TECHNICAL SPECIFICATION

ISO/TS 15007-2

Second edition
2014-09-01

Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems —

Part 2: Equipment and procedures

Véhicules routiers — Mesurage du comportement visuel du conducteur en relation avec les systèmes de contrôle et d'information sur le transport —
Partie 2: Équipement et procédures

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

This second edition of ISO/TS 15007-2 cancels and replaces the first edition (ISO/TS 15007-2:2001), which has been technically revised.

ISO/TS 15007 consists of the following parts, under the general title *Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems*:

— *Part 1: Definitions and parameters*

— *Part 2: Equipment and procedures* [Technical Specification]

Introduction

This Technical Specification supports ISO 15007-1, which defines key terms and parameters for the assessment of the visual impact on driver visual behaviour of TICS (Traffic Information Control Systems), and other vehicle tasks or on-board systems.

ISO/TS 15007-2 supports ISO 15007-1 by giving guidance on equipment and procedures that can be used in a practical TICS evaluation, with recommendations on how to interpret selected metrics (standards of measurement) of visual behaviour.

Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems —

Part 2:
Equipment and procedures

1 Scope

This Technical Specification gives guidelines on equipment and procedures for analysing driver visual behaviour, intended to enable assessors of transport information and control systems (TICS) to

— plan evaluation trials;

— specify (and install) data capture equipment, and;

— validate, analyse, interpret and report visual-behaviour metrics (standards of measurement).

It is applicable to both road trials and simulated driving environments.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15007-1, *Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems — Part 1: Definitions and parameters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15007-1 apply.

4 Evaluation and trial planning

4.1 Subject selection

Evaluation trials of TICS applications should use a representative sample from the target population for the specific TICS. This driver sample should be categorized by age, gender, visual ability (including colour vision deficiencies, as well as whether and what type of corrective lenses are required to drive) and driving experience.

4.2 Trial procedures

4.2.1 General

Assessment of driver visual demand can be carried out in relation to many forms of TICS applications and road environments. Therefore, consideration should be given to the following factors influencing driver visual behaviour.

4.2.2 Roadway/traffic specification

An appropriate operational environment for the specific TICS application under evaluation should be chosen. The type of roadway and likely traffic conditions to be encountered should be defined within the trial (or study). This may entail defining and documenting the roadway geometry, signals, and surroundings – as well as describing the driving scenarios that participant will experience (including speeds of travel, manoeuvres, traffic densities, movement of traffic, and so forth).

4.2.3 Vehicle specification

Experimental apparatus used to represent the driving task should be described as fully as practicable.

EXAMPLE Document the make and model of the road vehicle employed or the driving simulator characteristics employed (including key parameters of the vehicle dynamics model, whether the simulator has a fixed- or moving-base, the breadth of its field of view, etc.).

4.2.4 TICS specification

The characteristics of the TICS should be reported.

EXAMPLE Type, position and image quality of a visual display (resolution, contrast, colour-rendition, reflectivity/glare).

4.2.5 Subject training

Trial objectives will determine the need for subject training in the use of the TICS. Assuming that some form of training is required, subjects should receive clear and consistent guidance. The tasks and subtasks associated with the TICS should be fully explained to the subject and the limitations of responsibility and pacing of these between the driver and experimenter should be specified. Each subject's familiarity with the TICS prior to the trial should be reported. When determining the usability of the TICS device, consideration should be given to the level and assessment of training required.

4.2.6 Data exclusion

Control procedures for individual evaluation trials within an experimental programme should include guidelines for the conditions under which the trial is to be terminated.

EXAMPLE Trial aborted for failure to complete a task or subtask: document how this is to be recorded or how the trial is to be re-scheduled.

4.2.7 Experimental conditions, tasks, subtasks, sub-subtasks, and relationship

4.2.7.1 Experimental condition

This is considered to encompass all visual behaviour of the driver during an experimental session.

EXAMPLE The distributions of visual scanning to all specified areas of interest of the visual scene (including the TICS), from the specified start of a test route to its specified end.

Researchers will need the flexibility to define experimental conditions that are relevant for their research goals. However, when studies involve examining glance patterns for secondary tasks while driving, the following experimental conditions may be useful for planning and for performing the research. The following terms are introduced because they define intervals of time and behaviour that may be of particular interest when evaluating a TICS – and, hence, in analysing the glance data associated with a TICS.

4.2.7.2 Task

refers to a sequence of interactions undertaken to achieve a goal glance behaviour may be measured over the duration of a task.

EXAMPLE All visual behaviour occurring during the task of entering a destination into a route guidance system.

4.2.7.3 Subtask

A sequence of interactions undertaken to achieve a sub goal of the task (often one specific interaction). Glance behaviour may be measured over this (shorter) duration of the subtask.

EXAMPLE When entering a destination into the route guidance system, all visual behaviour associated with entering the "city name" portion of the destination.

4.2.7.4 Sub-Subtask

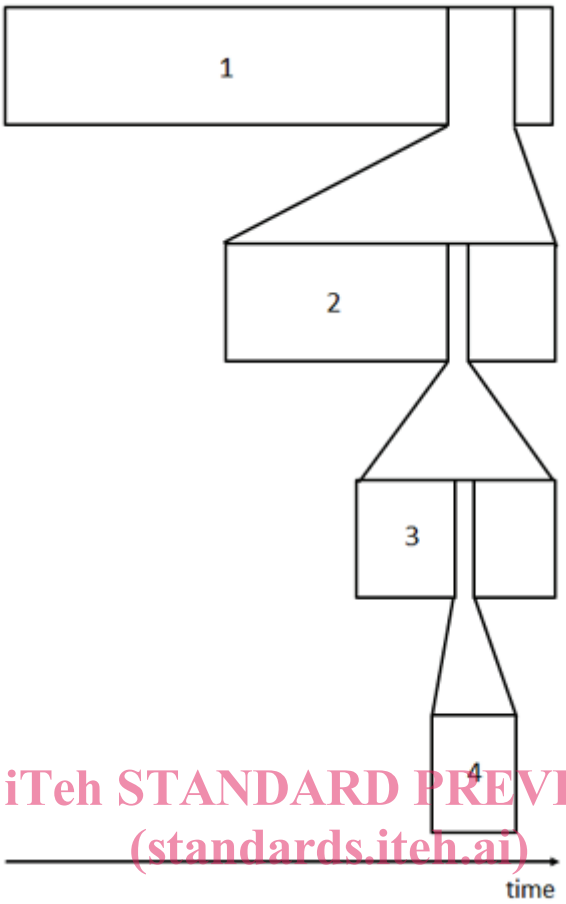
Operations or interactions with lower-level subtask elements (e.g. individual controls or screens).

EXAMPLE On the route guidance system, glance behaviour associated with the sub-subtask of "verify the city name appeared" on destination entry screen.

4.2.7.5 Relationship

The relationship between an experimental condition, a task, a subtask and a lower level subtask element is graphically represented in Figure 1.

Annotation: Users of this standard may wish to consult references on hierarchical task analysis for guidance on how to decompose a task (e.g. see Reference [4]).



Key

1 experimental condition
2 task
3 subtask
4 sub-subtask

Figure 1 — Experimental condition, task and subtask — Relationship

5 Recording equipment

5.1 General

The following gives practical advice on the use of data recording equipment to monitor driver visual demand.

5.2 Eye-Tracking equipment

In general, there are two different methodologies for recording eye-tracking data:

— Head-mounted eye-tracking systems.

— Remote eye-tracking systems.

5.2.1 Head-mounted eye-tracking systems

With head-mounted eye-tracking systems, the subject wears components of the eye-tracking system directly on the head. The components necessary for the eye-tracking are mounted on a helmet, a cap or on a device similar to glasses. Head-mounted eye-trackers may consist of the following components:

— Scene camera: this camera records what the subject can see.

— Eye camera: this camera records at least one eye.

NOTE 1 The eye can be recorded directly or via an infrared (IR) reflective mirror.

NOTE 2 Calibration of eye camera to scene camera is necessary to transform the x- and y-coordinates from the eye camera coordinate system to the scene camera coordinate system. Thereby the head-mounted eye-tracking system is able to indicate in the scene camera view where the subject is looking.

— Infrared LED: the infrared LED typically makes the eye visible in the infrared spectrum. Thereby the system becomes more independent and robust from the surrounding lighting conditions.

5.2.2 Remote eye-tracking systems

With remote eye-tracking systems the glance behaviour is recorded by at least one camera mounted in some location that can record the driver's eyes, such as the dashboard.

Remote eye-trackers (and/or image recording systems) may consist of the following components:

— Eye camera: at least one camera is directed to the drivers face to capture where the subject is looking

— Scene camera: the scene camera records the road scene ahead.

NOTE 1 Calibration of eye-camera to scene-camera is necessary to transform the x- and y-coordinates from the eye-camera coordinate system to the scene-camera coordinate system. Thereby the remote eye-tracking system is able to indicate in the scene-camera view where the subject is looking.

— Infrared LED: the infrared LED typically makes the eye visible in the infrared spectrum. As a result, the system becomes more independent and robust from the surrounding lighting conditions.

NOTE 2 Remote systems include conventional methods of capturing glance behaviour on video.

5.2.3 Additional components

The following additional components are typically required:

— Computer unit for storage and control

— Eye-tracking software: the eye-tracking software records, processes and stores the data

5.3 Additional recording equipment

5.3.1 Cameras

Additional cameras should be used for capturing the road scene ahead and in-vehicle activities. These cameras should be as small and unobtrusive as is practicable. All recorded videos and the recorded eye-tracking data should be synchronized using a single time code (as well as documentation of degree of accuracy obtained), preferably the same time code from the eye-tracking equipment. If an experiment includes acquisition of other types of data such as driving performance data consideration should be given to applying the same time code or synchronization of eye-tracking, videos and any remaining data.

