



BSI Standards Publication

Road vehicles — Visibility — Requirements and recommendations for automotive interior display systems

National foreword

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Road vehicles — Visibility — Requirements and recommendations for automotive interior display systems

*Véhicules routiers — Visibilité — Exigences et recommandations
relatives aux systèmes d'affichage intérieur des véhicules
automobiles*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 35, *Lighting and visibility*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Display systems are increasingly replacing traditional instrument clusters in vehicles. Transportation information and vehicle control systems (TICS) are now being integrated with one or two digital display systems to provide vital information to drivers and passengers.

This display system can be located anywhere in front of the driver as the instrument cluster display, in the centre of the vehicle, in front of the passenger on front or rear seats, or throughout the dashboard, or anywhere in the vehicle.

The display system is intended to provide vehicle data, navigation, infotainment and other information such as comfort and warning systems.

In the past, display systems were designed for static applications in the home or workplace, such as TV screens or computer monitors. There are many IEC standards on electronic display systems.

An in-vehicle display system is not only exposed to the elements, but also to constant shock and vibration. A touch screen will assemble fingerprint marks. Therefore, it is important that it can withstand cleaning solutions, beverage and food spills. In addition, the display is subjected to misuse like scratches and dents. Large displays put a significant area of glass in front of the passenger. The glass must not cause any bodily injury if it breaks for any reason. The in-vehicle display system must function in all the environmental operating and storage conditions for which the vehicle is designed. The display must also remain readable and operable even after years of use.

The IEC has published standards for display device systems for video, TV and IT, covering operational, optical and safety requirements. IEEE has published reports and articles about in-vehicle display technology, recognizing the special requirements for displays as information systems in vehicles. The German Display Forum (DFF) has established a European Original Equipment Manufacturer (OEM) specification for in-vehicle displays. Another source of information about optical measurements can be found in the Society for Information Displays (SID) and its International Committee for Display Metrology (ICDM) standard.

Road vehicles — Visibility — Requirements and recommendations for automotive interior display systems

1 Scope

This document specifies requirements and recommendations regarding performance criteria for display systems in vehicles as a guideline for suppliers and manufacturers under normal operating conditions.

This document applies to in-vehicle display systems designed to provide vital information to the driver and passenger. This document applies to the system as a whole as well as its relevant components, such as cover lenses, coatings, and properties of the device itself.

This document covers display systems in passenger vehicles (including sport utility vehicles and light trucks) and commercial vehicles (including heavy trucks and buses).

NOTE Static and dynamic laboratory testing and dynamic field operational assessment to measure display and cover glass attributes are also included, where available, in the scope of this document.

This document is not applicable for:

- technology and type of display device (e.g. LED, LCD, OLED);
- manufacturing and handling of components in production;
- electrical setup and integration into the vehicle;
- EMC requirements for electrical subassemblies;
- head-up display (HUD) and e-mirror displays [e.g. camera monitoring system (CMS)];
- behaviour in accidents besides the regulatory head impact test (HIT).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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*

IEC 62977-2-1, *Electronic displays - Part 2-1: Measurements of optical characteristics - Fundamental measurements*

IEC 62977-2-11, *Electronic displays - Part 2-11: Measurement of optical characteristics - Local luminance and uniformity*

IEC 62977-3-9, *Electronic displays - Part 3-9: Evaluation of optical performance - Display sparkle contrast*

IEC 63211-2-21, *Durability test methods for electronic displays - Part 2-21: Environmental tests - Test methods for heat and humidity*

IEC 63211-3-2, *Durability test methods for electronic displays - Part 3-2: Mechanical tests - Static stress*

IEC 63211-3-5, *Durability test methods for electronic displays - Part 3-5: Mechanical tests - Surface durability*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15008 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Vehicle related terms

3.1.1

eyebbox

simplified two-dimensional (2D) rectangular box model providing the representative distribution range of the driver's eye reference point for evaluation, encapsulation and having its frame line tangential to the eyellipse

[SOURCE: ISO/TS 21957:2023, 3.2.2, modified — Note 1 to entry was deleted.]

3.1.2

eyellipse

contraction of the words “eye” and “ellipse” used to describe the statistical distribution of eye locations in three-dimensional (3D) space located relative to defined vehicle interior reference points

[SOURCE: ISO 4513:2022, 3.1, modified — Figure 1 was deleted.]

3.1.3

field of view

FOV

angular extent of what can be seen, either with the eye or with an optical instrument or camera

[SOURCE: SAE J264:2021, 3.1.4 and 3.1.7, modified — This is a compilation of two terminological entries: direct field of view and indirect field of view.]

3.1.4

instrument cluster display

ICD

display located right in front of the driver providing information that is vital for driving

Note 1 to entry: This display delivers primary information available at a glance or is detectable without changing gazing direction.

3.1.5

driver information display

DID

display providing information to the driver in a location directly in or close to the normal straightforward gazing direction

Note 1 to entry: This display provides primary information that is vital for the driving task, e.g. the status of the vehicle and messages for safe driving. Typical information is the speedometer, warning signals, fault messages and fuel levels.

3.1.6

secondary information display

SID

display integrated in an adjacent location to the driver to show secondary information typically related to navigation, parking aids and audio system positioned at the middle point.

3.1.7

co-driver display

CDD

relays information to the co-driver supporting the driver from the passenger seat

Note 1 to entry: The typical information given in a CDD is navigation or infotainment, like interfaces for communication or audio systems' information to the co-driver on the passenger seat. The main purpose of the CDD or passenger information display (PID) is infotainment.

3.1.8

passenger information display

PID

display providing information to passengers where they are seated.

Note 1 to entry: The information is specifically adapted to what is useful for passengers who are not directly involved in the driving task.

3.1.9

rear seat entertainment display

RSED

display located behind the front seats with the specific purpose to provide information for rear seat passengers

Note 1 to entry: Examples of typical information in an RSED are entertainment and control feedback for climate and audio systems which are incorporated in the back of the front seats with the sole purpose of entertaining rear seat passengers.

3.2 Device-related terms

3.2.1

display

electronic display device capable of visibly communicating information, including hardware and software

[SOURCE: ISO 9241-302:2008, 3.4.6, modified — "including hardware and software" added.]

3.2.2

cover lens

transparent layer in front of a display system with the purpose of physically protecting the display and of adding additional properties, e.g. anti-glare

Note 1 to entry: The cover lens is generally made of a highly transparent material, e.g. glass or certain polymers, such as polycarbonate (PC), polymethyl methacrylate (PMMA), or combinations.

Note 2 to entry: The term cover glass is often used as well, regardless of the material.

3.2.3

contrast ratio

CR

relationship or degree of tonal gradation between the lightest and darkest areas in an original or reproduction

[SOURCE: ISO 12637-2:2008, 2.38]

3.2.3.1

luminance contrast ratio

quotient of the luminance of two active parts of a display surface having the same or different colours

Note 1 to entry: The luminance contrast ratio has unit one.

[SOURCE: IEC 60050-845:2020, 845-32-029]

3.2.3.2

ambient contrast ratio

ACR

ratio of the luminance of the white state to the luminance of the black state, under specified ambient lighting conditions

Note 1 to entry: It is a measure of a display's performance in the presence of ambient light.

[SOURCE: IDMS 1.03, 3.6, modified —Second sentence moved to Note 1 to entry.]

3.2.3.3

static contrast ratio

ratio of the luminance of the brightest colour (white) to that of the darkest colour (black) that the system can produce simultaneously on the screen at the same time

[SOURCE: IDMS 1.03, 3.6]

3.2.3.4

dynamic contrast ratio

DCR

ratio of the luminance of the brightest colour (white) to that of the darkest colour (black) that the system is capable of producing over time, but not necessarily at the same time

[SOURCE: IDMS 1.03, 3.6]

3.2.4

display response time

time it takes the display to switch from one colour to another, expressed in milliseconds

Note 1 to entry: The definition of response time in general is the time from a sudden change of a control quantity until the corresponding change of an output quantity has reached a specified fraction of its final value.

Note 2 to entry: The display response time is expressed in milliseconds.

3.2.5

gamma

Y

maximum slope of the straight line which gives the best approximation to the curve representing, on a logarithmic scale, the luminance of a screen element as a function of the amplitude of the corresponding video signal, over the useful range of the curve

[SOURCE: IEC 60050-723:1997, 723-06-36]

3.2.6

3D display

display device or system including a special functionality for enabling depth perception

Note 1 to entry: 3D can also be used to describe curved or angled cover lenses.

[SOURCE: ISO/TR 9241-331:2012, 2.1.1 modified — Note 1 to entry has been added.]

3.3 Location-related terms

3.3.1

display viewing area

limited area for seated occupants that allows good viewing conditions independent of the relative dimensions of the projected information

Note 1 to entry: The occupant can be the driver or a passenger. The area corresponds to what is visible from the occupant eye location without any obstructions by bezel or frames.

[SOURCE: ISO 11315-2:1997, 3.4]

3.4 Optical- and display-related terms

3.4.1

luminance

intensity of light emitted from a surface per unit area and per unit solid angle in a given direction

Note 1 to entry: The SI unit of luminance is candela per square meter (cd/m^2); sometimes the term *nit* is used instead. Nits are the light of candles per square meter: 1 nit = 1 cd/m^2 , but this term has been deprecated.

[SOURCE: ISO 24550:2019, 3.6, modified — Note 1 to entry has been replaced.]

3.4.2

reflection

process by which radiation is returned by a surface or a medium, without change in the frequency of its monochromatic components

Note 1 to entry: Reflection refers to visible light in this document.

[SOURCE: IEC 60050-845:2020, 845-24-047, modified — Note 1 to entry has been added.]

3.4.3

reflectance

ratio of the reflected luminous flux to the incident luminous flux

Note 1 to entry: Luminous reflectance depends on relative spectral power distribution of the light source.

Note 2 to entry: For automotive display, all contributing sources of a module should be considered, e.g. including the internal contributions from an LCD or a touch sensor.

[SOURCE: ISO 3538:1997, 2.6, modified—Term changed from "luminous reflectance" to "reflectance" and Note 2 to entry has been added.]

3.4.4

glare

condition of vision in which there is discomfort or a reduction in the ability to see details or objects, caused by an unsuitable distribution or range of luminance or by extreme contrasts

[SOURCE: ISO 16505:2019, 3.8]

3.4.5

ghosting

either a reflected image that overlaps with actual image content or an image that fails to adjust in brightness in time and produce ghosts of the previous image

3.4.6

sparkle

random brightness pattern (modulation) extending across the display area which changes with the viewing direction

Note 1 to entry: Sparkle pattern are refraction based and can also be observed with incoherent light.

[SOURCE: IEC 62977-3-9:2023, modified — Note 1 to entry has been added.]

3.4.7

speckle

brightness pattern, e.g. generated by light incident on a rough surface

Note 1 to entry: In contrast to sparkle, speckle patterns are created by interference effects and therefore require sufficiently coherent light to be observed.

3.4.8

colour

characteristic of visual perception that can be described by attributes of hue, brightness (or lightness) and colourfulness (or saturation or chroma)

Note 1 to entry: Perceived colour depends on the spectral distribution of the colour stimulus, on the size, shape, structure and surround of the stimulus area, on the state of adaptation of the observer's visual system, and on the observer's experience of the prevailing and similar situations of observation.

[SOURCE: IEC 60050-845:2020, 845-22-040, modified — Notes 2 and 3 to entry have been deleted.]

3.4.8.1

hue

attribute of a visual perception according to which an area appears to be similar to one of the colours red, yellow, green, and blue, or to a combination of adjacent pairs of these colours considered in a closed ring

3.4.8.2

colour difference

DE

difference between two colour stimuli, defined as a distance between the points representing them in a specified colour space

Note 1 to entry: A colour distance metric defined by the International Commission on Illumination (CIE) is called delta E (ΔE).

[SOURCE: ISO 18314-4:2024, 3.3 modified — Notes 1 to entry has been added.]

3.4.8.3

gamut

colour gamut

subset of colours which can be accurately displayed or measured within a given 2D or 3D colour space

Note 1 to entry: A 2D or 3D colour space includes, for example, CIE 1931 or CIELAB.

3.4.8.4

tristimulus

three primary colours for which the human eye has receptors

Note 1 to entry: Their ratio is defined in the CIE 1931 colour spaces. More specific definitions for colours can be found in Annex A.

3.4.9

black mura

display mura

Japanese word meaning blemish that has been adopted in English to provide a name for imperfections of a display pixel matrix surface that are visible when the display screen is driven to a constant grey level

Note 1 to entry: Mura defects appear as low contrast, non-uniform brightness regions, typically larger than single pixels. They are caused by a variety of physical factors. For example, in LCD displays, the causes of mura defects include non-uniformly distributed liquid crystal material and foreign particles within the liquid crystal. Mura-like blemishes occur in CRT, FED, and other display devices.

[SOURCE: ISO/TR 9241-310:2010, 2.13, modified — Original term was “mura”.]

3.5 Material-related terms

3.5.1

toughened glass

glazing material consisting of a single layer of glass which has been subjected to special thermal treatment to increase its mechanical strength and to condition its fragmentation after shatter

Note 1 to entry: Other terms such as “heat treated glass,” “tempered glass”, “case-hardened glass”, are used as well.