

**SAE Recommended Practice**  
**Navigation and Route Guidance Function Accessibility While Driving**  
**(SAE 2364) January 20, 2000**

## **Introduction**

Navigation and Route Guidance Systems have some functions that can take significantly more time to use than conventional controls and displays such as the headlights, windshield wipers, the speedometer, the fuel gauge, or the radio (Kurokawa, 1990; Green, 1998a, Tijerina, Parmer and Goodman, 1998). Consequently, there are concerns that navigation and route guidance systems could unduly distract drivers from the primary task of driving. Automated route planning provided by such systems is a convenience for drivers and reduces their pre-trip workload. Driving with route guidance may offer some safety benefit, but special care should be taken in the design of these systems to limit the distraction due to the visual demands placed on the driver while the vehicle is in motion.

## **1. Scope**

This Recommended Practice applies to both Original Equipment Manufacturer and aftermarket route-guidance and navigation system functions for passenger vehicles. It establishes a design limit for the total task time for the presentation of visual information and the manual control inputs associated with navigation functions accessible by the driver while the vehicle is in motion. The Recommended Practice does not apply to voice-activated controls or to passenger operation.

## **2. Normative References**

The following Standards and Recommended Practices contain provisions that are referenced in this text and therefore are provisions of SAE J2364. At the time of publication, the editions listed were current. All recommended practices are subject to revision, and parties to agreements based on this section of J2364 are encouraged to investigate the possibility of applying the most recent editions of the standards listed in this section. SAE maintains a list of currently valid standards.

SAE Recommended Practice J287 (1988). Driver Hand Controls Reach, volume 3, SAE.

SAE Recommended Practice J1050 (1994). Describing and Measuring the Driver's Field of View, volume 3, SAE.

## **3. Definitions**

For the purposes of this Recommended practice, the following definitions apply.

**3.1 Navigation System** - A system that identifies the current position of a vehicle on the earth's surface and may provide guidance to a destination. Information that may

be provided includes the road being driven, the location of cross roads, the heading or compass directions, the distance to a destination, and other items.

**3.2 Route Guidance System** - A system that selects a pathway to a user-specified destination. It also provides directions to a destination by indicating the route or routes to take using graphics, text, voice, or other means. Route guidance may be a feature of a navigation system.

**3.3 Control** - A device used to enter information into a vehicle system. While controls may be either manual or voice operated, only manual controls are considered in this recommended practice.

**3.4 Display** - A device which presents information to a driver, typically by visual or auditory means.

**3.5 Driver Interface** - A general term used to describe the means by which a driver interacts with a vehicle or vehicle subsystem. The interface typically includes one or more controls and/or displays, as well as the system's operating logic.

**3.6 Goal** - A system end state sought by a driver. Examples include: obtaining guidance to a particular destination; greater magnification of a map display; determining the location of a point of interest; and canceling route guidance.

**3.7 Task** - A sequence of control operations (i.e., a specific method) leading to a goal at which the driver will normally persist until the goal is reached. Example: Obtaining guidance by entering a street address using the scrolling list method until route guidance is initiated.

**3.8 Total Task Time** - The time to complete a task. (See Section 5.5 for measurement procedure.)

**3.9 Static Total Task Time** - The total task time measured in a stationary vehicle, buck, or mock-up in which a subject is only performing the task of interest. (See Section 5.5 for measurement procedure.)

**3.10 Computationally-Interrupted Task** - A task where the driver must wait 1.5 seconds or more for the driver interface to respond to a driver input in order to complete a task such as when an off-board computer is queried. (See Section 5.5 for measurement procedure.)

**3.11 In Motion** - A vehicle is considered in motion when its speed exceeds the minimum nonzero speed that can be reliably detected by the vehicle sensors.

**3.12 Accessible by the Driver** - A feature is accessible by a driver when: the controls to complete the task are within reach of the unconstrained driver as defined by SAE J287; and the display is visible with head movement as defined by SAE J1050; and the system is operable by the driver.

## 4. Function Accessibility Criterion

Any navigation function that is accessible by the driver while a vehicle is in motion shall have a static total task time of less than 15 seconds<sup>1</sup>.

### 4.1 Background

This Recommended Practice encourages interface designs that do not unduly distract drivers from the primary task of driving. Predictive estimation of crash risk resulting from driver distraction caused by any particular implementation, whether or not it meets the stated performance criterion, is difficult. However, it can be reasonably stated that if drivers are not looking at the road (i.e., looking inside the vehicle to operate a control or read a display), then the probability for a crash is increased (Wierwille, 1995).

Direct measurements of eyes-off-the-road times, i.e., glance time measurements, are typically difficult and very costly to measure. Static total task time provides a useful surrogate of visual distraction since it is easy to measure, and can be readily incorporated early in the product design process.

The criterion of 15 seconds was established because:

- The Subcommittee Experts concluded that a longer static task time could unduly degrade safety (Green 1999a, 1999b, Wierwille, 1995) and
- Most tasks commonly performed with existing devices take less than 15 seconds to complete (such as HVAC adjustments, radio adjustments, and CD/CD changer).

## 5. Compliance Measurement Procedure

The following procedure shall be used to determine compliance with the Function Accessibility Criterion.

**5.1 Set-up.** The system under investigation must be operational and fitted to a vehicle, buck or mock-up in the design intent location.

**5.2 Subjects.** The subjects shall be:

- Licensed drivers not familiar with, or technically knowledgeable about, the system under investigation
- Capable of learning and completing the test procedure, and
- 45 to 65 years of age.

**5.3 Training.** Prior to testing, each subject shall be given a clear explanation of the system operation and the task of interest. Each subject will be given five (5) practice

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<sup>1</sup> The criterion time does not imply that drivers can engage in long glance times, i.e., those exceeding two seconds without degrading their ability to drive safely. Even very brief eyes-off-the-road times can have adverse consequences if the glance corresponds to a critical event in the driving scene such as a lead vehicle braking.

trials prior to testing. Practice for all tasks to be examined shall be completed before beginning the test trials for any single task.

#### **5.4 Test Trials**

Each subject shall be tested individually. The data to be entered for the specific tasks in practice trials shall be different from that in test trials. Coaching is not allowed during test trials. As each task is completed, the subject will be given the next task.

Each task that is desired to be accessible while the vehicle is in motion should be tested. The specific data to be entered for each of the three test trials should be unique but representative of an average level of difficulty for that task.

The database should be representative of what is planned to be offered in production.

#### **5.5 Task Timing**

**Start:** The timing of a task starts when the driver's hand begins to move to a control (typically, when the hand leaves from the steering wheel) until the goal has been achieved.

**Duration:** Tasks are timed from beginning to end without interruption, including error times, except for computationally interrupted tasks. The initial screen for the task of interest is the starting point, such as the main menu or main screen.

**End:** Timing ends with system confirmation that the last operation is accepted.

The mean time of three trials determines whether or not the criterion has been exceeded.

**Calculation of static total task time:** For each subject compute the mean time of the three trials for each task. Determine whether or not the mean time meets the 15 second criterion.

The time assigned to the total due to the computational interruption is determined as follows:

- (1) If the computational interruption is less than 1.5 seconds, then entire computational interruption is included in the task time;
- (2) If the computational interruption is greater than or equal to 1.5 seconds, without feedback indicating the computational interruption and estimated completion, then the entire computational interruption will be included in the task time; or
- (3) If the computational interruption is greater than or equal to 1.5 seconds with feedback indicating a computational interruption and estimated completion, then only 1.5 seconds of the delay is included in the total task time.

#### **5.6 Verification Requirements.**

The verification procedure requires 5 to 10 subjects as described below (Table 1).

- If five of the first five subjects all have mean static total task completion times that meet the criterion, then that function complies with the Recommended Practice.
- If six of the first seven subjects have mean static total task completion times that meet the criterion, then that function complies with the Recommended Practice
- If eight of ten subjects have mean static total task completion times that meet the criteria that function complies with the Recommended Practice.

- If at any point three subjects have mean static total task completion times that do not meet the criterion and that function does not comply with the Recommended Practice and should not be accessible while driving.

Table 1. Verification Requirements

<b>Number of Subjects Meeting Criterion</b>	Accept	Reject
5 of 5	<b>X</b>	
6 of 7	<b>X</b>	
8 of 10	<b>X</b>	
<b>Number of Subjects Not Meeting Criterion</b>		
3		<b>X</b>

### 5.7 Alternative Procedures

This Recommended Practice provides a means to estimate visual demand at any stage of product development by using total static task time as a surrogate measure. The static test conditions prescribed herein involve a driver's full visual attention to the in-vehicle device, with no scanning, divided attention, or time-sharing. As a predictive tool the results of applying this Recommended Practice could be validated by dynamic procedures that directly measure visual behavior and driver control. This would help ensure that the best designs are realized in navigation interfaces. Because this static test procedure is limited in scope, an alternative procedure that considers the time-sharing conditions of over-the-road driving could be useful, also. When a dynamic practice is developed and published by SAE, product designers should consider it as an alternative in their design process.

## 6. References

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