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Road vehicles — Ergonomic aspects of transport information and control systems — Dialogue management principles and compliance procedures

Véhicules routiers — Aspects ergonomiques des systèmes de commande et d'information du transport — Principes de gestion du dialogue et essais de conformité

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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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15005 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

Introduction

This International Standard deals with the ergonomic design of transport information and control systems (TICS) and provides general ergonomic principles for their dialogues, independent of any specific dialogue techniques.

The utmost care needs to be taken in the design and installation of TICS equipment in order to ensure that it does not impair the driver's safe control of the vehicle. This is in recognition of the fact that the driving environment has variable conditions, such as road surface, visibility, weather, ambient lighting and traffic conditions.

Dialogue management principles for TICSs are characterized by the need to take into account the following:

— TICSs are intended for use in a moving vehicle;

— TICSs help functions need to be appropriate to a moving vehicle;

— TICS dialogues take place in a constantly changing vehicle environment;

— TICS technologies need to be suited to that environment;

— TICS dialogues include the driver's vehicle-control actions in response to the TICS.

The driver of a vehicle equipped with a TICS device is responsible for the safety of the vehicle, its occupants and other road users. A dialogue therefore needs to take into account the driver workload as a whole, including the cognitive, perceptual and physical tasks associated with driving, so that there will be no impairment of the safe and effective operation of the vehicle. An important objective is to ensure effective and efficient TICS operation while respecting the in-vehicle environment and recognizing the paramount importance of the primary driving task.

In addition to the recommendations and requirements related to the principles it presents, ISO 15005 also gives the conditions for compliance. As the manner in which each dialogue principle is applied will depend on the particular characteristics of the TICS function and the specific dialogue technique used, application examples have been provided.

The ultimate beneficiary of this International Standard will be the TICS end-user: the driver of the road vehicle. It is the needs of the driver that have determined the ergonomic requirements included by the developers of ISO 15005.

Road vehicles — Ergonomic aspects of transport information and control systems — Dialogue management principles and compliance procedures

1 Scope

This International Standard presents ergonomic principles for the design of the dialogues that take place between the driver of a road vehicle and the vehicle's transport information and control systems (TICS) while the vehicle is in motion. It also specifies compliance verification conditions for the requirements related to these principles.

This International Standard is applicable to TICS consisting of either single or multiple devices, which can be either independent or interconnected. It is not applicable to TICS without dialogues, TICS failures or malfunctions, or controls or displays used for non-TICS functions.

The requirements and recommendations of this International Standard could need to be reconsidered for drivers with special needs.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard 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 3958, *Passenger cars — Driver hand-control reach*

ISO 15008[1)], *Road vehicles — Ergonomic aspects of transport information and control systems — Specifications and compliance procedures for in-vehicle visual presentation*

SAE[2)] J1050, *Describing and measuring the driver's field of view*

3 Terms and definitions

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

3.1
communication
exchange or transfer of information

3.2
control
part of an item of equipment used by a human operator to bring about a change in the performance of the equipment

1) To be published.

2) US society of automotive engineers.

3.2.1
primary control
device used by a driver to control longitudinal and lateral motion of a vehicle

EXAMPLE Steering wheel, brake pedal, accelerator, gear selector or clutch.

3.2.2
secondary control
non-primary device used by the driver to control mandatory functions

EXAMPLE Parking brake, horn, light switches, turn indicator control, washer and wiper controls, hazard flasher control or demister control.

3.3
control action
configuration or adjustment of a control that causes a specific piece of information to be input to the system

3.4
data entry
act of providing the information that the selected function requires to be able to perform in a desired way

3.5
dialogue
exchange of information between a driver and a system, instigated by either one, to achieve a particular goal, consisting of a related sequence of control actions that can involve more than one modality

3.6
dialogue effectiveness
successful exchange of the required information between the system and the user

3.7
dialogue efficiency
effective exchange of information performed with little demand on the user in terms of information gathering (e.g. reading, listening), or information processing and information input (e.g. control actions)

3.8
dialogue management
control of the exchange of dynamic information between a driver and a TICS, organized and displayed through any type of interface

3.9
display
device that allows the presentation of visual, auditory or tactile dynamic information to a driver

3.10
distraction
significant capture of driver attention by stimulations from non-driving-related information or from driving-related information presented in such a way that the stimulation attracts more driver attention than necessary to obtain the relevant information

3.11
driver
vehicle occupant in control of the vehicle

3.12
dwell time
sum of consecutive individual fixation and saccade times to a target in a single glance

[ISO 15007-1:2002, definition 3.5]

3.13
function
transformation of incoming information into outgoing results

3.14
H-point
pivot centre of the torso and thigh of the three-dimensional H-point machine which simulates the pivot centre of the human torso and thigh and is used for actual H-point determination

NOTE It is located on the centreplane of the device which is midway between the H-point sight buttons on either side of the H-point machine.

[ISO 6549:1999, definition 3.2]

3.15
interface
physical facility (or hardware) between driver and system that provides the media through which they can connect and interact

3.16
manufacturer
person or organization responsible for TICS operational characteristics

NOTE The term covers the designer, component supplier and system integrator, and also system suppliers who, by putting a name, trademark or other distinguishing feature on a product, present themselves as its producer.

3.17
primary driving task
activities that the driver has to undertake in navigating, manoeuvring and handling a vehicle

EXAMPLE Steering, braking or accelerating.

3.18
prompt
indication that the system is available to receive input

3.19
sensory mode
perceptual medium used for information transmission or reception (auditory, visual, tactile, etc.)

3.20
status
current available or active system mode(s), or both, of the TICS

3.21
system acknowledgement
information provided to the driver by the system in response to a driver request

3.22
system initiated information
information provided to the driver by the system, other than in response to a driver request

3.23
system mode
specified subset of system functions or behaviour patterns

3.24
task
work performed to accomplish a set goal or end state sought by a driver

3.25
transport information and control system
TICS
single function, such as route guidance, or number of functions designed to work together as a system

See ISO/TR 14813-1 for TICS services.

3.26
timing
temporal relationship between display presentations and control actions, other presentations, system changes, the road or traffic situation, and driving

3.27
traffic situation relevant information
information received via communication channels, such as broadcasting receivers and on-board sensors, where the driver has no control over the time of reception

EXAMPLE Traffic information, route guidance information or collision warning.

3.28
vehicle in motion
vehicle whose speed relative to its supporting surface is “nonzero”

NOTE Practical limitations on existing vehicle sensors may cause small velocities (typically $\leqslant$ 5 km/h) to be registered as zero.

3.29
vehicle not in motion
vehicle whose speed relative to its supporting surface is zero

NOTE Practical limitations on existing vehicle sensors may cause small velocities (typically $\leqslant$ 5 km/h) to be registered as zero.

4 Application

The ergonomic principles for TICS dialogues given in clause 5 are to be applied within the context to which they are relevant, for example, for particular TICS functions and input/output technologies. The principles take into account a range of user characteristics. Therefore, the application of this International Standard to a specific TICS function should take into account the characteristics of the target user population.

If controls or displays or both are used for non-TICS functions, these functionalities are excluded from the provisions of this International Standard.

5 Dialogue principles

5.1 General

The following principles have been identified as being important in the design and evaluation of a TICS dialogue.

a) Appropriate for use while driving:

— compatibility with driving;

— simplicity;

— timing/priorities.

b) Appropriate for the TICS task:

— consistency;

— controllability.

c) Appropriate for the driver:

— self-descriptiveness;

— conformity with driver expectations;

— error tolerance.

These dialogue principles are explained, and the related requirements and recommendations are given, together with examples demonstrating how the principles can be applied. Wherever there are requirements, compliance verification conditions for these are also given.

5.2 Appropriate for use while driving

5.2.1 Explanation of principle

A TICS dialogue is appropriate for use while driving to the extent that it recognizes the paramount importance of the driving task, the driver's need to respond to stimuli from the traffic environment and, where applicable, from TICS that enhance the driving task.

5.2.2 Compatibility with driving

5.2.2.1 Explanation of principle

A TICS dialogue is compatible with driving when the use of the TICS optimizes, or at least does not adversely influence, the driver's ability to control the vehicle.

5.2.2.2 Requirements

5.2.2.2.1 Whenever a TICS provides inputs to either the primary driving controls or secondary controls, or both, the vehicle's response to driver operation of these controls shall not be adversely affected.

EXAMPLE 1 The driver will be able to override an ACC function by application of the service brake or accelerator.

EXAMPLE 2 The driver's input or braking force will be modified or improved for collision avoidance purposes.

A TICS is in compliance with this requirement if

a) the TICS has no connection to, or interaction with, either the primary or secondary driving controls or both, or

b) the TICS does have such a connection or interaction, but the driver's operations always override the TICS operation.

5.2.2.2.2 TICS dialogues shall not require removal of both hands from the steering wheel while driving.

EXAMPLE Hand-held TICS equipment requiring two hands for operation will not be designed for use while driving.

A TICS is in compliance with this requirement if it is possible for a driver to perform all TICS control actions while keeping at least one hand on the steering wheel.

5.2.2.2.3 TICS dialogue displays and controls shall be designed and positioned such that both the driving task and the TICS function can be accomplished in an unhindered manner.

EXAMPLE 1 TICS displays designed for use by the driver will be positioned and oriented so that they are easily visible, audible or both.

EXAMPLE 2 TICS hand controls that are frequently used in conjunction with steering activities (e.g. cruise-control switches) will be positioned within fingertip reach of the steering-wheel rim.

EXAMPLE 3 TICS dialogue devices will not block the driver's direct or indirect view out of the vehicle.

A TICS is in compliance with this requirement if

a) all TICS controls are located in accordance with the reach requirements of ISO 3958,

b) for a TICS device stored in a holster or storage position, at least half of the grasp area is forward of the rearmost driving H-point,

c) the TICS is in accordance with the requirements of the applicable auditory presentation standard,

d) the TICS visual displays are in accordance with the requirements of ISO 15008, and

e) the vehicle with TICS is in accordance with the requirements of SAE J1050.

5.2.2.2.4 TICS functions not intended to be used by the driver while driving (as determined by regulations or by device manufacturers) shall be inaccessible for, or inoperable by, the driver, or both, when the vehicle is in motion. Otherwise, the driver shall be provided with the intended scope of the TICS use, together with suitable warnings.

EXAMPLE 1 A typewriter keyboard intended for the driver will be deactivated.

EXAMPLE 2 Dynamic images (e.g. television or videogames) other than those related to driving will not be shown.

A TICS is in compliance with this requirement if

a) TICS functions considered to be inaccessible or inoperable for the driver while driving are inaccessible or inoperable even under reasonably foreseeable and probable misuse, or

b) a system, subsystem or menu system is inaccessible for the driver when the means of providing data entry (including the means for switching "on" and "off") is either unavailable, disabled, cannot be viewed or found, or has its access for use physically blocked, or

c) complex information entry is preceded by advice to use the function only when the vehicle is not in motion, or

d) information is provided with the TICS defining intended use.

5.2.3 Simplicity

5.2.3.1 Explanation of principle

A TICS dialogue is simple when it limits the amount of information and interaction to the extent necessary for the TICS task.

5.2.3.2 Recommendations

5.2.3.2.1 TICS dialogues affecting vehicle dynamics through control and warning systems should be designed to maximize understanding and facilitate operation.

EXAMPLE 1 Since it is assumed that even a naive user of the TICS will have knowledge of vehicle operation, dialogue for information systems will use familiar icons, symbols and text found in other vehicles.

EXAMPLE 2 Information that implies distinctive TICS behaviour or requires distinctive driver actions will be presented such that it can be readily distinguished from other (routine) information.

EXAMPLE 3 Warning displays will be more conspicuous than, and easily distinguished from, status displays.

5.2.3.2.2 The design of TICS dialogues should optimize physical and mental driver effort and minimize distraction, except where the attraction of the driver's attention is required.

EXAMPLE 1 Collision avoidance systems use will display by exception principles, i.e. only when a critical situation is sensed by the system will a warning message be displayed to the driver.

EXAMPLE 2 Visual displays will be able to detect the ambient illumination and adapt their own brightness accordingly.

EXAMPLE 3 Visual demands of a route guidance function will be minimized by providing spoken, turn-by-turn guidance instructions.

EXAMPLE 4 In a dynamic route guidance situation, the guidance information presented on a visual display will be tailored to the driving task: as in a road map for highway travel or an intersection diagram for a turn manœuvre, etc.

5.2.4 Timing/priorities

5.2.4.1 Explanation of principle

A TICS dialogue has fulfilled timing and priority requirements for driving when continuous driver attention to traffic situations is supported, or not adversely influenced.

5.2.4.2 Requirements

5.2.4.2.1 A TICS dialogue shall regulate the flow of information into sufficiently short and concise groups that can be easily perceived.

EXAMPLE 1 The amount and content of visual information will be limited so that the driver can assimilate it with glances of duration appropriate to the driving situation.

EXAMPLE 2 Related pieces of information will be presented in close spatial or temporal proximity to allow the message to be shorter and more easily understood.

EXAMPLE 3 The amount of textual driver information will be limited in length. Text on maps will be avoided as much as possible.

EXAMPLE 4 Junction representation within a navigation system will be stylized to represent only essential features.

A TICS is in compliance with this requirement if

a) dwell times of 1,5 s are sufficient to acquire relevant information, and

b) the auditory components of a TICS device are in accordance with the applicable auditory presentation standard.

5.2.4.2.2 A TICS device shall not require the continuous visual attention of the driver providing it with input.

EXAMPLE 1 An acoustical signal will inform the driver when a route calculation is completed.

EXAMPLE 2 Entering of a route guidance destination will not have to be completed within a set time period.

EXAMPLE 3 Scrolling or changing the scale of a displayed map will be performed in discrete steps.

A TICS is in compliance with this requirement if input tasks are able to be performed in a series of one or more discrete steps, none of which requires more than a 1,5 s dwell time.

5.2.4.2.3 A TICS device shall respond to or acknowledge driver input, or do both, in a timely manner.

EXAMPLE 1 System feedback of changes in state or errors will be perceived as instantaneous by the driver.

EXAMPLE 2 An appropriate timescale for response to a button or touchscreen press made by a driver in a moving vehicle will be long enough to prevent the system from reading “repeat presses” unintended by the driver.

EXAMPLE 3 Vehicle response to the deactivation of an adaptive cruise control (ACC) system will be immediate and clearly perceptible.

EXAMPLE 4 ACC system confirmation of status or change of mode will be perceived as instantaneous by the driver.

EXAMPLE 5 The dialogue system will change menu when the driver requests it in a time that is perceived as instantaneous by the driver.

A TICS is in compliance with this requirement if the system responds or provides an acknowledgement to the driver's tactile input within 250 ms.

5.2.4.2.4 Individual TICS dialogues shall be designed to guide the driver in giving a priority to the information displayed.

EXAMPLE 1 A collision-avoidance system will rapidly attract the driver’s attention (but without startling the driver) when a collision is imminent.

EXAMPLE 2 Flashing signals will be reserved for attracting the driver’s attention when an immediate or imminent action is required.

EXAMPLE 3 Messages from a visual display will not be so bright that they startle the driver.

EXAMPLE 4 Status information will be presented in a calm and unemotive way.

A TICS is in compliance with this requirement if

a) the procedure for determining the priority of TICS and other messages presented to drivers in accordance with the appropriate standard has been applied, and

b) the calculated priority of information is reflected in the way the information is presented.

5.2.4.3 Recommendations

5.2.4.3.1 A TICS should not limit the amount of time within which the driver has to respond when providing inputs to the TICS.

EXAMPLE 1 Selection of route characteristics from a preference list on a visual display will be driver-paced.

EXAMPLE 2 Route guidance information will continue to be provided following deviation from the suggested route and a driver will be able to confirm a rerouting proposal, possibly due to changes in the traffic situation, when this is convenient.

EXAMPLE 3 There will be no time limit for driver actions requested by the TICS.

5.2.4.3.2 The TICS should maintain visually displayed information for as long as needed.

EXAMPLE 1 Both warning and status will remain active on an ACC visual display while the triggering situation still exists and will be automatically terminated or replaced as soon as the situation changes.

EXAMPLE 2 The position of the vehicle shown on the display of a route guidance system will be updated according to real time. In the case of step-by-step instructions, the display will change once the manœuvre is complete to reflect the new position.

EXAMPLE 3 The screen will only be updated by the TICS when new information relevant to the current task is to be displayed to the driver.

EXAMPLE 4 If the system-initiated information is no longer applicable to the current task context, the information will be removed from the display.

5.2.4.3.3 When multiple TICS are installed in a vehicle, the integrated designs should take account of the relative priority of their functions.

EXAMPLE A collision warning will have priority over an incoming phone-call signal.

5.2.4.3.4 TICS should provide timely visual information to the driver.

EXAMPLE 1 Route information will be given sufficiently in advance of the manœuvre for it to be accomplished safely.

EXAMPLE 2 Updating of the vehicle's position on a map will be sufficiently frequent to avoid driver confusion.

5.3 Appropriate for the TICS task

5.3.1 Explanation of principle

A dialogue is appropriate for a TICS task when it supports the driver in the safe, efficient and effective completion of that task.

5.3.2 Consistency

5.3.2.1 Explanation of principle

TICS dialogues are consistent when they conform to rules and logic governing TICS interactions and behaviour.

5.3.2.2 Requirements

5.3.2.2.1 Information presentation and dialogue within a TICS shall be consistent with respect to mode, location, orientation and dialogue management.

EXAMPLE 1 As the primary use of most ACC information is for periodic reference and confirmation of status, this information will be consistently available in a defined place, orientation and format.

EXAMPLE 2 Side collision warning will always be presented in or near the corresponding side rear-view mirror.

EXAMPLE 3 Error messages will always appear in a fixed position on the screen, following an incorrect entry.

EXAMPLE 4 All screens for a given type of task will be consistently designed to contain all the elements of information (route guidance, maps, etc.) needed to perform the task.

EXAMPLE 5 System dialogue and status messages will always appear in the same area on the display.

EXAMPLE 6 Audible signals will always use the same format for the same message.

EXAMPLE 7 A function on the menu will always be selected in the same way or ways.

A TICS is in compliance with this requirement if

a) visual information is either

   — always presented in the same apparent location, orientation, size and coding, or

   — there is a stable and prescribed relationship between displayed information for every TICS state, and the temporal and spatial relationships between various TICS visual information elements are only varied to support the TICS task, and

b) auditory information elements are presented in the same sequence (or are only varied to support the TICS task).

5.3.2.2.2 State changes that require driver attention shall be displayed without driver action, and information about current TICS states shall be displayed either continuously or on request.

EXAMPLE 1 When headway setting on an ACC system can be adjusted, the driver will be informed clearly and visually of the setting even when the system is operating at a pre-set value of headway.

EXAMPLE 2 After “Resume” on an ACC, the previously displayed values will be shown.

EXAMPLE 3 When the driver switches a TICS off and then on again, the system state will be indicated when it comes back on.

The TICS is in compliance with this requirement if

a) system state changes requiring driver action to avoid immediate or imminent danger to persons or very serious damage to equipment are displayed automatically, and

b) information for the TICS states “on”, “off” and other predefined driver-relevant TICS states that can affect the vehicle and the driver’s understanding of the TICS (type of route guidance, ACC set speed. etc.) is available to the driver.

5.3.2.3 Recommendation

TICS presentation should be appropriate and consistent with the content and characteristics of the information.

EXAMPLE It will be possible to discriminate between warning messages on the basis of their colour and message content.

5.3.3 Controllability

5.3.3.1 Explanation of principle

A TICS dialogue is controllable when the driver can direct its initiation and termination, as well as the manner and conditions in which the dialogue can occur.

5.3.3.2 Requirements

5.3.3.2.1 The driver shall be able to terminate a dialogue at any step during an interaction and return to a prescribed state except where the dialogue is legally required or considered mandatory by the manufacturer.

EXAMPLE 1 The driver will be able to cancel a telephone call when a partial telephone number has been entered.

EXAMPLE 2 The driver will be able to escape from or undo a destination entry of a route guidance system to return directly and easily to a previous menu level.

The TICS is in compliance with this requirement if

a) a termination or escape procedure is available to the driver at any dialogue step or state, and

b) the termination results in a defined and consistent TICS state.

5.3.3.2.2 The TICS shall be designed so that following any system-paced interruption of driver input to the TICS, the driver is able to resume the dialogue at the point of interruption or at the last completed control action.

EXAMPLE 1 A partially entered telephone number or search for a hotel, restaurant or any other facility will be retained until completed (or aborted) by the driver.

EXAMPLE 2 If an input sequence is interrupted by a traffic message, the input will be resumed when the input display is reactivated.

The TICS is in compliance with this requirement if, following driver-paced or system-paced state changes unrelated to the actual task, there is no loss of relevant entered data on resumption.

5.3.3.2.3 Except for legally required messages and traffic-situation-relevant messages, the driver shall be able to control the flow of information displayed by the TICS.

EXAMPLE 1 Dynamic traffic congestion information will be immediately presented to the driver.

EXAMPLE 2 In a traffic information system, the driver will be able to access any stored traffic message or messages.

EXAMPLE 3 The driver will be able to request a repeat of an auditory message from a route guidance system.

The TICS is in compliance with this requirement if

c) the driver cannot terminate the display of legally required messages or messages considered mandatory by the manufacturer, and

d) the driver can control when to access available information from the TICS when the TICS is active and when the information is not traffic-situation-relevant, legally required or considered mandatory by the manufacturer.

5.3.3.3 Recommendations

5.3.3.3.1 Controls should be designed and positioned to avoid their inadvertent operation.

EXAMPLE 1 Buttons that are easily discriminated between and spatially segregated will be used to enhance tactile location and operability and to minimize error.

EXAMPLE 2 Push buttons will require a certain level of force to operate them, thus preventing inadvertent operation.

5.3.3.3.2 Except for legally required messages, the driver should be able to select the TICS information to be displayed from that available within the TICS.

EXAMPLE 1 The driver will be able to switch off auditory traffic information.

EXAMPLE 2 In navigation mode, the driver will be able to select visual or audible guidance information or both.

EXAMPLE 3 The driver will be able to select traffic information specific only to the present route.

5.4 Appropriate for the driver

5.4.1 Explanation of principle

A TICS dialogue is appropriate for the driver when it takes account of driver expectations, characteristics and limitations.

5.4.2 Self-descriptiveness

5.4.2.1 Explanation of principle

A dialogue is self-descriptive when the essential meaning of information is conveyed unambiguously and the driver is kept constantly aware of what can or must be done through the dialogue.

5.4.2.2 Recommendations

5.4.2.2.1 The particular input required to reach the intended goal should be made obvious to the driver.

EXAMPLE 1 When a menu is used, only the available options will be presented for selection.

EXAMPLE 2 Guidance will be given to the driver on the current phase within the system dialogue structure.

EXAMPLE 3 Prompts will be displayed indicating that the system is available for input. These will provide information on the type of driver input that is valid, given the current system status.