INTERNATIONAL STANDARD

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

Part 1: Definitions and parameters

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

Partie 1: Définitions et paramètres

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 15007 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15007-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

ISO 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 procedure*

Annex A of this part of ISO 15007 is for information only.

Introduction

Vision provides the primary source of information available to a driver. Information is gathered by looking at objects and events and this in turn affords control and navigation of the vehicle in the road traffic environment. Assessment of a driver's visual behaviour provides a method of quantifying the driver's visual allocation to the roadway or in-vehicle information sources.

Transport Information and Control Systems (TICS) applications for vehicles may have visual displays that can present a range of driver-selected information. If these visual displays have associated controls (e.g. to select a zoom level or menu option) then these associated hand-control activities may also be visually guided and become part of the visual behaviour associated with a display/TICS application. For this reason it may be important to consider not only the visual behaviour in relation to information display, but also the duration and frequency of glances following driver control actions.

Comparisons between separate evaluations of specific vehicle systems in different environments have been made more difficult by dissimilar approaches in experimental technique and analysis methods.

ISO 15007 has been developed to give guidance on the terms and measurements relating to the collection and analysis of driver visual behaviour data. This approach aims to assess how drivers respond to vehicle design, the road environment, or other driver-related tasks in both real and simulated road conditions. It is based on the assumption that efficient processing of visual information is essential to the performance of the driving task.

Practical assessments of drivers in real or simulated environments are conducted to quantify the allocation of visual behaviour to specified targets. It may be quantified by the location, duration and frequency of glances to a specified target in the visual scene. This approach often uses commonly available video-recording equipment. However, it does not preclude the use of more sophisticated technologies which may elicit additional driver visual behaviour information.

Results from such assessments should enable comparison of the relative influence of the TICS use with reference conditions.

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

Part 1: Definitions and parameters

1 Scope

This part of ISO 15007 defines key terms and parameters applied in the analysis of driver visual behaviour. It can be applied in environments from real-world trials to laboratory-based driving simulator studies.

Minimum requirements for reporting the results of Transport Information and Control Systems (TICS) evaluations are provided.

The procedures described in this part of ISO 15007 could also apply to more general assessments of driver visual behaviour without the introduction of TICS specific systems. The parameters and definitions described below are intended to assist development of a common source of reference for driver visual behaviour data.

Due to the limitation of visual behaviour measurement techniques, e.g. related to the effects of accommodation and adaptation of the eyes, this part of ISO 15007 does not apply to the evaluation of head-up displays.

Further guidance including the specification of analysis methodologies and results presentation for visual behaviour analysis is available in other ISO publications. Data collated and analysed in this way allow comparisons to be performed across different TICS applications and experimental scenarios.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15007. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 15007 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2854, *Statistical interpretation of data — Techniques of estimation and tests relating to means and variances*

ISO 13425, *Guide for the selection of statistical methods in standardization and specification*

ISO 15007-2, *Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems — Part 2: Equipment and procedures*

3 Terms and definitions

For the purposes of this part of ISO 15007 the following terms and definitions apply.

3.1
accommodation
adjustment of the lens of the eye to bring about focusing of an image of an object upon the retina

3.2
adaptation
ability of the eye to adjust to changing light conditions

3.3
direction of gaze
target to which the eyes are directed

3.4
duration of diversion
period of glance duration(s) associated with directions of gaze away from one target to another target during a defined period of interest

See A.4.

3.5
dwell time
sum of consecutive individual fixation and saccade times to a target in a single glance

See A.3.

3.6
fixation
alignment of the eyes so that the image of the fixated target falls on the fovea for a given time period

3.7
glance duration
time from the moment at which the direction of gaze moves towards a target (e.g., the interior mirror) to the moment it moves away from it

See A.2.

3.8
glance frequency
number of glances to a target within a pre-defined time period, or during a pre-defined task, where each glance is separated by at least one glance to a different target

3.9
glance location probability
probability that the eyes are fixated at a given target (location) during a sample interval

NOTE This would be defined as the number of glances to target A divided by the number of glances to all targets in the sample.

3.10
link value probability
probability of a glance transition between two different locations

NOTE Operationally, the link value probability between, e.g. target locations A and B, is defined as the number of glance transitions from A to B plus the number of glance transitions from B to A; this sum is divided by the total number of glance transitions between all pairs of locations in the sample interval.

3.11
saccade
brief movement of the eyes between fixations

3.12
sample interval
reference time period that constitutes a sample of interest (e.g. an in-vehicle task) in the data

NOTE Usually, this will be the time associated with a reference event.

3.13
scan duration
time interval consisting of two or more glances that are linked in a consecutive set of fixations to targets in the visual scene

3.14
target
pre-determined area within the visual scene, e.g., a rear-view mirror

3.15
transition
change in eye fixation location from one defined target location to a different location

3.16
transition time
duration between the end of the last fixation on a target and the start of the first fixation on another target

3.17
visual angle
angle subtended at the eye by a viewed object or separation between viewed objects

3.18
visual demand
degree of visual activity required to extract information from an object to perform a specific task

See A.1.

3.19
visual display
device used to present visual information

4 Data collection and analysis

4.1 Guidance on the collection and analysis of driver visual behaviour data is provided in ISO 15007-2.

4.2 Further guidance on the categorization and interpretation of experimental data is given in annex A.

4.3 For statistical interpretation of data, ISO 2854 and ISO 13245 should be taken into account.

5 Data presentation

5.1 To enable consistent recording of comparable data on TICS evaluation, common summary information shall be reported. Results from evaluation trials shall include the following parameters per sample interval for each target, experimental condition, subject and a summary for all subjects.

a) glance frequency (mean, standard deviation and total frequency);

b) glance duration (mean, standard deviation and total duration);

c) percentage time (mean, standard deviation and total percentage time);

d) measurement type.

5.2 Where possible, results from evaluation trials shall also include the following measurements for each target, experimental condition, subject and a summary for all subjects:

a) range;

b) 10th and 90th percentiles;

c) percentage of extended duration glances (e.g., glances over 2 seconds).

5.3 Any exclusion of data recorded from a trial, such as static vehicle occurrences or uncontrolled subject reactions, shall be defined and reported to ensure a consistent interpretation of results.

Annex A
(informative)

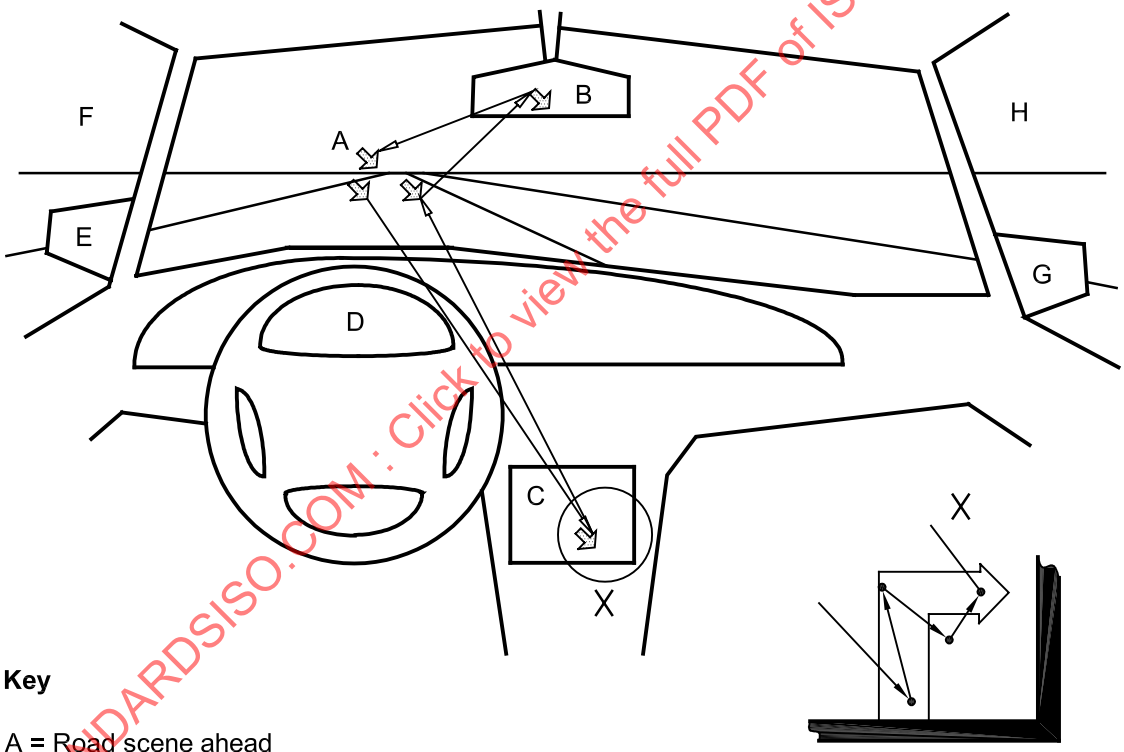
Supporting information for the interpretation of driver visual behaviour

A.1 Visual behaviour in the vehicle

This is a function of the complexity of the information being presented, and the difficulty of extracting that information from the surrounding visual environment (e.g., the duration and/or frequency of glances required).

Various parameters may be calculated from the distribution of the driver's eye movements around the specified targets the visual scene. The visual demand associated with specific targets may be inferred from the various parameters that can be calculated from this data.

Driver visual behaviour typically consists of a series of fixations and saccades within a pre-determined target followed by a transition to another target, see Figure A.1.



Key

A = Road scene ahead
B = Interior mirror
C = TICS display
D = Instrument panel
E = Driver side mirror
F = Driver side window
G = Passenger side mirror
H = Passenger side window
◄— = Transition time
⇘ = Dwell time
◄— = Saccade
• = Fixation

NOTE This figure applies to left-hand drive vehicles.

Figure A.1 — Pre-defined targets and an illustration of example driver fixation and saccadic movements within a target (C)

A.2 Glance duration

A single glance duration may also be simply referred to as a glance. It should be noted that glance duration includes the transition time to a target and the dwell time on that target. There may also be some accommodation of the eyes during the transition time, see Figure A.2.

Glance duration = Transition time + Dwell time

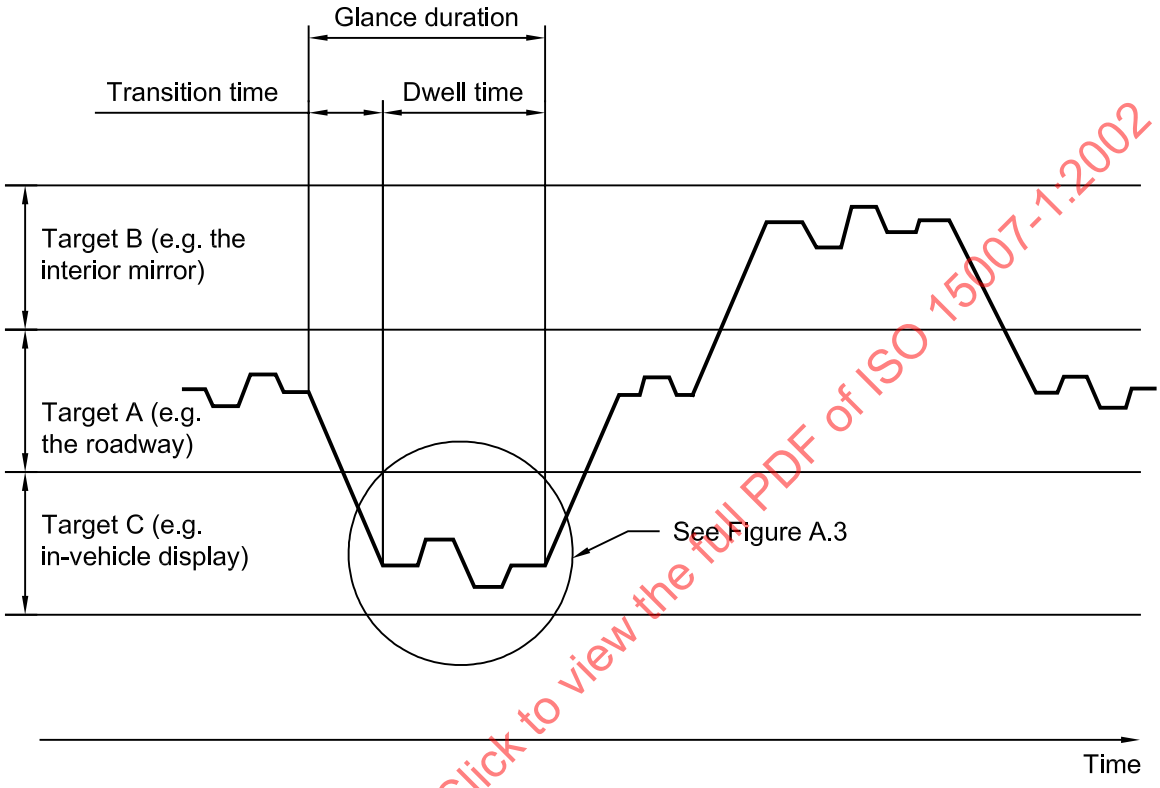


Figure A.2 — Chronological relationship of driver visual allocation between target regions

A.3 Dwell time

This is measured as the time period from when a driver first fixates on a target until the eyes shift to a different target. See Figure A.3.

Dwell time = F1 + S1 + F2 + S2 + ... Fn + Sn

where:

F = fixation

S = saccade

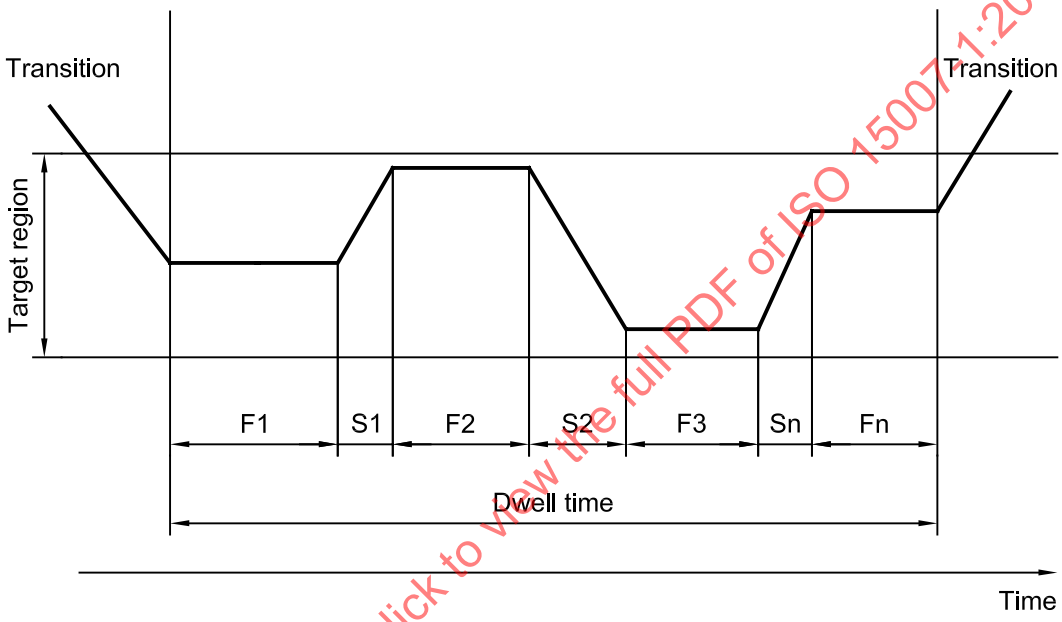


Figure A.3 — Chronological relationship between fixations and saccades during dwell time to one target