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Road vehicles — Ergonomic aspects of transport information and control systems — Calibration tasks for methods which assess driver demand due to the use of in-vehicle systems

Véhicules routiers — Aspects ergonomiques des systèmes d'information et de contrôle du transport — Tâches de calibration pour méthodes qui évaluent la distraction du conducteur due à l'utilisation des systèmes embarqués

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Foreword

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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.

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— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

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An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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

ISO/TS 14198 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

Introduction

The number of standardized methods to assess driver attentional demand due to the use of in-vehicle information and communication devices is continuing to increase. In applying these methodologies, it is important to understand and document variability in participants' performance of standard calibration tasks and procedures across laboratories and/or time.

A suitable calibration task should have the following attributes:

— It should be robust against the variations in cultural background of participants.

— Properly applied, the task should give repeatable quantitative results. It should be sensitive to inappropriate variations in participants, equipment, location, experimenter and instruction.

— It should use durable and readily available equipment for conducting the task

— It should apply to the driver population and be usable in a driving-like context.

A standardized calibration task can be used to produce a range of statistically stable, repeatable and comparable secondary task demands for a participant in an experimental setting. This setting can be used to assess the effect on driving performance of the attentional demand due to driver interaction with an information, entertainment, and control or communication system while a vehicle is in motion.

Different calibration tasks are specified in this Technical Specification to cover calibration manual and visual aspects of various secondary task characteristics.

Road vehicles — Ergonomic aspects of transport information and control systems — Calibration tasks for methods which assess driver demand due to the use of in-vehicle systems

1 Scope

This Technical Specification provides procedures that can be used as a secondary task in a dual task setting to determine whether that evaluation setting is standardized and valid for purposes of assessing driver attentional demand due to the use of an in-vehicle system. This Technical Specification does not define calibration procedures for other evaluation activities that a laboratory might undertake.

This Technical Specification provides advice on the selection of an appropriate candidate calibration task, given an attentional demand evaluation procedure that uses primary driving-like task settings and procedures which are defined outside of this Technical Specification.

The description of a calibration task includes its application, experimental set-up, data collection, and procedures for analysis of results.

The purpose of this Technical Specification is not to define a reference criterion as to whether a given secondary task is suitable for use while driving. Although specific settings of parameters of a calibration task might be used to realize such a predefined pass/fail criterion, this Technical Specification does not provide such a criterion for a given level of attentional demand.

2 Normative references

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

ISO 15008, *Road vehicles — Ergonomic aspects of transport information and control systems — Specifications and test procedures for in-vehicle visual presentation*

ISO 26022, *Road vehicles — Ergonomic aspects of transport information and control systems — Simulated lane change test to assess in-vehicle secondary task demand*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
calibration task
type of reference task used for the purpose of comparing different tests or test results between sites, or over time at a given site

3.2
criterion
threshold or value of a variable to be met

3.3
demand
total visual, auditory, cognitive, or physical resources required of the driver to accomplish the primary driving task and interact with a Transport Information and Control System (TICS) in a dual task setting

3.4
dual task
two tasks concurrently performed, typically the primary driving task plus the secondary task

3.5
environment
physical surroundings in which data are captured and collected, consequently, the level of control over the independent variables in a study

EXAMPLE Laboratory, simulator, test track, real road.

3.6
evaluation
procedure in which the effect of a Transport Information and Control System (TICS) or other device is assessed

NOTE 1 It may be undertaken retrospectively after the TICS has been in use for a considerable time as a product.

NOTE 2 The results of the evaluation will depend on the HMI, but also on the equipment reliability and subsequent behavioural changes which may affect driving performance.

3.7
method
high-level approach to an assessment, based on theory and principles, which implies an underlying rationale in the choice of assessment techniques

EXAMPLE Behaviour analysis, workload assessment, and analysis of psycho physiological responses.

3.8
metric
quantitative measure of driver behaviour independent of the tool used to measure it

EXAMPLE Eye glance duration and vehicle speed.

3.9
performance
result of skill application demonstrated by a participant in performing a driving task or Transport Information and Control System (TICS) related task

3.10
primary driving-like task
primary task in a dual task setting that simulates or approximates a primary driving task

NOTE The Lane Change Task in ISO 26022 is one example.

3.11
primary driving task
activities that the driver must undertake while driving including navigating, path following, manoeuvring, avoiding obstacles, and controlling speed; and which a participant may perform through the duration of a test (simulated substitute for driving)

3.12
secondary task
non-driving related additional task

NOTE A calibration task for the purpose of this Technical Specification.

3.13
secondary task demand
sum of visual, auditory, cognitive, motor, and speech resource demands required by a non-driving related task

3.14
system paced secondary task
activity in which the change from the current to the next state in the interaction between user and system is initiated by the system

NOTE The pace can be fixed or variable.

3.15
target bar
moving line on the critical tracking task display which indicates the task error

3.16
task
process of achieving a specific and measureable goal using a prescribed method

3.17
user paced secondary task
activity in which the change from the current to the next state in the interaction between user and system is initiated by the user

4 Abbreviated terms

CI	Confidence Interval
CTT	Critical Tracking Task
LCT	Lane Change Test
MDEV	Mean Deviation (According to ISO 26022)
SURT	Surrogate Reference Task
TICS	Transport Information and Control System (A list of TICS fundamental services has been defined by ISO/TC204/WG1)

5 Calibration tasks

5.1 Principle and overview

For calibration purposes, a standardized calibration task shall be used as a secondary task in a dual task setting in combination with a method to assess attentional demand due to the use of an in-vehicle system. The dual task setting shall include a primary driving-like task (primary task) and the secondary calibration task.

Examples for driving-like dual task settings may include the operation of a TICS secondary task in the Lane Change Test or in a driving simulator environment.

The calibration shall be performed in a setting that is intended for the assessment of secondary tasks and follow the training and experimental procedures of that method for assessing attentional demand.

To date, development of the calibration tasks and associated procedures have used the ISO 26022, Lane Change Test (LCT) to represent the primary task. While the calibration tasks described herein are intended to be applicable to other primary driving-like task implementations and dual task settings, care must be taken to ensure that the conditions are sufficiently similar to those of ISO 26022 considering equipment and instructions to ensure a valid application of this specification and its procedures.

5.2 Types of calibration tasks

There are various possibilities to realize a calibration task. In the following subclauses, two example alternatives are specified in detail. These alternatives include a system-paced secondary task (critical tracking task) as well as a user-paced secondary task (surrogate reference task). Both alternatives represent visual-manual tasks that can be used in a dual task setting and are recommended as calibration tasks.

5.3 Critical Tracking Task (CTT)

5.3.1 Description

The CTT is a visual-manual task, which requires continuous control activity by the participant.

The participant controls the position of a vertically moving target bar with respect to a fiducial line (centreline) within a target area by manipulating up and down arrow keys. The arrow key control gives discrete commands to the target bar which moves it up and down. The up key moves the target bar up, and the down key moves it down.

The dynamics of the motion of the target bar are a first order instability. If the participant does nothing, the target bar moves (divergently) towards the edge of the display. The participant then has to make suitable corrective arrow key inputs to bring the target bar back towards the centre (the red dashed line in Figure 2).

A control system block diagram of the CTT is shown in Figure 1.

5.3.2 Operation of the CTT

When the program is first started, the screen will look like Figure 2. Nothing will happen initially. The centreline is displayed as a red dashed horizontal line in the centre of the display. The target bar is displayed as a black line. The target bar will start to move away from the centreline showing an increasing error. Two short blue reference lines are shown above and below the centre to subdivide the screen for better orientation. The instruction to the participant is to control the position of the target bar with the arrow keys (arrow up key and arrow down key) and keep it as close to the centreline as possible so as to minimize the errors.

5.3.3 Setup for CTT

The setup consists of a 19 inch (483 mm) screen with SVGA resolution plus keyboard. The subtended vision angle (width) of the display area relative to participant's eyes shall be 13±1 degrees horizontally. The width to height ratio of display area shall be 4:3. The centre of the secondary display shall be positioned 28±2 degrees horizontally (right or left depending on the intended display position in the vehicle, LHD or RHD) and 20±2 degrees vertically from participant's straight ahead line of sight. For further details see Annex A.

To control the target bar movement, the arrow key of a standard PC keyboard (or an equivalent arrangement of keys, for example Figure 4) shall be used. Participants are allowed to place the keyboard in a comfortable position on the same side of the steering wheel as the CTT display on a table or console aside but not connected to their body.

5.3.4 Test conditions for CTT

The test in the dual task setting shall include one specified level of lambda, 0.5, the CTT easy condition. The lambda level has to be set prior to each run and kept constant during the run. In each run the primary task and the CTT task are to be performed for at least 2 min.

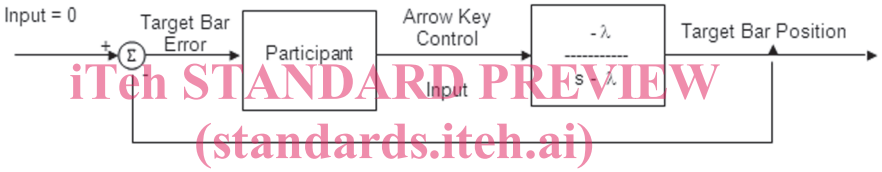
5.3.5 Participants for CTT

The CTT as a calibration task shall be performed in a dual task setting by at least 16 [n = 16] participants who are licensed drivers. Participants should be familiar with the primary task as well as operation of the CTT. The level of participant familiarity shall be documented in the protocol. In the case of calibration using an LCT setting it is recommended to select the participants according to the ISO 26022 LCT standard, and following the sample description regarding age, gender and familiarity with primary and secondary task in Bengler, K., Mattes, S., Hamm, O., Hensel, M., 2010 [1]. Typically, this was an average age of 32 to 45, gender balanced, and instructed and practiced in both the primary and secondary tasks.

5.3.6 Participant instruction of CTT

The following verbal/written instructions for CTT shall be given to the participant:

"A horizontal black target bar is displayed on the secondary task screen. There is also a red dashed horizontal line in the centre of the screen. When the task is started, the black target bar will tend to move away from the red centreline. The motion of the black target bar can be controlled by the arrow-up- and arrow-down keys in order to bring the target bar back to the centre. These keys give discrete commands to the target. (The down arrow key moves the target bar down; the up arrow key moves the target bar up.) The goal is to control the motion of the black target bar to keep it as close as possible to the red dashed centre line."



Key

λ level of instability or rate of divergence (adjustable)

s Laplace transform variable

Figure 1 — Control system block diagram of the CTT

The lambda level is set to a fixed value at the beginning of a run and defines the secondary task difficulty.