INTERNATIONAL STANDARD

ISO 15008

First edition
2003-03-15

Road vehicles — Ergonomic aspects of transport information and control systems — Specifications and compliance procedures for in-vehicle visual presentation

Véhicules routiers — Aspects ergonomiques des systèmes de commande et d'information du transport — Spécifications et modes opératoires de conformité pour la présentation visuelle à bord du véhicule

Reference number
ISO 15008:2003(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 2.

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

ISO 15008 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

Introduction

Driver and vehicle form an integrated system that includes the environment, the primary vehicle controls, the instrumentation and the transport information and control systems (TICS). The driving task, as well as human capabilities and limitations, are other important factors in the performance of this system.

TICS are intended to support the driver in his or her primary task, and it is therefore expected that the overall workload of the driver will not be negatively influenced by their use, while performance and comfort are increased.

The visual characteristics of display systems are only one set of factors influencing this process. They therefore have to be considered, along with human capabilities, in relation to the other elements of the driving environment.

Visual specifications fall within a wide range of environmental conditions, and constitute only a necessary condition for adequate performance, comfort and workload. Thus they refer to the relevant range of illumination conditions and to the location of the display with respect to the driver.

Road vehicles — Ergonomic aspects of transport information and control systems — Specifications and compliance procedures for in-vehicle visual presentation

1 Scope

This International Standard gives minimum specifications for the image quality and legibility of displays containing dynamic (changeable) visual information presented to the driver of a road vehicle by on-board transport information and control systems (TICS) used while the vehicle is in motion. These specifications are intended to be independent of display technologies, while test methods and measurements for assessing compliance with them have been included where necessary.

This International Standard is applicable to mainly perceptual, and some basic cognitive, components of the visual information: these include character legibility and colour recognition. It is not applicable to other factors affecting performance and comfort such as coding, format and dialogue characteristics, or to displays using

— superimposed information on the external field (e.g. head-up displays),

— pictorial images (e.g. closed-circuit TV for reversing),

— maps and topographic representations (e.g. those for setting navigation systems), or

— static information (e.g. control labels, telltales).

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 2575, *Road vehicles — Symbols for controls, indicators and tell-tales*

ISO 4513, *Road vehicles — Visibility — Method for establishment of eyellipses for driver's eye location*

ISO 9241-3:1992, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 3: Visual display requirements*

CIE[1)] 15.2, *Colorimetry*

CIE 17.4, *International Lighting Vocabulary*

CIE 85-1989, *Solar spectral irradiance*

1) Commission Internationale de l'Eclairage/International Commission on Illumination.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. For terms and definitions relations to photometric quantities, including illuminance, luminance, luminance contrast, luminance modulation, saturation, chromatic aberration and CIELUV, see CIE 17.4.

3.1
adaptation
adjustment of the eye's sensitivity to the brightness of the observed visual field

NOTE Dark adaptation occurs at a slower rate than does light adaptation.

3.2
blink
intended periodic variation of the luminance of a light or visual information, normally from "OFF" to a given value, typically used for attracting attention

3.3
brightness
subjective attribute of light sensation by which a stimulus appears to be more or less intense or to emit more or less light

3.4
critical specular line
CSL
line from the centre of the display to the centre of the eyellipse

3.5
critical specular light direction
CSLD
line symmetrical to the CSL in respect of the normal direction to the centre of the display

3.6
critical specular light cone
specular light cone with apex angle $\varepsilon + \beta$ (10°) all around

3.7
chromatic
having hue or being coloured: appearing different in quality from a neutral grey having the same brightness

NOTE Related to the colour properties of a visual stimulus.

3.8
contrast ratio
C_R
ratio between the luminance L_{high} of an area in its "bright" state (e.g. the strokes of a character in the case of negative polarity) and the luminance L_{low} of the same area in its "dark" state

3.9
fill factor
⟨matrix display⟩ ratio between the area occupied by the physical pixel area and the active pixel area

3.10
flicker
unintended perceived temporal variation of the brightness of a visual stimulus, usually generated by refresh displays such as cathode ray tube devices

3.11
glare
⟨disability⟩ dazzling (disabling) effect produced by a bright light: retinal effect, primarily caused by light scatter in the eye, which produces a luminous veil over the retinal image, and thus reduces contrast

3.12
glare
⟨discomfort⟩ distracting or disrupting effect of bright point sources in the field of view: perceptual effect, interfering with visual attention and selection

3.13
jitter
unintended periodic movement of an image or parts of it

3.14
legibility
visual properties of a character or graphics representation that determine the ease with which it can be recognized

3.15
map
representation on plane surface of the features of a connected part of the earth surface (especially of the road and traffic environment), shown in their representative forms, sizes and relationship according to some convention of representation

3.16
pixel
⟨general⟩ smallest selectively addressable area of a display

NOTE It is an abbreviation for “picture element.”

3.17
pixel
⟨multicolour display⟩ smallest selectively addressable area of the display capable of producing the full colour range

3.18
polarity
relationship in a display between the brightness of a symbol and background

NOTE It is negative if symbols are lighter than the background, positive if symbols are darker than the background.

3.19
raster
ensemble of the adjacent lines in a display composed by sequentially addressable points

3.20
resolution
ability of display to represent fine detail

NOTE It can be expressed quantitatively in terms of the number of distinguishable lines per unit length or subtended angle.

3.21
segment
pixel with definite geometric form to give a basic entity of a character or symbol

EXAMPLE Stroke.

3.22
specular light cone
cone symmetrical to the viewing cone in respect of the normal direction to the centre of the display

3.23
transparent diffuser
material that allows the light to pass through it while scattering the light evenly in all directions

EXAMPLE Sanded white glass, white Mylar[2].

3.24
viewing cone
cone with opening angle, ε, formed by lines from the centre of the display tangential to the eyellipse surface

3.25
night
condition under which the adaptation level of the driver is mainly influenced by

— the portion of the road ahead covered by the vehicle's own headlights and surrounding street lights, and

— display and instrument brightness

See 4.2.2.

3.26
day
condition under which the adaptation level of the driver is mainly influenced by the external environment of a cloudy sky

See 4.2.2.

3.27
sunlight
condition under which the viewing conditions are mainly influenced by direct light from the sun on the display surface

See 4.2.2.

4 Specifications and measurement methods

4.1 General

The following minimum specifications have been chosen to help ensure that visual displays used in TICS are legible. The specifications are accompanied by standard measurement conditions in terms of ambient illuminance and observer positions.

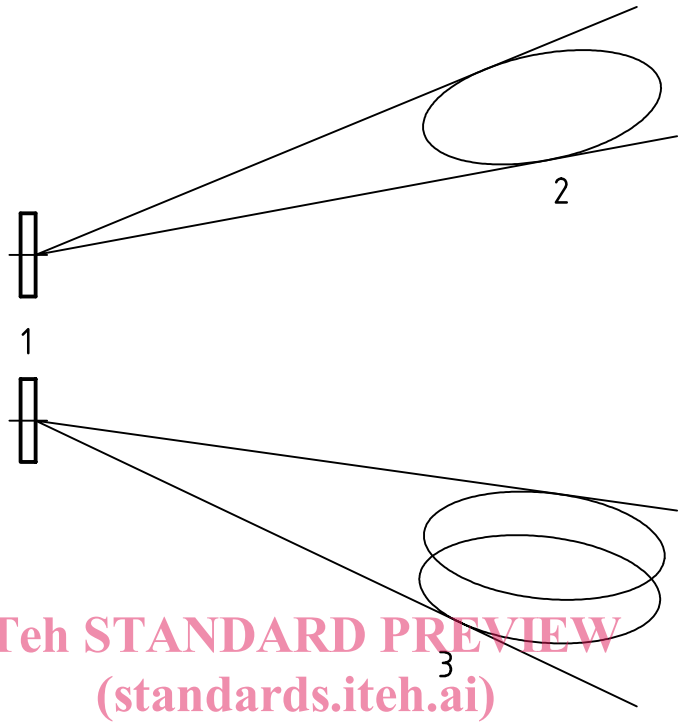
4.2 Design viewing position and illumination range

4.2.1 Design viewing position

These specifications are applicable to displays in their installed vehicle locations as seen from any point in the 95th percentile driver eyellipse according to ISO 4513 (for passenger vehicles only). Four viewing angles shall be defined, in accordance with Figure 1, from the display centre to the opposite sides of the top and side view eyellipses, and referred to the display perpendicular direction. The 95th percentile eyellipses shall be used.

2) Mylar is the trade name of a product supplied by DuPont. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

If the display is fixed to the vehicle, the relevant specifications shall be complied with for each of the four angles. If the angle and position of the display are adjustable, the display may be adjusted for each viewing angle in order that a position can be found in which all the relevant specifications are complied with simultaneously.



Key

1 display
2 side view
3 top view

Figure 1 — Design viewing angles (display at right-hand side of driver)

4.2.2 Illumination range

The design illumination range establishes the three conditions of *night*, *day* and *sunlight*.

— Night condition is replicated in a dark environment such that the maximum illuminance on the object to be measured shall not exceed 2 lx.

— Day condition is replicated with ambient light omni-directional to the point of measurement. The ambient light measured on the surface of the display (on the standard diffuse reflector) shall be 3 klx. See Annex A for suggested methodologies.

— Sunlight condition is replicated with a standard measurement condition. The light intensity at the point of measurement shall measure $\geqslant$ 45 klx. See Annex B for details.

For day and sunlight conditions, an artificial illumination system with light type close to that of CIE 85:1989, Table 4 ($\pm$ 20 %) shall be used. Light sources with large spikes in the spectrum (such as fluorescent lamps) should be avoided. The colour temperature is secondary to this issue.

Due to the very wide range of ambient illuminations that determine the adaptation level of the driver, a brightness control which allows adjustment over a suitable range should be provided.

4.3 Luminance contrast

4.3.1 Minimum contrast

The minimum contrast ratio (higher to lower luminance) between symbol and background shall be

— 5:1 for night conditions,

— 3:1 for day conditions, and

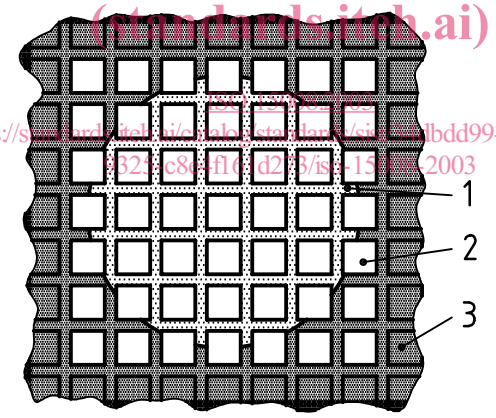
— 2:1 for sunlight conditions.

This is especially important if characters are close to the minimum specifications for the dimensions (see 4.5). Lower contrast should be avoided unless dimensions are properly increased or the reading task is simple or when both these apply.

The contrast ratio shall be calculated from two measurements in the centre of the display. For matrix display, the measurements shall be taken with a luminance meter having a field of view (FOV) of 10′ to 20′ over an area covering at least 5 × 5 pixels (see Figure 2).

For segment displays, the measurement shall be taken within a single segment using a luminance meter having a FOV angle of 10′ to 20′. The diameter of the collection area shall be less than 80 % of the relevant dimension of the segment to be measured, for all measurement directions.

The measurements shall be taken at four angles, derived in accordance with 4.2.1, in night and day conditions.



Key

1 collection area
2 pixel “bright”
3 pixel “dark”

Figure 2 — Measurement on matrix displays

4.3.2 Luminance balance

The ratio of area average luminance of the display and of the surrounding (luminance balance) should not exceed 10:1 (higher to lower luminance). Higher ratios are often acceptable. However, a ratio of 100:1 (higher to lower luminance) would be expected to produce a small but significant drop in performance.

Luminance balance is measured as the ratio between the average luminance of the display over nine points in its active area with all pixels in bright state and the average luminance over eight points of the immediate surrounding as shown in Figure 3. The measurements shall be taken in daylight. The measurement direction shall be determined by a line passing through the centre of the display and the centre of the eyellipses as shown in Figure 4. The other points shall be reached by rotating the measuring instrument.