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Road vehicles — Ergonomic aspects of transport information and control systems (TICS) — Procedures for determining priority of on-board messages presented to drivers

Véhicules routiers — Aspects ergonomiques des systèmes de commande et d'information du transport (TICS) — Modes opératoires pour la détermination de la priorité des messages embarqués présentés aux conducteurs

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

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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order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn.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again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.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.

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Introduction

When multiple in-vehicle information systems are present, including both transport information and control systems (TICS) and non-TICS, various kinds of messages will be presented to drivers from these systems and displayed at various times. If these messages are not managed properly, drivers could fail to obtain critical information, which may degrade safety. This Technical Specification establishes two prioritization methods for TICS and other system-initiated or driver-requested messages presented to drivers while driving. Other prioritization methods are possible. The primary method given in this Technical Specification takes criticality and urgency ratings of such messages into consideration when calculating a priority index. An alternative method involving paired comparisons of all possible messages to form a priority matrix is presented in Annex A and its relative advantages and disadvantages are discussed.

Priority is one of the parameters to consider in determining when, where and how system messages are to be displayed. As TICS applications are deployed, the number and frequency of TICS messages presented to drivers can be expected to increase. This Technical Specification will provide road vehicle manufacturers and TICS suppliers with a consistent basis for the management of messages competing for the driver's limited information processing capability. This, in turn, will reduce the driver's workload and help ensure that the most important messages reach the driver. This Technical Specification complements ISO 15005 [3], a dialogue management standard.

This Technical Specification is intended for those involved in the design of message management systems that integrate in-vehicle messages. It describes how to establish message priorities. It also specifies criteria for message prioritization and, therefore, serves as an evaluation tool for TICS installed in vehicles as standard equipment and for after-market TICS devices.

Road vehicles — Ergonomic aspects of transport information and control systems (TICS) — Procedures for determining priority of on-board messages presented to drivers

1 Scope

This Technical Specification provides formal procedures and two, alternative, methods (users are advised to choose whichever of the two suits their individual requirements) for determining the priority of on-board messages presented to drivers of road vehicles by transport information and control systems (TICS) and other systems. It is applicable to the whole range of TICS in-vehicle messages, including traveller information, navigation, travel and traffic advisories, "yellow pages" information, warnings, systems status, emergency calling system information, and electronic toll/fee collection, as well as to messages from non-TICS sources such as telephone, warnings and telltales. Although applicable to systems that allow the free generation of messages, it neither provides guidance on how to use the messages deriving from its procedures nor is it applicable to mandatory or legally required messages.

2 Terms and definitions

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

2.1
contents of message
information presented to a user by the TICS or other on-board system

EXAMPLE A message containing system status information, warnings or alarms presented using characters, symbols, figures, audible tones, voices or other means.

2.2
criticality
severity of the impact of the most likely accident or malfunction that can occur when the message is not received or is ignored by the driver

2.3
display
device that allows the presentation of visual, auditory, or haptic dynamic information to a driver

2.4
driving
activities undertaken by the driver to navigate, manœuvre and handle the vehicle to achieve lateral and longitudinal control

2.5
evaluator
person who judges the contents of a message from the point of view of criticality and urgency to the driver

2.6
examiner
person who manages and conducts the use of this Technical Specification for determining priority

2.7
k_c
weighting of criticality used to calculate the priority index

2.8
k_u
weighting of urgency used to calculate the priority index

2.9
message management system
system that controls and evaluates a wide range of information and presents it ergonomically to drivers, allowing them to cope with the information while driving and assisting them in driving safely and comfortably

2.10
priority
relative importance of two or more messages which determines their ranking in a time sequence or emphasis of presentation

NOTE The message with the highest priority is assigned first place (larger priority ratings correspond to higher priority items).

2.11
priority index
index used to determine which messages should be given precedence when two or more messages are available for presentation

2.12
scenario
explanation of the driving context and situation for the message presented to evaluators

2.13
system-initiated message
message provided by a TICS or conventional system (both inside and outside of the vehicle) without a specific request from the driver

2.14
transport information and control system
TICS
system comprised of an advanced information and telecommunications network for users, roads and vehicles that contributes to solving problems such as traffic accidents and congestion

NOTE See ISO/TR 14813-1 for a list of TICS services [4].

2.15
urgency
time within which driver action or decision has to be taken if the benefit intended by the system is to be derived from the message

3 Data collection for the priority index procedure

This clause presents the steps for collecting the data used to calculate a priority index for each message. See the example outputs given in Annex E and Annex H.

3.1 Appoint an examiner

The priority index procedure requires an examiner to coordinate the data preparation, analysis, and reporting. The role of the examiner is detailed in 3.6.

The examiner shall be familiar with the prioritization process, knowledgeable on message management, and have automotive experience.

If the examiner has similar qualifications to that of the evaluators, the examiner may participate as both an examiner and evaluator.

3.2 Identify and assemble messages

It is necessary for the examiner to identify in advance messages that are to be presented to drivers. Generally speaking, the messages represent the aggregate output given by the TICS and non-TICS connected to a message management system. The examiner shall collect these messages and prepare them for presentation to the evaluators.

3.3 Define driving context and situation

For each message, the examiner shall define, or assist in defining, a driving context and situation in terms of the road environment and the traffic condition in which the message is likely to be presented.

The contextual and situational factors should be defined at the moment when the message is presented because the priority (assignment of criticality and urgency ratings) depends heavily on the driving context. Particular attention should be given to the presentation of messages in potentially hazardous situations. All hazardous situations should be considered, except for highly unlikely possibilities. Based on these situations the examiner may define one or more (normally not more than four) scenarios for a particular message.

The same message in two different scenarios shall be regarded as two different information items to be evaluated. This is because messages may occur in several different driving contexts, and each context could yield a different message priority. For example, the priority given to a message pertaining to a system malfunction will be different depending on whether the driver is starting the car or is relying on the system whilst driving.

If only one scenario is used for a given message, that scenario should represent a reasonable "worst-case" situation. At minimum, a TICS or non-TICS expert and the examiner should agree on the worst-case driving scenario. A traffic safety expert may also be consulted.

3.3.1 Consider the sensing capability of the vehicle

In practice the messages that are provided to the driver will depend on the capability of the vehicle to sense or detect various relevant situations. For example, if the vehicle can detect the driver's state of arousal, then the driver's state can be considered in describing the driving scenario.

For situations in which the vehicle is incapable of sensing, the message priority should be determined for a scenario representing a "reasonable" worst-case situation for the factors listed in 3.3.2.

3.3.2 Factors to consider in developing the driving scenarios (see Table 1)

Table 1 is provided to assist the examiner in developing driving context and relevant situations. A sample of situation and context factors is given in the rightmost column. The examiner may use these or other factors to define driving scenarios. If the context cannot be categorized into one of the candidate factors listed in Table 1, it should be clearly described within the "Other" parentheses. If neither the context nor situation is defined for one of the factors, select "not defined (N-D)" from the list of the candidates.

The following factors should be considered in developing the driving contexts and situations for evaluators to consider when making their ratings.

3.3.2.1 Trip context

The trip context is a factor that considers the aim of the trip (e.g. commuting, leisure), the timing or position along the route (e.g. relative position between start and destination), and the preparatory distance to the next manœuvre.

EXAMPLE "Close (e.g. 20 m) to turn (or merge)".

3.3.2.2 Road environment

The road environment is a static factor related to road structure that affects driving. Considerations shall include the road type (e.g. highway, urban road, country road), the speed limit, the number of lanes, and the road width. Consideration shall also be given to the effect on driving of the surrounding environment, including weather conditions and time of day (e.g. morning, daytime, night time, raining).

3.3.2.3 Traffic situation

The traffic situation is a dynamically changing factor related to traffic or obstacles on the road that affect driving. Considerations here include the relationship to other vehicles, such as headway distance and speed difference to the lead vehicle.

EXAMPLE 1 "Headway distance".

EXAMPLE 2 "Lateral vehicle exists".

EXAMPLE 3 "Speed difference to the lead vehicle".

3.3.2.4 Vehicle condition

This factor originates from the vehicle itself and derives from the relationship between the vehicle and the road. Vehicle condition can be separated into "vehicle type" and "vehicle state".

EXAMPLE 1 Vehicle type: "passenger vehicle", "heavy vehicle".

EXAMPLE 2 Vehicle state: "driving speed"; "driving in left [right] lane"; "negotiating curve [intersection]"; position of the vehicle within a lane.

3.3.3 Document the driving context and situation

The defined driving context, situation, appropriate driver behaviours and/or cognitive demands associated with each message shall be documented. An example for a specific configuration is given in Annex E.

Table 1 — Factors to consider in developing driving scenarios

Driving context/situation		Candidate situational or contextual factors
Trip context		Close to turn (or merge, or diverge) Other (……) N-D
Road environment:	Road	Highway / urban / country / curve / icy / wet Speed limit (…) Number of lanes (…) Other (……) N-D
	Weather	Rain / fog Time of day (morning / daytime / night-time) Other (……) N-D
Traffic situation		Headway distance is approx. (…) m or (…) s Lateral vehicle(s) exists (yes or no) Speed difference to the lead vehicle is approx. (…) km / h N-D
Vehicle condition	Type	Passenger vehicle / heavy vehicle Other (……) N-D
	Status on roadway / manœuvre	Driving speed (…) km/h (mph) Driving in left (or right) lane Curve (intersection) negotiation Other (……) N-D
	Status of vehicle subsystem(s)	Systems check after start-up shows all systems are normal Malfunction of system (……) — provide relevant details Other (……) N-D
Miscellaneous		Driver's state of arousal N-D
N-D Not defined.		

3.4 Select the evaluators

The examiner shall select a minimum of 5 evaluators (see 4.1 and Annex C).

Evaluators should include experienced human factors and road safety practitioners and others who possess a good understanding of the functions of the subject TICS system. They must be well-informed of the traffic environment and road environment of the subject country/region and have the ability to evaluate and take into account the safe presentation of messages. Actual use of the system is recommended for all evaluators.

The profile of each evaluator should be recorded. Profiles should include field of expertise, knowledge of road safety, human factors, and knowledge of the systems producing messages that are prioritized (see Annex D).

3.5 Evaluate criticality and urgency of a message

The contents of messages and the driving scenarios shall be explained by the examiner so that the evaluators have a common understanding of the scenario, the functions of the system, and the contents of messages being examined.

Examiners shall ensure that evaluators understand the definitions of criticality and urgency, the two evaluation criteria composing the priority index. For this, evaluators must understand the four-category ordinal evaluation scales used to assign criticality and urgency values (see Tables 2 and 3).

Each evaluator shall assign a criticality and urgency rating for each message assuming he/she is the driver.

In general, urgency will be time dependent. Controllability is one of the important factors that must be considered in determining urgency. If the situation is uncontrollable, no action shall be expected from drivers. However, if there is a possibility of controlling the situation, then urgency shall be determined depending on when the system expects drivers to take an action to handle it [2].

If the examiner has not fully defined the driving context and situation, evaluators shall be instructed to consider all hazardous situations, except for highly unlikely possibilities. They should assume a reasonable worst-case scenario when determining their criticality and urgency ratings.

3.6 Instructions for the examiner

The role of the examiner is to

a) record information about each evaluator in the evaluator profile (see Annex D),

b) create the questionnaire according to Annex E for the vehicle and system to be evaluated, and distribute the questionnaire and Tables 2 and 3 to each evaluator (definitions of criticality and urgency should be provided with the questionnaire),

c) explain the evaluation items and the contents of the message(s) in the questionnaire, while providing a means for evaluators to record the driving context and situation they used in making their evaluations, whenever the examiner's description was not clear or sufficient,

d) explain the classification of criticality and urgency according to Tables 2 and 3,

e) explain how to record the rating for criticality and urgency in the appropriate column of the questionnaire,

f) collect the questionnaire, and

g) analyse the data and report the results.