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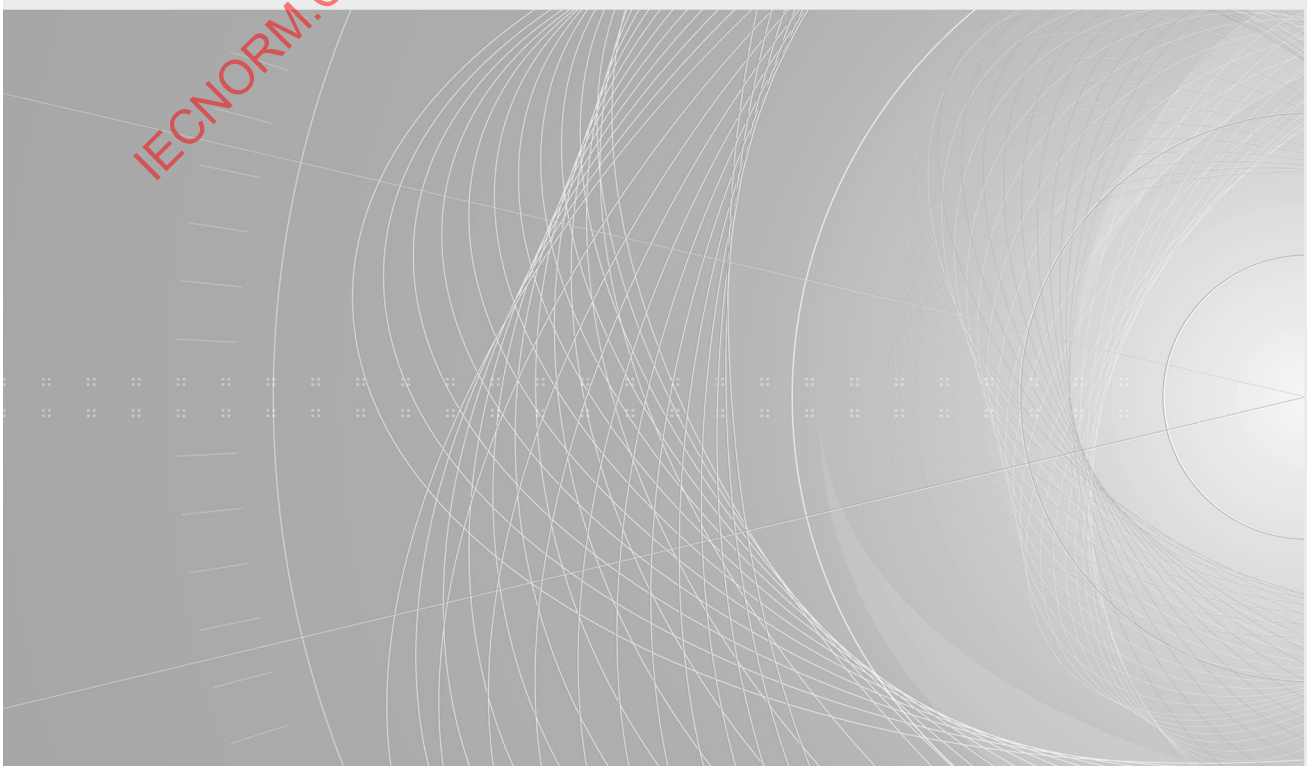
TECHNICAL SPECIFICATION

Safety of laser products –
Part 19: Moving platform laser products



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colour inside

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SAFETY OF LASER PRODUCTS –

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The text of this Technical Specification is based on the following documents:

Draft	Report on voting
76/746/DTS	76/749/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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INTRODUCTION

Laser products are sometimes used on moving platforms. Currently the standard IEC 60825-1:2014 considers only a stationary aperture; it does not address the situations where the emitting aperture is mounted on a platform, such as a vehicle, that can be in motion. Failure to consider the effects of the motion of the platform can result in overly restrictive assessment of the hazard.

Although accounting for a platform's movement during the assessment of a laser product's classification can lead to less restrictive measurement conditions, it is important not to overlook that there can be apertures, even on other moving platforms, moving at a relative speed of zero or close to zero with respect to the moving platform laser product being classified.

SAFETY OF LASER PRODUCTS –

Part 19: Moving platform laser products

1 Scope

This part of IEC 60825 specifies the velocity-dependent closest points of human access (VCPHA) for the classification of moving platform laser products when considering the movement of the platform with respect to a stationary frame of reference. This presupposes that the inherent kinetic hazard of the moving platform creates a zone in which persons would not be reasonably expected to be located. Additionally, it takes neighbouring moving platforms into account by defining stationary and moving apertures.

This document is applicable to all laser products whose laser apertures are on a moving platform.

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.

IEC 60825-1:2014, *Safety of laser products – Part 1: Equipment classification and requirements*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 60825-1:2014 and the following apply.

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

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

3.1
moving platform laser product
product which is designed to move and incorporates an aperture that can emit laser radiation

Note 1 to entry: This definition is different from the definition of a *scanning laser product* (3.3) where the aperture stop is stationary for the determination of the accessible emission.

Note 2 to entry: A moving platform laser product can use scanning laser radiation.

Note 3 to entry: A moving platform can be so small that there is no place for a person to be in or on the moving platform. Alternately, a moving platform can be sufficiently large to allow one or more persons to be in or on the moving platform.

Note 4 to entry: Examples of moving platforms are vehicles, aircrafts, boats and trains.

3.2
moving platform laser product velocity
$\vec{v}$
velocity vector, composed of speed and direction, averaged over the time period t_{move}

Note 1 to entry: $|\vec{v}|$ is expressed in metres per second.

3.3
scanning laser product
laser product where the accessible emission has a time-varying direction or pattern of propagation with respect to a stationary frame of reference

Note 1 to entry: This definition is changed compared to the definition of scanning laser radiation in IEC 60825-1:2014, 3.78 because a time-varying origin is a characteristic of a moving platform laser product (see 3.2) and not of a scanning laser product.

Note 2 to entry: For the determination of the accessible emission of scanning laser radiation, a stationary aperture stop is used.

3.4
closest point of human access
CPHA
closest position where a human body can be exposed to laser radiation emitted from the laser product that is ensured by mechanical design

Note 1 to entry: The minimum measurement distances as given in IEC 60825-1:2014, Table 10 are determined from the measurement reference point (IEC 60825-1:2014, Table 11), but IEC 60825-1:2014 does not permit measurements closer than the CPHA.

3.5
velocity-dependent closest point of human access
VCPHA
closest position of human access to a moving platform laser product's laser emission that is defined by the motion of the moving platform laser product

Note 1 to entry: The term closest point of human access is also used in IEC 60825-1. This document defines a velocity-dependent CPHA due to the movement of a laser device. In the case of a velocity $\vec{v}$ = 0, this VCPHA corresponds to the closest point of human access in IEC 60825-1.

3.6
t_{move}
time for VCPHA
time used to calculate the distance δ

Note 1 to entry: t_{move} is expressed in seconds.

3.7
δ
distance for VCPHA
distance used to determine the VCPHA for a moving platform laser product, where $\delta = t_{move} \cdot |\vec{v}|$

Note 1 to entry: δ is expressed in metres.

3.8
δ_{max}
maximum distance for VCPHA
maximum value of δ above which the VCPHA for a moving platform laser product is independent of velocity

Note 1 to entry: δ_{max} is expressed in metres.

4 Classification principles

All classification principles of IEC 60825-1:2014 apply.

5 Determination of the accessible emission level and product classification

5.1 General

All subclauses of IEC 60825-1:2014 for the determination of the accessible emission and product classification apply and are supplemented by 5.2.

5.2 Evaluation of moving platform laser products

For the evaluation of the moving platform laser product, both measurement apertures which are moving with the platform and which are stationary shall be considered. It is important to include neighbouring platforms (e.g. persons on vehicles with the same velocity as a moving platform laser product) and stationary observers (e.g. pedestrians) in the evaluation. All reasonably foreseeable use cases and scenarios shall be considered during the assessment of the moving platform laser product's classification. An example for stationary and moving apertures is given in Annex A.

For a moving platform laser product, a velocity-dependent closest point of human access (VCPHA) can be applied as follows.

Considering a moving platform laser product with a velocity $|\vec{v}|$ at a certain point in time t_0, the volume swept by this moving platform within the time duration $t_0 - t_{move}$ to $t_0 + t_{move}$ (see blue area in Figure 1) can be excluded as location for reasonably expecting presence of persons. Therefore, the boundary of this volume can be used as a VCPHA for the moving platform laser product (see red dashed line in Figure 1). The extent of the swept volume parallel to the direction of motion, defined by δ, depends on the moving platform laser product velocity, $\vec{v}$, and is calculated as $\delta = t_{move} \cdot |\vec{v}|$. The maximum of this extent is limited to $\pm\delta_{max}$. If the actual extent of intended movement of a moving platform laser product is smaller (see NOTE 3) than the calculated δ based on the moving platform laser product velocity, the smaller one shall be used to calculate the VCPHA. The VCPHA can then be used for the evaluation. The values for t_{move} and δ_{max} shall be taken from Table 1.

Table 1 – Values for the parameters t_{move} and δ_{max}

t_{move}	δ_{max}
0,04 s	1 m

This document specifies a VCPHA due to the movement. All other measurement distances and conditions from IEC 60825-1:2014, Table 10 and IEC 60825-1:2014, Table 11 shall be applied. The classification principle for moving platform laser products is summarized in the flowcharts in Annex A. Annex A also provides exemplary moving platform laser products and the determination of their minimum evaluation distances.

NOTE 1 The value of δ = 1 m is reached in t_{move} of 0,04 s if the moving platform has a velocity of 25 m·s^{-1}, equal to 90 km·h^{-1} and 55,9 mile·h^{-1}. These values are conservative values applicable for all moving platforms. The minimum human reaction time is in the range of about 100 ms to 250 ms (see bibliography) and a factor 2,5 to 6,25 higher than the value of t_{move} in Table 1.

NOTE 2 All reasonably foreseeable use cases and scenarios include realistic kinematic estimates, such as size, inertia, direction and range of motion.

NOTE 3 An example where the actual extent of movement is smaller than the calculated δ would be a reciprocating machine or a robot arm with high speed but limited extent.

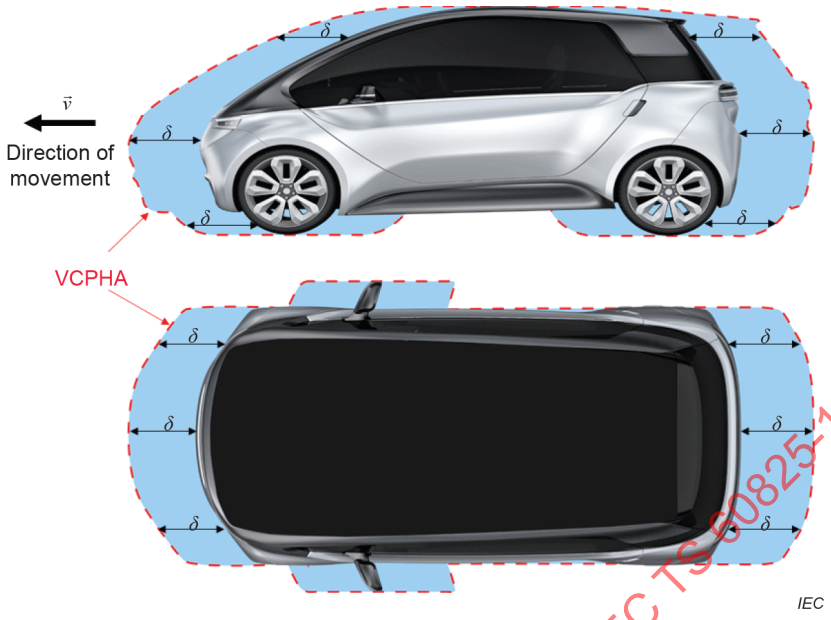


Figure 1 – Example in side view and top view of a swept volume, filled in blue, where human access can be excluded (VCPHA is represented by dashed red line) for a moving platform laser product moving at velocity $\vec{v}$

The use of this VCPHA for a moving platform laser product is optional and its classification may also be based on the CPHA for a non-moving platform. If the VCPHA for moving platform laser products is applied, the following conditions shall be met.

a) The laser shall be securely mounted on or incorporated into the moving platform.

b) All reasonably foreseeable velocities and corresponding emission shall be considered.

c) Human access to laser radiation exceeding the AEL of the class of the moving platform laser product shall not be reasonably foreseeable.

NOTE 4 Examples of potential human access are sunroofs in cars, beds of pick-up trucks, laser radiation accessible by drivers or passengers, reflections from objects on the platform, etc.

NOTE 5 Access can be prevented by engineering features, protective housing, physical location, etc.

d) If it is reasonably foreseeable that the movement of the moving platform laser product compensates at least partly the movement of a scanning laser, this shall be considered.

e) If it is reasonably foreseeable that a person still can be located within the swept volume excluded for the CPHA, adequate measures shall be taken.

NOTE 6 An example is skitching, where persons on skateboards or roller skates are hitching a ride by holding on the back of a motor vehicle. Adequate measures could be for example to limit the VCPHA to the front of the moving platform (see, for example, Figure A.6 in Annex A), to apply the VCPHA backwards only above a certain height, to detect this condition or to prevent it by mechanical means.

f) The sensing method for the moving platform laser product velocity shall be reliable and reflect real relative motion to the surroundings of the moving platform, and the required reliability of the velocity sensing method, controlling emission levels to stay within a given laser class, shall be based on IEC 60825-1:2014, 5.1.

NOTE 7 For example, in the case of an automobile, wheel motion alone can be misleading, e.g. testing cars on a (roller) dynamometer.

NOTE 8 Guidance for the assessment and principles of risk analysis methods can be found in IEC 61508, ISO 21448 and the ISO 26262 series.

g) It shall be ensured that the correct mechanical extent of the moving platform laser product is used for the calculation of the VCPHA.

h) If the laser is removable or able to be fitted to multiple different platforms or different locations on a single platform, it shall be ensured that fitting, removal or relocation of the laser to different platforms or locations on a single platform is compliant with the classification of the moving platform laser product.

NOTE 9 An example of different platforms are platforms with different VCPHA for different sized vehicles like SUV and motorcycle. An example of same platform is fitting on the roof versus fitting on the bumper of the same platform.

For guidance regarding requirements in the above list that include the term "reasonably foreseeable", IEC 60825-1:2014, 5.1 can be used.

6 Engineering specifications

IEC 60825-1:2014, Clause 6 applies.

7 Labelling and user information

The requirements of this Clause 7 apply additionally to the requirements of IEC 60825-1:2014, Clause 7 (labelling) and IEC 60825-1:2014, Clause 8 (information for the user, purchasing and servicing information).

A statement of conformance with IEC TS 60825-19:202x shall be included in the information for the user.

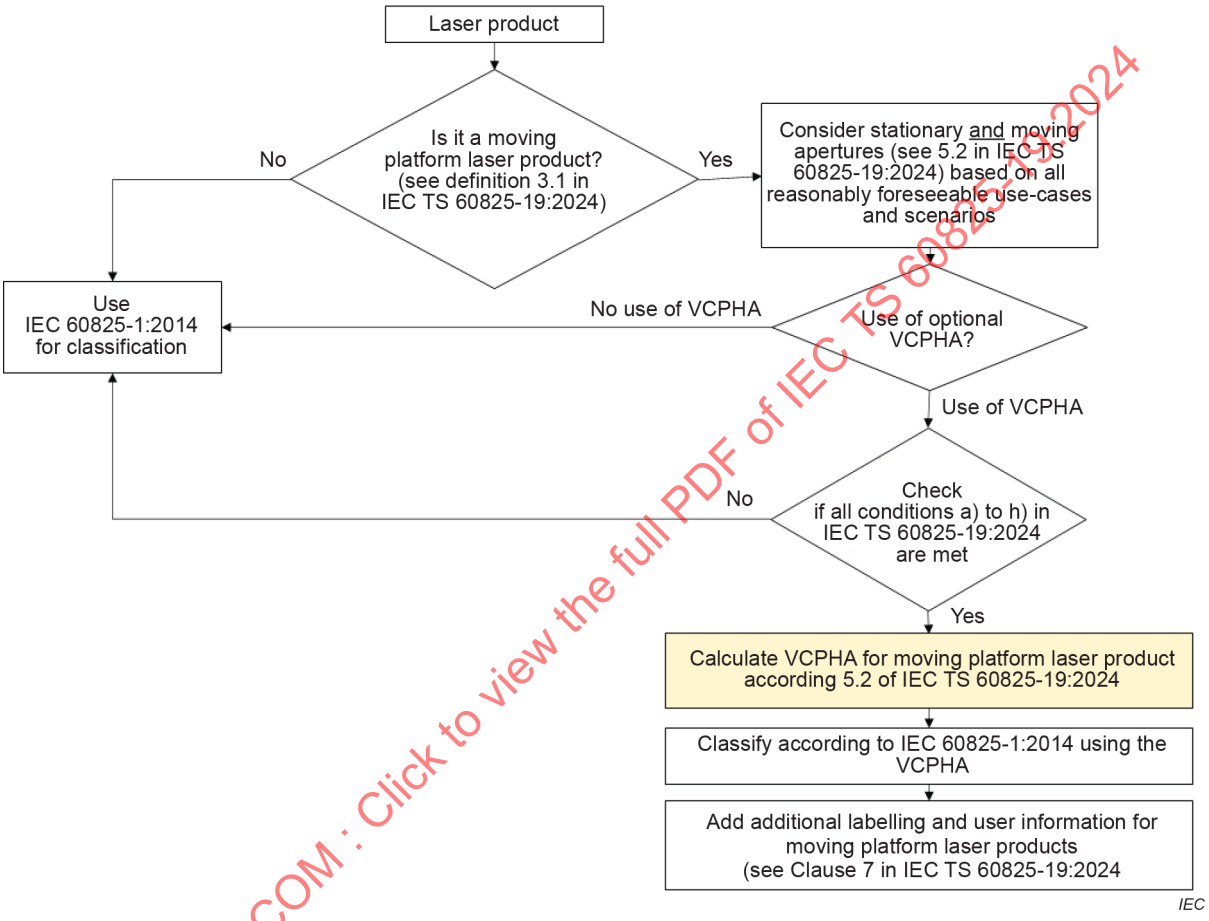
Additional to the standards information required in IEC 60825-1:2014, 7.9, a moving platform laser product shall show conformance with this document. Therefore, the name and publication date of this document shall be included on the explanatory label, on the labels shown in IEC 60825-1:2014, 7.2 to 7.7 or elsewhere in close proximity on the product.

For Class 1 moving platform laser products, with the exception of laser products classified as Class 1 based on IEC 60825-1:2014, 4.4, instead of the above label on the product, at the discretion of the manufacturer, the same statement may be included in the information for the user only.

Annex A
(informative)

Flowcharts and examples for the classification of moving platform laser products

Figure A.1 and Figure A.2 show a simplified schematic of the classification of moving platform laser products.



The calculation in the yellow box is described in more detail in Figure A.2.

Figure A.1 – Schematic flow chart of the classification of moving platform laser products

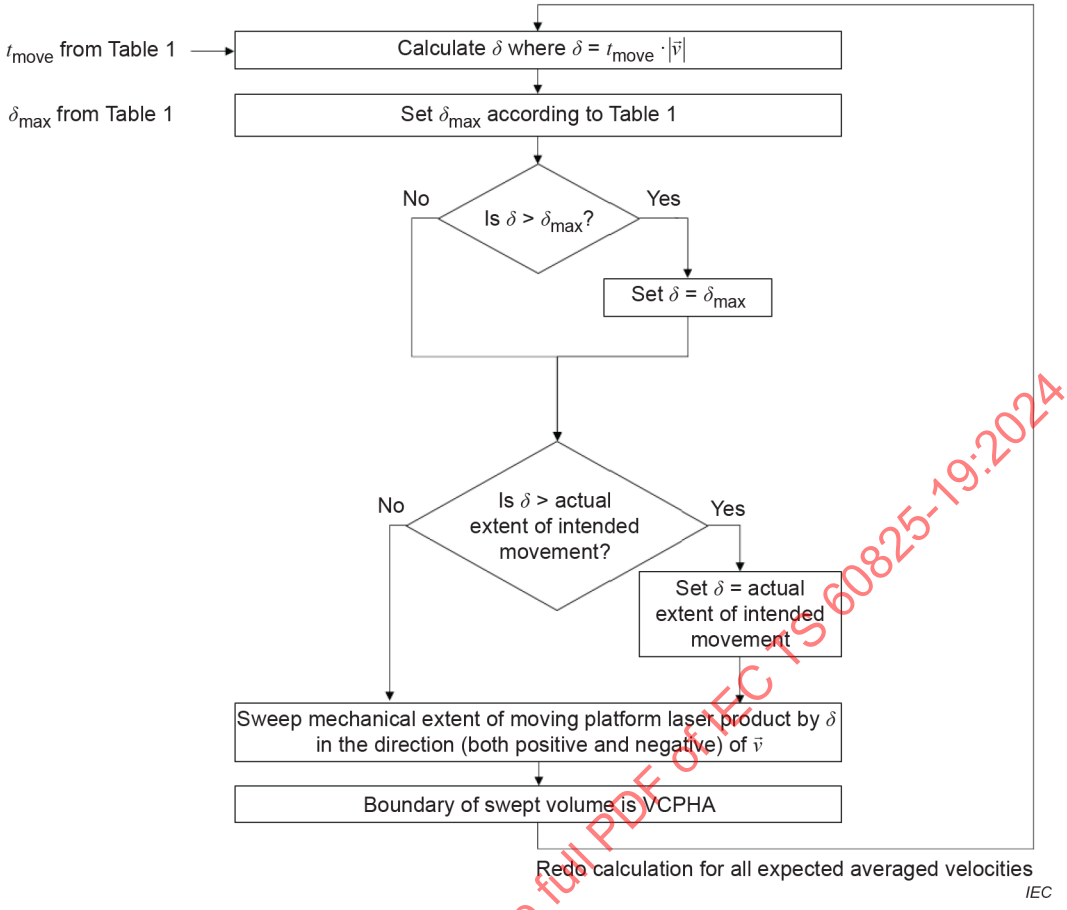
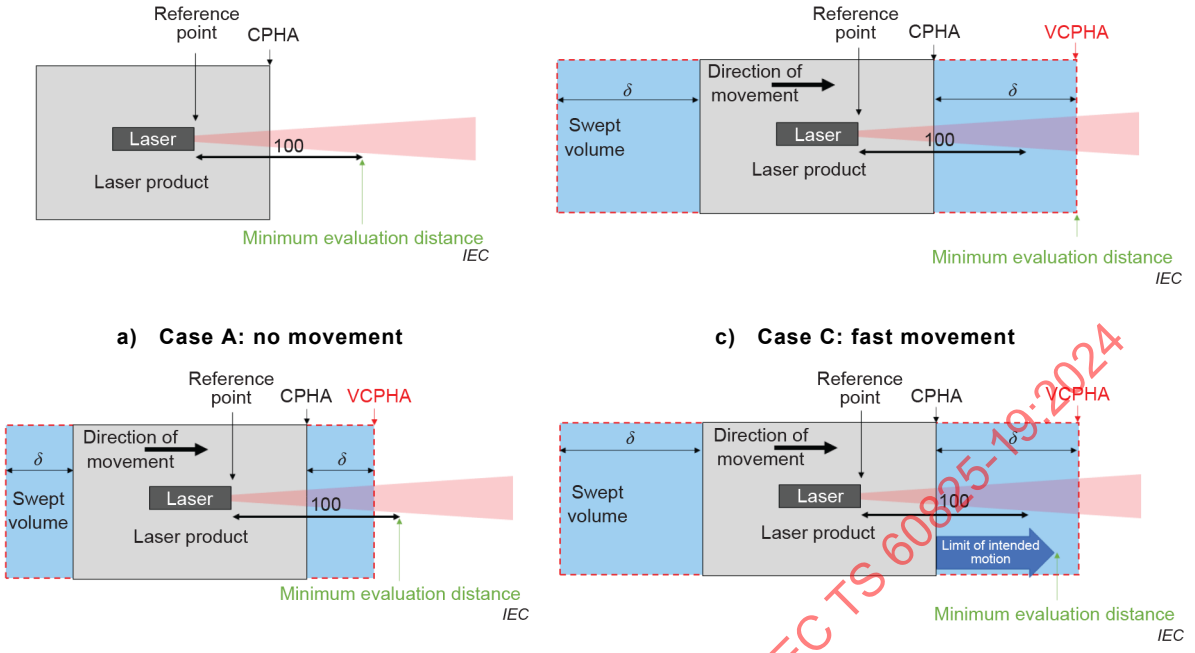


Figure A.2 – Calculation of the VCPHA for a moving platform laser product according to 5.2 for a specific averaged velocity $\vec{v}$ over the time period t_{move}

Figure A.3, Figure A.4 and Figure A.5 (not to scale) show the minimum evaluation distance for different exemplary moving platform laser products.

Dimensions in millimetres



a) Case A: no movement

c) Case C: fast movement

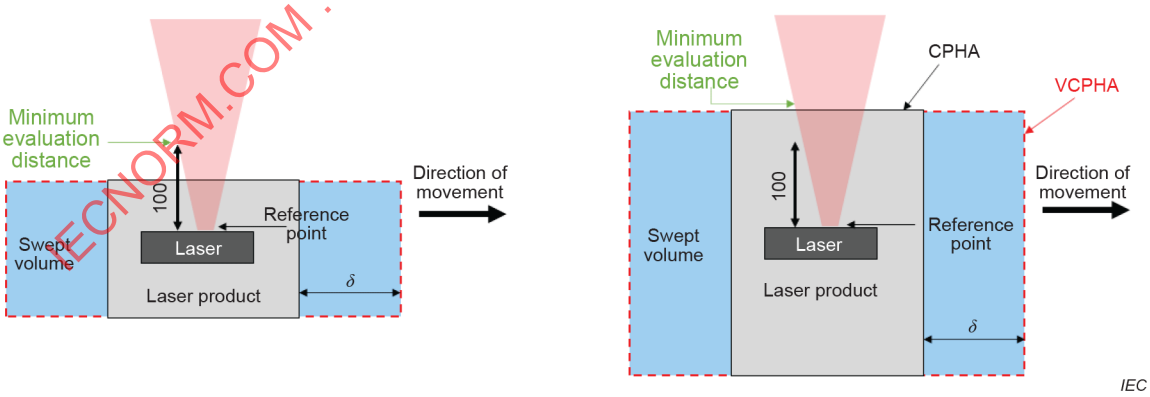
b) Case B: slow movement

d) Case D: fast movement with reduced intended motion

The minimum evaluation distance according to IEC 60825-1:2014 and this document is sketched for the four different cases.

Figure A.3 – Example of a moving platform laser product emitting in direction of movement with a reference point at the emitting chip or the vertex of the fan angle according to IEC 60825-1:2014, Table 11 and emitting visible or near infrared radiation resulting in a minimum measurement distance of 100 mm according to IEC 60825-1:2014, Table 10

Dimensions in millimetres



The minimum evaluation distance for measurement apertures to the side according to IEC 60825-1:2014 and this document is sketched for two different cases.

Figure A.4 – Example of a moving platform laser product emitting perpendicular to the direction of movement with a reference point at the emitting chip or the vertex of the fan angle according to IEC 60825-1:2014, Table 11 and emitting visible or near-infrared radiation resulting in a minimum measurement distance of 100 mm according to IEC 60825-1:2014, Table 10

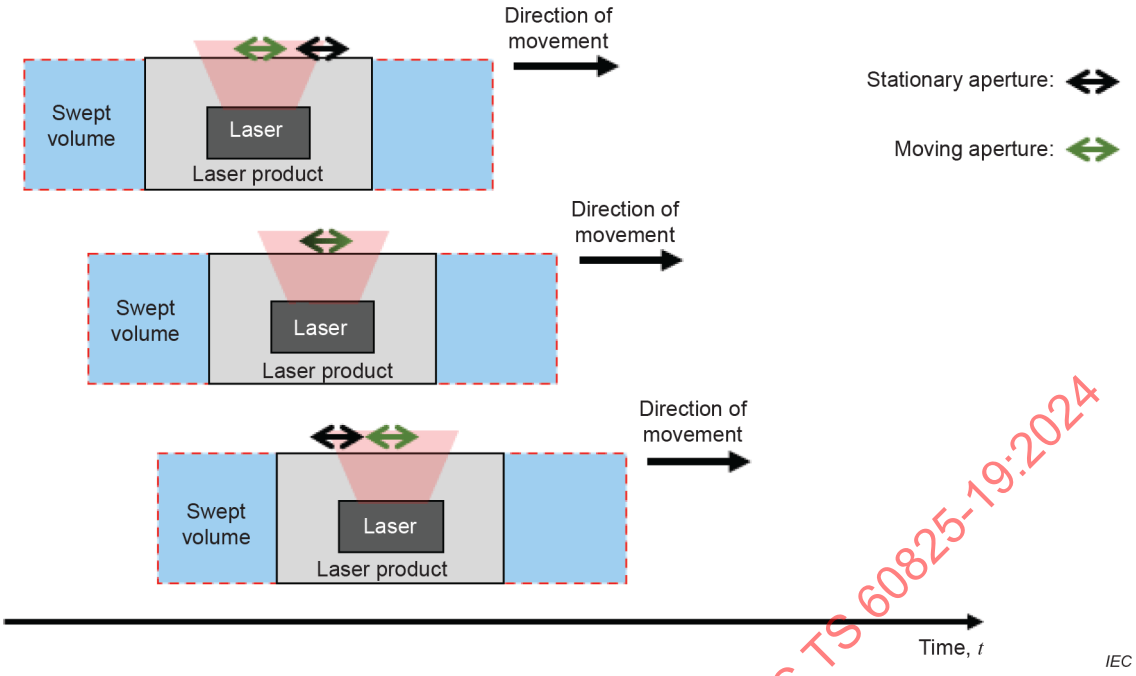
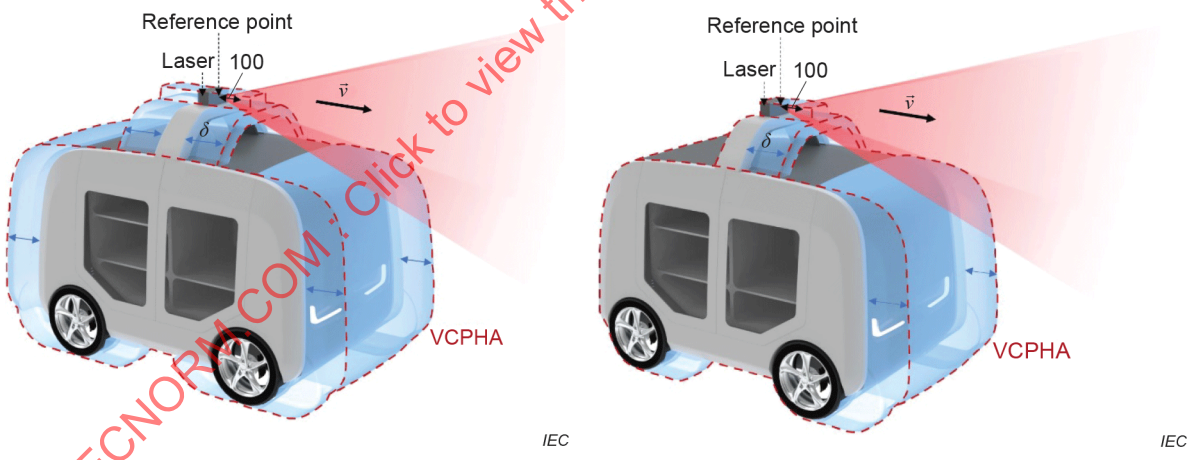


Figure A.5 – Position of the stationary and the moving aperture over time when evaluating neighbouring platforms

Figure A.6 shows a concrete example of a moving platform laser product.

Dimensions in millimetres



a) With a VCPHA

b) Possible solution with a VCPHA limited to the front if skitching is reasonably foreseeable

Figure A.6 – Example of a moving platform laser product