputs should all be specified.

2. For testable tasks with a variety of possible inputs of different lengths (e.g., city names for navigation systems), a typical or average length input should be used. Precise mean values need not be used and there may be some variation in length from input-to-input. For example, for the input of city names into a navigation system, lengths of 9 through 12 letters might be used.

3. For testable tasks that involve reading, nearby text unrelated to the task being performed should not be considered part of the text that is to be read during the testable task.

4. For the purposes of acceptance testing, text unrelated to the task and the labels of buttons or controls need not be included as part of the text that is read during a testable task.

V. DEVICE INTERFACE RECOMMENDATIONS.

Each device's human-machine interface should meet the recommendations specified below.

A. No Obstruction of View.

1. No part of the physical device, when mounted in the manner intended by the manufacturer, should obstruct a driver's view of the roadway.
2. No part of the physical device, when mounted in the manner intended by the manufacturer, should obstruct a driver's view of any vehicle controls or displays required for driving.

B. Easy to See and Reach.

The mounting location for a device should be in a location that is easy to see and/or reach (as appropriate) while driving.

C. Maximum Display Downward Angle.

Each device's display(s) should be mounted in a position where the downward viewing angle, measured at the geometric center of each active display area, is less than at least one of the following two angles:

- The 2D Maximum Downward Angle, or
- The 3D Maximum Downward Angle.

The values of these maximum angles depend upon the location of the nominal driver eye point as follows:

1. Location of the nominal driver eye point. The method used for calculating the location of the nominal driver eye point varies depending upon which version of SAE Recommended Practice J941 "Motor Vehicle Drivers' Eye Locations" is being used. If the June 1992, June 1997, September 2002, or October 2008 version of SAE J941 is being used, then the nominal driver eye point is located 8.4 mm above and 22.9 mm rearward of the mid-eye centroid of the SAE

eyellipse. If the March 2010 version of SAE J941 is being used, then the nominal driver eye point is located at the mid-eye centroid of the SAE eyellipse.

2. The 2D Maximum Downward Angle is equal to 30.00 degrees for a vehicle with the height of the nominal driver eye point less than or equal to 1700 millimeters above the ground.

3. The 2D Maximum Downward Angle is given by the following equation for nominal driver eye point heights greater than 1700 millimeters above the ground:

$$\theta_{2DMax} = 0.01303\, h_{Eye} + 15.07$$

where

θ_{2DMax} is the 2D Maximum Downward Angle (in degrees), and

h_{Eye} is the height above the ground of the nominal driver eye point (in millimeters).

4. The 3D Maximum Downward Angle is equal to 28.16 degrees for a vehicle with the height of the nominal driver eye point less than or equal to 1146.2 millimeters above the ground.

5. The 3D Maximum Downward Angle is given by the following equation for nominal driver eye point heights greater than 1146.2 millimeters above the ground:

$$\theta_{3DMax} = 57.2958\ \tan^{-1}\left[0.829722\ \tan\left(0.263021 + 0.000227416\, h_{Eye}\right)\right]$$

where

θ_{3DMax} is the 3D Maximum Downward Angle (in degrees), and

h_{Eye} is the height above the ground of the nominal driver eye point (in millimeters).

6. The downward viewing angle of each display is determined in two ways, two dimensionally (the 2D Downward Viewing Angle) and three dimensionally (the 3D Downward Viewing Angle).

7. Determination of 2D Downward Viewing Angle.

a. Coordinate System.

The SAE J670 JAN2008 Vehicle Axis System, denoted by (X_V, Y_V, Z_V) is used. SAE J670 JAN2008 provides two choices for the direction of the Z_V axis, pointing upward (the Z-Up orientation) or pointing downwards (the Z-Down orientation). For this document, the Z-Up orientation is chosen.

The SAE J670 JAN2008 Vehicle Axis System (X_V, Y_V, Z_V) in the Z-Up orientation is an *axis system* fixed in the *reference frame* of the vehicle *sprung mass* such that the X_V axis is substantially horizontal, points forward, and is parallel to the *vehicle plane of symmetry*. The Y_V axis is perpendicular to the *vehicle plane of symmetry* and points to the left. The Z_V axis is perpendicular to both the X_V and Y_V axes and points upward.

b. Create a fore-and-aft plane (Plane FA) through the nominal driver eye point. Determine the (X_{EP}, Y_{EP}, Z_{EP}) coordinates of the nominal driver eye point. Plane FA is parallel to both the X_V and Z_V axes and is perpendicular to the Y_V axis. Since the nominal driver eye point is generally not on the *vehicle plane of symmetry*, Plane FA will normally be offset, either to the left or to the right, from the vehicle reference point shown in Figure 1. All points in Plane FA will have the same Y_V coordinate, Y_{EP}.

c. Define Point B. Point B is the laterally projected position of the geometric center of the display of interest onto Plane FA. Determine the (X_V, Y_V, Z_V) coordinates of the geometric center of the display of interest. Then laterally project (i.e., while maintaining the same X_V and Y_V coordinates) the geometric center of the display of interest onto Plane FA. In other words, if the geometric center of the display of interest has coordinates of (X_{GC}, Y_{GC}, Z_{GC}), then the coordinates of Point B will be (X_{GC}, Y_{EP}, Z_{GC}).

d. Generate two lines in Plane FA, Line 1 and Line 2 as described in paragraphs e. and f., below.

e. Generate Line 1. Line 1 is a horizontal line (i.e., maintaining the same vertical (Z_V) coordinate) in Plane FA going through the nominal driver eye point. Figure 1 shows Plane FA. Line 1 is marked in Figure 1.

f. Generate Line 2. Line 2 is in Plane FA and goes through the nominal driver eye point and Point B. Figure 1 also shows Line 2 in Plane FA. Lines 1 and 2 will intersect at the nominal driver eye point.

g. Determine the 2D Downward Viewing Angle. The 2D Downward Viewing Angle is the angle, measured in Plane FA, from Line 1 to Line 2. Figure 1 also shows the 2D Downward Viewing Angle.

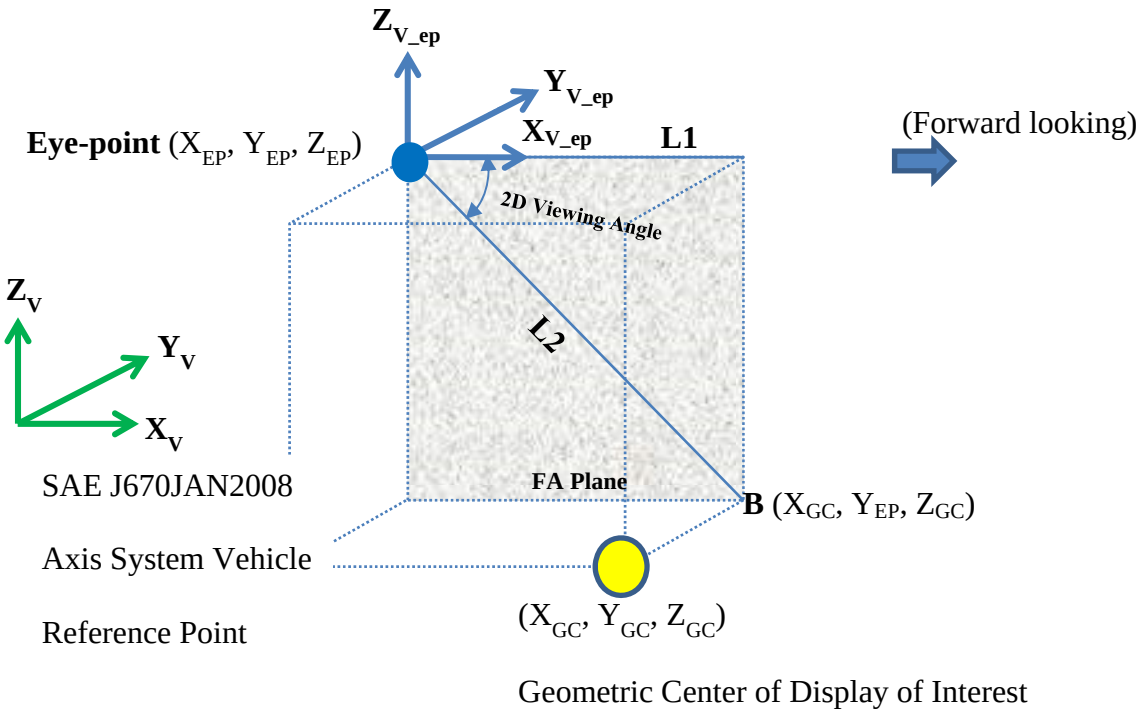

Figure 1. Plane FA Showing Lines 1 and 2 and the 2D Downward Viewing Angle

h. Equations for Calculating the 2D Downward Viewing Angle. The 2D Downward Viewing Angle can be calculated using the equations that follow:

Define the nominal driver eye point to be at coordinates (X_{EP}, Y_{EP}, Z_{EP}). As previously stated, the geometric center of the display of interest has coordinates of (X_{GC}, Y_{GC}, Z_{GC}) and the coordinates of Point B will be (X_{GC}, Y_{EP}, Z_{GC}). The 2D distance in Plane FA between the nominal driver eye point and Point B can be calculated by:

$$d_{2D} = \sqrt{(X_{EP} - X_{GC})^2 + (Z_{EP} - Z_{GC})^2} \qquad \text{(Equation 2)}$$

The 2D Downward Viewing Angle, θ_{2D}, can be calculated by:

$$\theta_{2D} = 57.2958 \sin^{-1}\left(\frac{(Z_{EP} - Z_{GC}}{d_{2D}}\right) \qquad \text{(Equation 3)}$$

Where the above arcsine is calculated in radians and converted to degrees by multiplying by 57.5958 (additional digits of accuracy acceptable if desired).

i. Supplemental Note. The 2D Downward Viewing Angle could be negative (i.e., the geometric center of the display of interest could be above the nominal driver eye point). Therefore, it is not necessarily a downward viewing angle.

8. Determination of 3D Downward Viewing Angle.

Note: This section builds upon the information contained in Subsection V.C.7, "Determination of 2D Downward Viewing Angle."

a. Generate two lines, Line 3 and Line 4. Start by determining the (X_V, Y_V, Z_V) coordinates of both the nominal driver eye point and the geometric center of the display of interest. Lines 3 and 4 are in a vertically-oriented plane, Plane EP-GC, that contains both the nominal driver eye point (at coordinates (X_{EP}, Y_{EP}, Z_{EP})), and the geometric center of the display of interest (at coordinates of (X_{GC}, Y_{GC}, Z_{GC})).

b. Generate Line 3. Line 3 is a horizontal line (i.e., maintaining the same vertical coordinate), in Plane EP-GC, going through the nominal driver eye point and a point vertically above, below, or at (depending upon the values of Y_{EP} and Y_{GC}) the geometric center of the display of interest. Figure 2 illustrates Line 3 in Plane EP-GC.

c. Generate Line 4. Line 4 goes through the nominal driver eye point and the geometric center of the display. It is in Plane EP-GC and intersects with Line 3 at the nominal driver eye point. Figure 2 also illustrates Line 4 in Plane EP-GC.

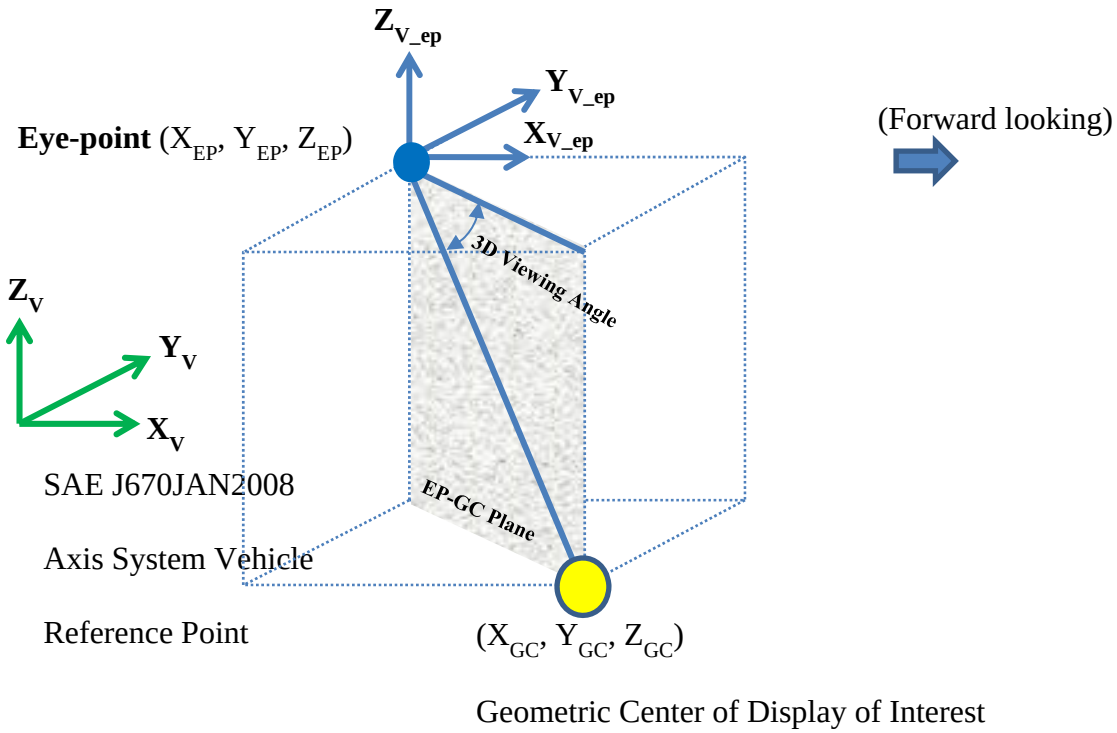

Figure 2. Plane EP-GC Showing Lines 3 and 4 and the

3D Downward Viewing Angle

d. Determine the 3D Downward Viewing Angle. The 3D Downward Viewing Angle is the angle, measured in Plane EP-GC, from Line 3 to Line 4. Figure 2 also shows the 3D Downward Viewing Angle.

e. Equations for Calculating the 3D Downward Viewing Angle. The 3D Downward Viewing Angle can be calculated using the equations that follow:

Define the nominal driver eye point to be at coordinates (X_{EP}, Y_{EP}, Z_{EP}). As previously stated, the geometric center of the display of interest has coordinates of (X_{GC}, Y_{GC}, Z_{GC}). The 3D distance in Plane EP-GC between the

nominal driver eye point and geometric center of the display of interest can be calculated by:

$$\boldsymbol{d_{3D} = \sqrt{(X_{EP} - X_{GC})^2 + (Y_{EP} - Y_{GC})^2 + (Z_{EP} - Z_{GC})^2}} \qquad \text{(Equation 4)}$$

The 3D Downward Viewing Angle, θ_{3D}, can be calculated by:

$$\boldsymbol{\theta_{3D} = 57.2958 \sin^{-1}\left(\frac{(Z_{EP} - Z_{GC})}{d_{3D}}\right)} \qquad \text{(Equation 5)}$$

Where the above arcsine is calculated in radians and converted to degrees by multiplying by 57.5958 (additional digits of accuracy acceptable if desired).

f. Supplemental Note. The 3D Downward Viewing Angle could be negative (i.e., the geometric center of the display of interest could be above the nominal driver eye point). Therefore, it is not necessarily a downward viewing angle.

9. Visual displays that present frequently needed and/or important information during the driving task and/or visually-intensive information should have downward viewing angles that are as close as practicable to a driver's forward line of sight. Visual displays that present less frequently needed or less important information should have lower priority, when it comes to locating them to minimize their downward viewing angles, than displays that present frequently needed and/or used information.

D. Lateral Position of Visual Displays.

Visual displays that present information relevant to the driving task and/or visually-intensive information should be laterally positioned as close as practicable to a driver's forward line of sight.

E. Minimum Size of Displayed Textual Information.

Visually presented text should meet the legibility recommendations contained in ISO International Standard 15008:2003, "Road vehicles – Ergonomic aspects of transport information and control systems – Specifications and compliance procedures for in-vehicle visual presentation."

F. Per Se Lock Outs.

The following electronic device tasks are recommended for per se lock out and should always be inaccessible for performance by the driver while driving:

1. Device functions and tasks not intended to be used by a driver while driving.
2. Manual Text Entry. Manual text entry by the driver for the purpose of text-based messaging, other communication, or internet browsing.

The following electronic device tasks are recommended for per se lock out and should always be a) inaccessible for performance by the driver while driving and b) inaccessible for performance by a passenger if the related display is within view of the driver properly restrained by a seat belt:

3. Displaying Video. Displaying (or permitting the display of) video including, but not limited to, video-based entertainment and video-based communications including video phoning and videoconferencing.

   Exceptions:

   a. The display of video images when presented in accordance with the requirements of any FMVSS.

   b. The display of a video image of the area directly behind a vehicle for the purpose of aiding a driver performing a maneuver in which the vehicle's

transmission is in reverse gear (including parking, trailer hitching), until any of the following conditions occurs:

i. The vehicle reaches a maximum forward speed of 10 mph;

ii After the vehicle has shifted out of reverse, it has traveled a maximum of 10 meters; or

iii. After the vehicle has shifted out of reverse, a maximum of 10 seconds has elapsed.

c. Map displays. The visual presentation of dynamic map and/or location information in a two-dimensional format, with or without perspective, for the purpose of providing navigational information or driving directions when requested by the driver (assuming the presentation of this information conforms to all other recommendations of these Guidelines). However, the display of informational detail not critical to navigation, such as photorealistic images, satellite images, or three-dimensional images is not recommended.

4. Displaying Images. Displaying (or permitting the display of) non-video graphical or photographic images.

Exceptions:

a. Displaying driving-related images including maps (assuming the presentation of this information conforms to all other recommendations of these Guidelines). However, the display of map informational detail not critical to navigation, such as photorealistic images, satellite images, or three-dimensional images is not recommended.

b. Static graphical and photographic images displayed for the purpose of aiding a driver to efficiently make a selection in the context of a non-driving-related task (e.g., music) is acceptable if the image automatically extinguishes from the display upon completion of the task. If appropriate, these images may be presented along with short text descriptions that conform to these Guidelines.

c. Internationally standardized symbols and icons, as well as Trademark™ and Registered® symbols, are not considered static graphical or photographic images.

5. Automatically Scrolling Text. The display of scrolling (either horizontally or vertically) text that is moving at a pace not controlled by the driver.

6. Displaying Text to Be Read. The visual presentation of the following types of non-driving-related task textual information:

- Books
- Periodical publications (including newspapers, magazines, articles)
- Web page content
- Social media content
- Text-based advertising and marketing
- Text-based messages (see definition) and correspondence

However, the visual presentation of limited amounts of other types of text during a testable task is acceptable. The maximum amount of text that should be visually presented during a single testable task is determined by the task acceptance test protocols contained in these Guidelines.

G. Acceptance Test-Based Lock Out of Tasks.

Any non-driving-related task or within-scope (identified as Guidelines Applicable in Table 3 of Section II), driving-related task that diverts a driver's attention from the primary driving task to the point it does not conform with one of the task acceptance methods contained in Section VI, should be locked out while driving.

H. Sound Level.

Devices should not produce sound levels likely to mask warnings either from within or from outside the vehicle, or that cause distraction. The device sound level control should demonstrate its ability to adjust sound levels down to a fully muted level.

I. Single-Handed Operation.

Devices should allow a driver to maintain at least one hand on the vehicle's steering control. All tasks that require manual control inputs (and can be performed with the device while the vehicle is in motion) should be executable by a driver in a way that meets all of the following criteria:

1. When manual device controls are placed in locations other than on the steering control, no more than one hand should be required for manual input to the device at any given time during driving.
2. When device controls are located on the steering wheel and both hands are on the steering wheel, no device tasks should require simultaneous manual inputs from both hands.
3. A driver's reach to the device's controls should allow one hand to remain on the steering control at all times.

4. Reach of the whole hand through steering wheel openings should not be required for operation of any device controls.

J. Interruptibility.

Devices should not require uninterruptible sequences of visual-manual interactions by a driver. A driver should be able to resume an operator-interrupted sequence of visual-manual interactions with a device at the point of interruption or at another logical point in the sequence.

1. Except as stated in Subsection V.J.5, below, no device-initiated loss of partial driver input (either data or command inputs) should occur automatically.
2. Drivers should be able to initiate commands that erase driver inputs.
3. A visual display of previously-entered data or current device state should be provided to remind a driver of where the task was left off.
4. If feasible, necessary, and appropriate, the device should offer to aid a driver in finding the point to resume the input sequence or in determining the next action to be taken. Possible aids include, but are not limited to:
    a. A visually displayed indication of where a driver left off,
    b. A visually displayed indication of input required to complete the task, or
    c. An indication to aid a driver in finding where to resume the task.
5. Devices may revert automatically to a previous or default state without the necessity of further driver input after a device defined time-out period, provided:
    a. It is a low priority device state (one that does not affect safety-related functions or way finding), and

b. The state being left can be reached again with low driver effort. In this context, low driver effort is defined as either a single driver input or not more than four presses of one button.

6. This subsection is not applicable to device output of dynamically changing data. The device should control the display of information related to dynamic events that are not within the driver's direct control (e.g., distance to the next turn).

K. Device Response Time.

1. A device's response (e.g., feedback, confirmation) following driver input should be timely and clearly perceptible.

2. As a "best practice," the maximum device response time to a device input should not exceed 0.25 seconds. The measurement of this time should begin starting at the completion of the driver's control input.

3. If a device's response time exceeds 2.00 seconds, a clearly perceptible indication should be given indicating that the device is responding. Again, the measurement of this time should begin starting at the completion of the driver's control input.

4. The device's response is clearly perceptible if it is obvious to the driver that a change has occurred in the device and that this change is the consequence of the input. If this change in the device resulting from an input is not always the same but depends on one or more previous inputs, it would be advisable to offer help (i.e., provide help if requested by the driver).

L. Disablement.

1. Devices providing non-safety-related information should provide a means by which the device can be turned off or otherwise disabled.

2. Devices providing dynamic (i.e., moving) non-safety-related visual information should provide a means by which that information cannot be seen by the driver. A device visually presenting dynamic non-safety-related information should make the information not visible by the driver through at least one of the following mechanisms:

   a. Dimming the displayed information,

   b. Turning off or blanking the displayed information,

   c. Changing the state of the display so that the dynamic, non-safety-related information cannot be seen by a driver while driving, or

   d. Positioning or moving the display so that the dynamic, non-safety-related information cannot be seen while driving.

M. Distinguish Tasks or Functions Not Intended for Use While Driving.

Devices should clearly distinguish between those aspects of a device that are intended for use by a driver while driving, and those aspects (e.g., specific functions, menus, etc.) that are not intended to be used while driving.

N. Device Status.

Information about current status and any detected malfunction within the device that is likely to have an adverse impact on safety should be presented to the driver.

VI. TASK ACCEPTANCE TESTING.

One of the following methods is recommended for task acceptance testing:

- Eye Glance Measurement Using Driving Simulator Testing (described in Subsection VI.E, below), or
- Occlusion Testing (described in Subsection VI.G, below).

A. Test Participant Recommendations.

1. These Test Participant recommendations apply to both Eye Glance Measurement Using Driving Simulator Testing and Occlusion Testing.

2. General Criteria. Each test participant should meet the following general criteria:

   a. Be in good general health,

   b. Be an active driver with a valid driver's license,

   c. Drive a minimum of 3,000 miles per year,

   d. Have experience using a cell phone while driving,

   e. Be unfamiliar with the device(s) being tested.

3. Test Participant Impartiality. Test participants should be impartial with regard to the testing. To ensure fairness, test participants should not have any direct interest, financial or otherwise, in whether any of the devices being tested meets or does not meet the acceptance criteria.

   a. NHTSA will not use any vehicle manufacturer employees in its Guidelines monitoring testing.

   b. NHTSA considers it acceptable for vehicle manufacturers to test their own employees as long as the employees are unfamiliar with the product being tested.

4. Mix of Ages in Each Test Participant Sample. Out of each group of 24 test participants used for testing a particular in-vehicle device task, there should be:

   a. Six test participants 18 through 24 years old, inclusive,

   b. Six test participants 25 through 39 years old, inclusive,

   c. Six test participants 40 through 54 years old, inclusive, and

d. Six test participants 55 years old or older.

5. Even Mix of Genders in Each Test Participant Sample. Each sample of 24 test participants used for testing a particular in-vehicle device task, should contain:

a. Twelve men and twelve women overall, and

b. An equal balance of men and women in each of the age ranges 18 through 24 years old, 25 through 39 years old, 40 through 54 years old, and 55 years old and older.

B. Test Participant Training Recommendations.

Each test participant should be given training as to how to operate the driving simulator or occlusion apparatus and how to perform each of the desired testable tasks using the electronic devices being evaluated.

1. These Test Participant Training recommendations apply to both Eye Glance Measurement Using Driving Simulator Testing and Occlusion Testing.

2. Test instructions should be standardized and be presented either orally or in writing. The display and controls of the interface should be visible during instruction. An instruction may be repeated at the request of a test participant.

3. Test participants should be given specific detailed instructions and practice as to how to perform each testable task of interest on each device being studied. A test participant should practice a task as many times as needed until they think that they have become comfortable in performing the task.

4. Test participants should practice each testable task on each device of interest first without using the acceptance test apparatus and then using the acceptance test apparatus.

C. Driving Simulator Recommendations.

1. A driving simulator is used for the Eye Glance Measurement Using Driving Simulator Testing option to determine whether driver operation of a device while performing a testable task produces an acceptable level of distraction. At a minimum, the driving simulator used for distraction testing should conform to the following recommendations. However, any driving simulator with better fidelity than recommended below is acceptable for performing task acceptance testing.
2. The driving simulator should be capable of testing using a substantial portion (the entire area that can be reached by a driver) of a full-size vehicle cab. Open cabs, partial cabs, and/or non-production cabs are fine to use for this testing as long as the driving simulator has a seating and dashboard arrangement similar to that of an actual production vehicle so that realistic eye glance behavior and control movements will occur.
3. To set up this portion of a vehicle cab for testing, no modifications should be made to the dashboard or human-machine interface other than:
    a. The addition of sensors to determine steering wheel angle, brake pedal position, throttle pedal position, driver gaze location, and other desired data.
    b. The addition of equipment to provide force feedback on the driving simulator's steering wheel, brake pedal, and throttle pedal. Linear feel steering and pedal feels are adequate.
    c. The addition of equipment to display the forward speed to the driver. This may be accomplished either through use of the vehicle's speedometer or

through a separate display. If forward speed is provided to the driver through a separate display, this display may be mounted:

- On the image display in front of the simulated vehicle, or
- On or above the dashboard.

4. The driving simulator should use information collected by the steering wheel angle, brake pedal position, and throttle pedal position sensors, along with an appropriate vehicle dynamics simulation, to predict vehicle orientation and position, angular and linear velocities, and angular and linear accelerations. A vehicle dynamics model with three degrees of freedom (lateral velocity, longitudinal velocity, and yaw rate) may be used. If more complex and accurate vehicle dynamics are desired, this is fine but not necessary.
5. The driving simulator should determine eye glance locations in one of two ways:
   a. Through the use of an eye tracker, or
   b. By collecting full-motion video data for each test participant's face and, subsequent to testing, a human data reducer determines from the video data the direction of a test participant's gaze at each instant in time.

   Additional details about eye glance characterization are presented below.
6. The driving simulator should generate and display full-color (16 bit minimum color depth), true-perspective, three-dimensional (as viewed by the driver) computer-generated imagery of the forward road scene free from distracting anomalies, such as abrupt changes in scene content, aliasing problems in image processing, and abrupt changes in illumination, color, or intensity (i.e., no flickering or flashing).

7. This computer-generated imagery should be displayed in front of the simulated vehicle. The minimum recommended field-of-view should have a width of at least 30 degrees.
8. The recommended screen resolution should be no greater than 3 arc minutes per pixel.
9. The recommended driver eye point to screen distance should be at least 2.0 meters.
10. The computer generated image should be updated at least 30 times per second.
11. The time lag to calculate the computer generated imagery should not be more than 0.10 second. As a "best practice," lead compensation should be provided to bring the driving simulator display into phase with the driver's perception.
12. The driving simulator should be capable of simulating the driving scenario described below.

D. Recommended Driving Simulator Scenario.

The driving simulator scenario described below is used for the Eye Glance Measurement Using Driving Simulator Testing option.

1. The road being simulated should:
    a. Traverse generally open, flat terrain with occasional trees or buildings,
    b. Be made of asphalt,
    c. Be light gray in color,
    d. Be undivided, four lanes wide, and have at least 1.0 meter (3.3 feet) of paved shoulders on each side of the traffic lanes,
    e. Each lane should be 3.7 meters (12 feet) wide,

f. Have a solid double yellow line down the center of the road,

g. Have solid white lines on the outside edges of the road,

h. Have dashed white lines separating the two lanes that go in the same direction on each side of the road,

i. Be flat (no grade or road crown), and

j. Have a speed limit of 50 mph.

k. Each of the above white and yellow lines on the road should be from approximately 100 mm to approximately 150 mm (4 to 6 inches) wide.

l. For the solid double yellow line, the spacing between the two yellow lines should be from approximately 50 mm to approximately 100 mm (2 to 4 inches) wide.

m. The dashed white lines should each consist of a white/asphalt pattern consisting of approximately a 3 meter (10 foot) white line segment followed by approximately a 9 meter (30 foot) gap of asphalt before the beginning of the next white segment.

n. All test data collection is performed on straight road segments. However, the road being simulated may, if desired, contain occasional curved segments not in the area used for data collection.

2. The lead vehicle should look like a typical, production, passenger vehicle (automobile or light truck) and be of a color that contrasts with the background.

3. The driving scenario should proceed as follows:

a. The subject vehicle begins motionless in the right lane of the road.

b. Test participant accelerates vehicle up to approximately the speed limit.

c. After approximately 360 meters (1,200 feet) of travel, the lead vehicle, which is initially traveling at the speed limit, suddenly appears in the travel lane in front of the subject vehicle at a distance of approximately 70 meters (220 feet).

d. The subject vehicle then follows the lead vehicle for the remainder of the test. This is defined as the car following portion of the test.

e. During the car following portion of the test, the driver of the subject vehicle should try to maintain a following distance of approximately 70 meters (220 feet).

4. All testing is performed while driving in the right lane of the simulated road.

5. A test participant should begin performing testable tasks as soon as feasible after the start of the car following portion of the test.

6. The speed of the lead vehicle should be a constant 50 mph throughout the car following period of the test.

E. Eye Glance Measurement Using Driving Simulator Test Procedure.

1. Test Device. The electronic device under evaluation should be operational and fitted to a vehicle, driving simulator, or vehicle mock-up in a design which duplicates the intended location of the interface in the vehicle (i.e., the viewing angle and control placement relationships should be maintained).

2. Test Participants. Twenty-four test participants should be enrolled using the previously described (Subsection VI.A) criteria.

3. Each test participant should have the driving simulator's controls and displays explained to him or her, and be shown how to adjust the seat.

4. Each test participant should be given instructions on the driving scenario that he or she is to perform. These should include:
    a. That he or she should drive in the right lane, and
    b. That, as a driver, his or her primary responsibility is to drive safely at all times.
5. Each test participant should be told to drive at a speed of 50 mph prior to the beginning of car following. Each test participant should be told that, once in car following mode, he or she should try to follow the lead vehicle at as close to the initial following distance (approximately 70 meters or 220 feet) as he or she can manage.
6. Each test participant should be given training and practice as follows:
    a. How to perform each testable task on each device of interest with the simulated vehicle parked. This training and practice may also be performed in a separate parked vehicle.
    b. How to drive the driving simulator while not performing a testable task.
    c. How to perform each testable task on each device of interest while driving the simulated vehicle on the driving simulator.
7. Each test participant should practice each testable task and simulator driving as many times as needed until he or she become comfortable in performing the task and driving the simulator.
8. Different task stimuli (e.g., addresses, phone numbers, etc.) should be used for each instance of testable task performance for a particular test participant. Task

stimuli should be provided to a test participant immediately prior to the beginning of each instance of testable task performance.

9. Following the completion of training, each test participant should drive the driving scenario one final time while performing a single instance of the testable task being studied (the Data Trial). Eye glance data should be collected during this trial. Data from this performance of the testable task is used to determine whether a task meets the acceptance criteria.

10. Results from individual testable task trials are only removed from analysis if:

- A test participant refuses to complete a trial,
- A test participant says he or she is done with a trial but is not, or
- The experimenter judges that the participant cannot successfully complete a trial.
- The experimenter judges that the participant is not genuinely doing their best to perform the protocol and related tasks as instructed.

When any of the above occurs, it is treated as a task performance error and handled as discussed in Subsection VI.H.

11. There should be a means of determining the exact time of the start and end of each testable task that is performed.

12. Multiple Testable Task Testing. To improve testing efficiency, multiple (different) testable tasks may be performed by the same test participant during one or more drives. There is no limit to the number of testable tasks that may be evaluated by a test participant. However, it should be noted that including multiple tasks in a single session may lead to performance degradation due to test

participant fatigue or confusion. Additionally, to ensure that the testing of each task reflects the demands of that task alone, all instructions, practice and testing for a single task should be completed before beginning a new task.

13. Eye Glance Characterization. Eye glances are determined for each test participant's Data Trials using the techniques described below.

14. Acceptance Criteria. A testable task should be locked out from performance by drivers while driving **unless** the following three criteria are all met:

    a. For at least 21 of the 24 test participants, no more than 15 percent (rounded up to the next whole number) of each participant's total number of eye glances away from the forward road scene have durations of greater than 2.0 seconds while performing the testable task one time.

Table 3: Maximum Allowable Number of Eye Glances Longer Than 2.0 Seconds

Number of Eye Glances Away from the Forward Road Scene Made by an Individual Test Participant in Performing a Task	15% of the Total Number of Eye Glances Away from the Forward Road Scene	Maximum Number of Allowable Off-Road Eye Glances Longer Than 2.0 Seconds
1	0.15	0*
2	0.30	1
3	0.45	1
4	0.60	1
5	0.75	1
6	0.90	1
7	1.05	2
8	1.20	2
9	1.35	2
10	1.50	2
11	1.65	2
12	1.80	2
13	1.95	2
14 through 20	>2.0	3

*Note: See Section VI.E.14.b. If a testable task takes a test participant exactly one glance to perform, that glance must be no longer than 2.0 seconds in order to have a mean duration that does not exceed 2.0 seconds for all eye glances.

b. For at least 21 of the 24 test participants, the mean duration of all eye glances away from the forward road scene is less than or equal to 2.0 seconds while performing the testable task one time.

c. For at least 21 of the 24 test participants, the sum of the durations of each individual participant's eye glances away from the forward road scene is less than or equal to 12.0 seconds while performing the testable task one time.

F. Eye Glance Characterization.

While driving the simulator and performing the testable task, the duration of each test participant's eye glances away from the forward roadway should be recorded and determined.

1. The duration of an individual glance is determined as the time associated with any eye glances away from the forward roadway. Due to the driving scenario, eye glances to the side of the roadway or to the vehicle's mirrors are expected to be minimal.
2. Eye glance durations should be determined in one of two ways:
    a. Through the use of an eye tracker, or
    b. By collecting full-motion video data for each test participant's face and, subsequent to testing, a data reducer determines from the video data the direction of a test participant's gaze at each instant in time.
3. Ensuring Eye Tracker Accuracy and Repeatability. If an eye tracker is used, the testing organization should have a procedure for ensuring the accuracy and repeatability of eye glance durations. This will require collecting relatively short segment(s) of full-motion video data and having a data reducer determine from this video data the duration of a test participant's eye glances. The testing organization should also have a written procedure for setting up and calibrating the eye tracker.
4. Ensuring Full-Motion Video Reduction Accuracy and Repeatability. If full-motion video is used, the testing organization should have a procedure for ensuring the accuracy and repeatability of eye glance durations. This will involve having multiple data reducers analyze the same, relatively short segment(s) of

full-motion video data and checking that they obtained the same glance durations. The testing organization should also have a written procedure for instructing and training data reducers as to how to determine eye glance durations. To the extent possible, data reducers should not have an interest as to whether a testable task or device being tested meets the acceptance criteria. Data reducers should not be closely involved with the development of a device.

G. Occlusion Testing.

1. Test Apparatus. Intermittent viewing of an electronic device interface can be provided by a variety of means such as commercially-available occlusion goggles, a shutter in front of the interface, or other means.
    a. The occlusion apparatus used should be transparent during the viewing interval and opaque during the occlusion interval.
    b. The occlusion apparatus should be electronically controlled.
    c. During the occlusion interval, neither the electronic device interface displays nor the device controls should be visible to a test participant.
    d. During the occlusion interval, operation of the device controls by a test participant should be permitted.
    e. The switching process between the viewing interval and the occlusion interval should occur in less than 20 milliseconds and vice versa.
2. Test Device. The electronic device under evaluation should be operational and fitted to a vehicle, driving simulator, or vehicle mock-up in a design which duplicates the intended location of the interface in the vehicle (i.e., the viewing angle and control placement relationships should be maintained).

3. Test Participants. Twenty-four test participants should be enrolled using the previously described (Subsection VI.A) criteria.

4. Each test participant should be given training and practice as follows:

    a. How to perform each testable task on each device of interest without using the occlusion apparatus.

    b. Become familiar with the occlusion apparatus operation while not performing a testable task.

    c. How to perform each testable task on each device of interest while using the occlusion apparatus.

5. Each test participant should practice each testable task and use of the occlusion apparatus as many times as needed until he or she becomes comfortable in performing the task and using the occlusion apparatus.

6. Different task stimuli (e.g., addresses, phone numbers, etc.) should be used for each instance of testable task performance for a particular test participant. Task stimuli should be provided to a test participant immediately prior to the beginning of each instance of testable task performance.

7. Test Procedure. Testing is performed in accordance with ISO International Standard 16673:2007(E),"Road vehicles – Ergonomic aspects of transport information and control systems – Occlusion method to assess visual demand due to the use of in-vehicle systems" with the following exceptions:

    a. Where the ISO Standard states that at least 10 participants are to be tested, the NHTSA Guidelines recommend that 24 participants be tested.

b. Where the ISO Standard states that each test participant should be given at least two and up to five practice trials for each testable task, the NHTSA Guidelines recommend that each test participant receive as many practice trials as needed to become comfortable in performing the task.

8. The viewing interval (shutter open time) should be 1.5 seconds followed by a 1.5-second occlusion interval (shutter closed time). The sequence of viewing intervals followed by occlusion intervals should occur automatically without interruption until the task is completed or the trial is terminated.

9. Task stimuli (e.g., addresses, phone numbers, etc.) are provided to a test participant prior to the start of testing. When the task stimuli are given to a test participant, the device should be occluded (i.e., a test participant cannot see the device interface) and it should remain occluded until after testing has begun.

11. Testing starts when a test participant informs the experimenter that he or she is ready to begin the trial. The experimenter then triggers the alternating sequence of viewing intervals followed by occlusion intervals.

12. When a test participant has completed the task, he or she verbally instructs the experimenter that the task has been completed with the word, “done” (or other standardized word). The experimenter stops the occlusion apparatus operation.

13. There should be an automatic means of recording the number of unoccluded intervals a test participant needed to complete the task.

14. Each test participant performs each task being tested five times to determine whether that task meets the acceptance criterion.

15. As per ISO 16673:2007, invalid trials are removed. Note that unoccluded total task time is not determined as part of this test procedure. Therefore, the occluded total task time greater than four times the average unoccluded total task time trial exclusion case in ISO 16673:2007 cannot be used. Individual trials are considered invalid and removed if:

- A test participant refuses to complete a trial,
- A test participant says he or she is done with a trial but is not,
- The experimenter judges that the participant cannot successfully complete a trial,
- The experimenter judges that the participant is not genuinely attempting to perform the protocol and related tasks as instructed, or
- A task performance error is made by the test participant. The handling of task performance errors is discussed in Subsection VI.H.

16. As per ISO 16673:2007, the mean Total Shutter Open Time (TSOT) for each test participant is calculated.

17. Acceptance Criterion. A task should be locked out for performance by drivers while driving **unless** the mean TSOT calculated above is 12.0 seconds or less for at least 21 of the 24 test participants.

18. Multiple Testable Task Testing. To improve testing efficiency, multiple (different) testable tasks may be performed by the same test participant during one or more sessions. There is no limit to the number of testable tasks that may be evaluated by a test participant. However, it should be noted that including multiple tasks in a single session may lead to performance degradation due to test

participant fatigue or confusion. Additionally, to ensure that the testing of each task reflects the demands of that task alone, all instructions, practice and testing for a single task should be completed before beginning a new task.

H. Task Performance Errors During Testing.

1. "Error-Free" Performance During Testing. During testing, only data from "error-free" test trials (as defined in section IV.B.5 and IV.B.6) performed by test participants should be used for determining whether a task is suitable for performance while driving.

2. Error means that a test participant has made an incorrect input when performing a requested task during a test trial. An error has occurred if the test participant has to backtrack during performance of the task or delete already entered inputs. If the device can accommodate an incorrect entry without requiring backtracking and extra inputs beyond those necessary to reach the desired end state of the task, then no error is deemed to have occurred.

3. For driving simulator testing, when an error is made, data from that test participant should not be used to determine task acceptability for performance while driving. This data would be retained for the determination as to whether a task was unreasonably difficult. An additional test participant in the correct demographic group should be added. Testing should continue until 24 test participants have completed the task without errors (or until four test participants do not meet the acceptance criteria).

4. For occlusion testing, when an error is made, data from that trial should not be used to compute a test participant's mean TSOT to determine task acceptability

for performance while driving. This data would be retained for the determination as to whether a task was unreasonably difficult. If a test participant makes errors on two or fewer of their five trials, then their average Total Shutter Open Time (TSOT) can still be computed and used to determine task acceptability for performance while driving. If a test participant makes errors on three or more of their five trials, then none of his or her data should be used to determine task acceptability (but all of it retained to determine whether a task was unreasonably difficult). In this situation, an additional test participant in the correct demographic group should be added. Testing should continue until 24 test participants have completed the task with two or less trials with errors (or until four test participants do not meet the acceptance criteria).

5. Unreasonably Difficult Tasks. A record should be kept during testing as to whether one or more errors occurred during each test trial. If errors occur during more than 50 percent of test trials while testing to determine a task's acceptability for performance while driving, then that task is deemed an "unreasonably difficult task" for performance by a driver while driving. Unreasonably difficult tasks are not recommended for performance while driving and should be locked out.

VII. RECOMMENDATIONS FOR PASSENGER OPERATED DEVICES.

These Guidelines primarily are applicable to human-machine interfaces of devices intended for use by a driver. They are applicable to a limited extent to devices intended for use by front seat passengers.

A. Apply if Within Reach or View of Driver.

These Guidelines are applicable to devices that can reasonably be reached and seen by a driver who is properly restrained by a seat belt even if they are intended for use solely by front seat passengers.

B. Not for Rear Seat Devices.

These Guidelines are not applicable to devices that are located solely behind the front seat of the vehicle.

VIII. DRIVER DISTRACTION GUIDELINES INTERPRETATION LETTERS.

NHTSA intends to clarify the meaning of its Guidelines in response to questions that are asked through the issuance of interpretation letters.

A. Guideline Interpretation Letter Procedure.

1. Guidelines interpretation letters will only be issued in response to specific written requests for interpretation of the NHTSA Guidelines.
2. Requests for Guidelines interpretation letters may be submitted to the National Highway Traffic Safety Administration. The mailing address is:

   Chief Counsel
   National Highway Traffic Safety Administration
   1200 New Jersey Ave., S.E.
   Washington, DC 20590

3. Responses will be mailed to requestors, published in the docket, and posted in a designated area on the NHTSA website.