

TECHNICAL REPORT

**Printed electronics –
Part 303-2: Equipment – Sheet to sheet printing – Mechanical dimensions**

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IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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TECHNICAL REPORT

**Printed electronics –
Part 303-2: Equipment – Sheet to sheet printing – Mechanical dimensions**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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PRINTED ELECTRONICS –

**Part 303-2: Equipment – Sheet-to-sheet printing –
Mechanical dimensions**

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It is a Technical Report.

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

Draft	Report on voting
119/504/DTR	119/513/RVDTR

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 Report 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.

A list of all parts in the IEC 62899 series, published under the general title *Printed electronics*, can be found on the IEC website.

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

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INTRODUCTION

The field of printed electronics represents an exciting frontier in modern technology, having recently progressed from experimental stages to actual commercial production. This advancement underscores the need for scalable industrial equipment to manufacture a large volume of products efficiently.

Unlike traditional electronic products, the nascent world of printed electronics lacks universally accepted standards for the mechanical dimensions of the final products or devices. This absence presents a unique challenge in an industry with a rich history of over 1 000 years, where 'printing' commonly refers to 'image printing' or simply 'print.'

Historically, international standards have been instrumental in shaping the printing industry. These standards, defining aspects like paper size and the input and output dimensions of the printing process, have streamlined production and mitigated complications arising from unknown or variable sizes.

Embracing this established tradition of standardization, IEC TC 119 is initiating a document to delineate standard mechanical dimensions for input and output from printed electronics equipment. The intention behind this standardization is to provide a cohesive framework, enhancing interoperability and efficiency, mirroring the success achieved in traditional printing processes. This initiative marks a significant step towards integrating printed electronics into the broader landscape of industrial production.

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PRINTED ELECTRONICS –

Part 303-2: Equipment – Sheet-to-sheet printing – Mechanical dimensions

1 Scope

This part of IEC 62899, which is a Technical Report, lays down the framework for defining standard mechanical dimensions of equipment utilized in the field of printed electronics. While primarily focused on substrate-based printing equipment, the guidelines and standards established in this document also maintain flexibility for application to transient printing equipment. Through this inclusivity, the document seeks to cover a broad spectrum of the industry, ensuring uniformity and adaptability across various printing technologies in the printed electronics domain.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

3.1

S2S

sheet-to-sheet

printing operation that demands the sequential feed-in of the substrate, aligning each sheet accurately for the subsequent steps in the process

Note 1 to entry: The substrate is also called wafer in semiconductor industry.

Note 2 to entry: See also IEC 62899-101:2019 [4], 3.123.

3.2

alignment mark

specific mark or indicator used within the fabrication process to dictate the exact positioning for alignment, to guide and ensure the correct alignment of various components or layers during production, thereby maintaining precision and consistency throughout the manufacturing stage

3.3

trigger mark

designated mark or sign that serves as an indication of where the printing process is required to begin or initiate

Note 1 to entry: This mark plays a critical role in the sequence of operations, ensuring that the printing commences at the correct point, thereby maintaining the alignment and consistency of the entire process.

3.4

shuttle

<printed electronics> device or mechanism that moves back and forth between two or more fixed points, often used to transfer or guide materials within a system or process

Note 1 to entry: The shuttle's function and design can vary significantly depending on its application, such as in printing, manufacturing, or transportation systems.

Note 2 to entry: Specific parameters or characteristics related to the shuttle might possibly be defined based on its application within the particular standard.

4 Mechanical dimensions

4.1 General

The specified conditions for measuring the mechanical dimensions will be consistent and adhere to the following parameters:

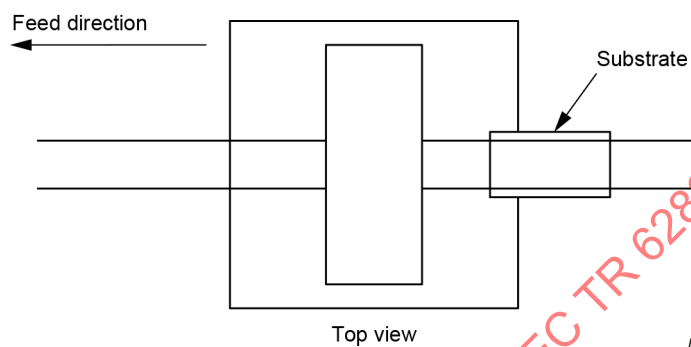
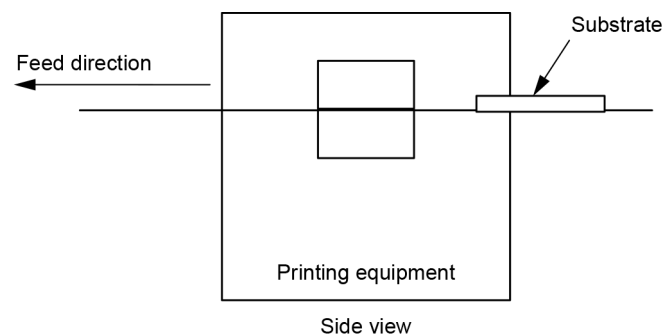
- room temperature;
- room humidity.

These measuring conditions will be accurately reported, as they play a crucial role in the precision and reliability of the measurements.

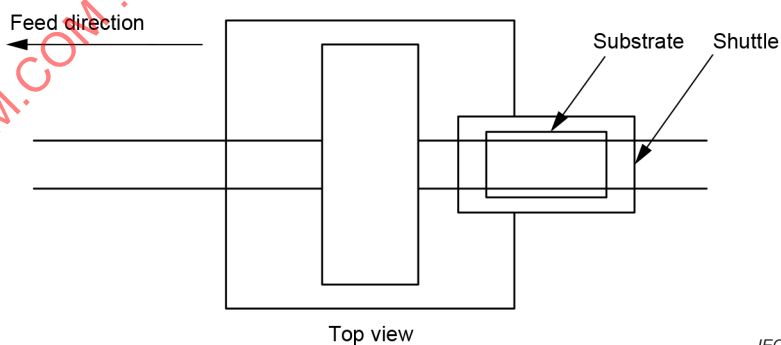
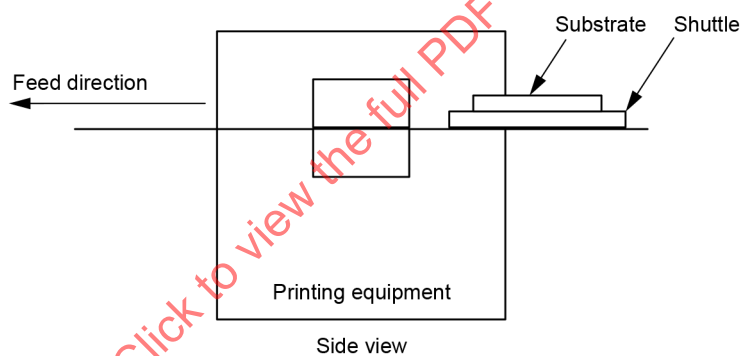
4.2 Overview of printing equipment for printed electronics

The printing systems designed for printed electronics can be broadly classified into two main categories, as shown in Figure 1:

- S2S printing system (feed substrate only): This system solely focuses on the feed-in of the substrate without any additional functionalities.
- S2S printing system with shuttles: This system includes shuttles, providing enhanced functionalities in the printing process by conveying substrate(s) on a shuttle that carries them.



a) Examples of an S2S printing system with substrate feed only



b) Examples of a S2S printing system with shuttles

Figure 1 – Overview of S2S printing system

4.3 Maximum substrate length and width, without shuttle

Figure 2 illustrates the mechanical dimensions of the maximum substrate width and length without a shuttle. As depicted in Figure 2, the maximum substrate length refers to the size of the longest substrate that the printing system can handle, while the maximum substrate width corresponds to the size of the widest substrate that the printing system can manage. These length and width measurements are expressed in millimetres.

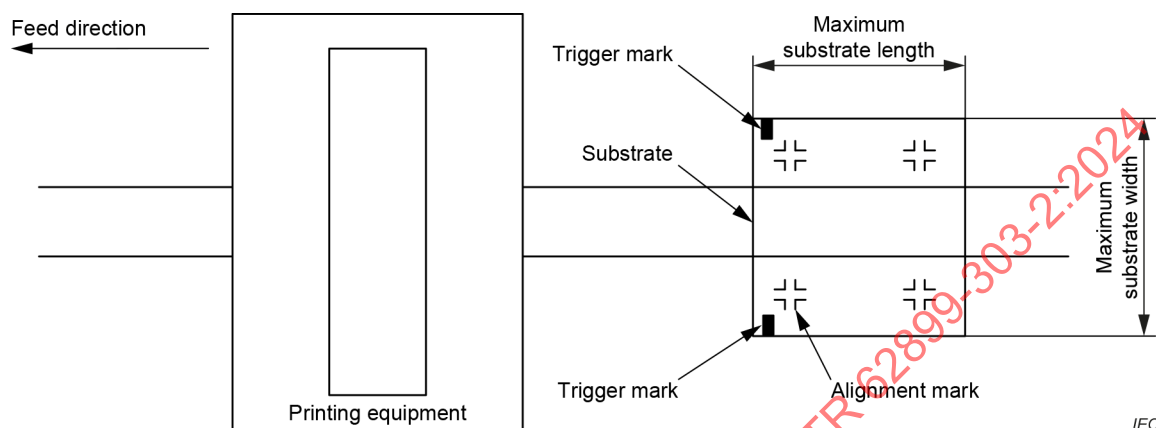


Figure 2 – Maximum substrate width and length without shuttle

4.4 Minimum substrate length and width without shuttle

As illustrated in Figure 3, the minimum substrate length refers to the size of the shortest substrate that the printing equipment can handle, while the minimum substrate width corresponds to the size of the narrowest substrate that the printing equipment can manage. These length and width measurements are expressed in millimetres.

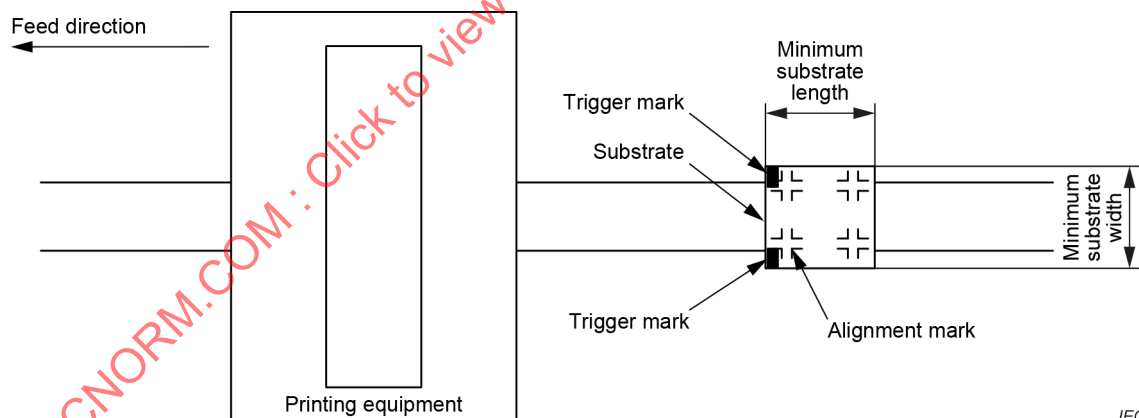


Figure 3 – Minimum substrate width and length without shuttle

4.5 Maximum printable length and width without shuttle

As Figure 4 illustrates, the maximum printable length refers to the size of the longest length that a piece of equipment can print, while the maximum printable width represents the size of the widest width that the equipment can print. These dimensions are measured in millimetres.

NOTE Neither the term 'minimum printable length' nor 'width' is defined in this context as it can vary significantly based on the printing system, substrate type, and other process parameters. Standardizing this term could inadvertently limit or misrepresent the capabilities of different S2S printing systems. Hence, it has been left open to interpretation based on the specific requirements and constraints of each individual application.

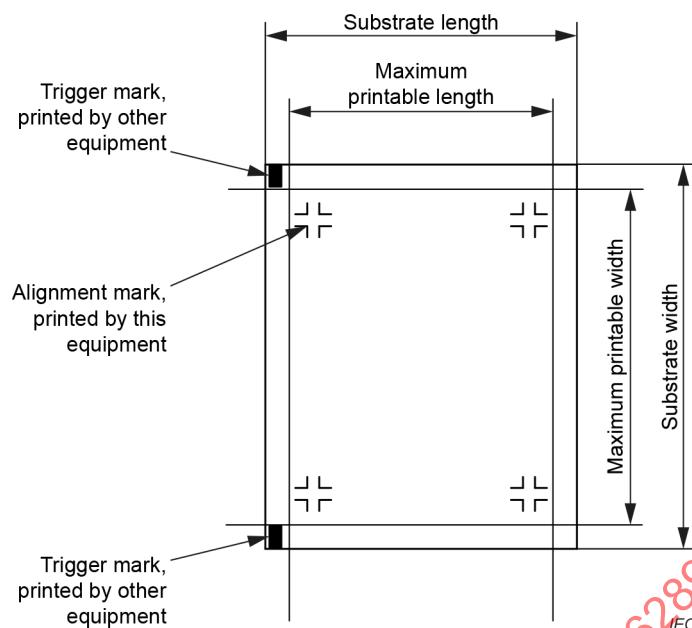


Figure 4 – Example of maximum printable width and length without shuttle

Non-functional matter, such as trigger mark(s), which can be printed by other equipment, or non-printed matter for any use, is permissible anywhere on the substrate, even outside of the maximum printable width or length.

4.6 Shuttle width

Figure 5 illustrates the mechanical dimensions pertaining to the width of a shuttle. As shown in Figure 5, the maximum shuttle width represents the size of the widest shuttle that the equipment can handle, while the minimum shuttle width indicates the size of the narrowest shuttle that the equipment can accommodate. These widths are measured in millimetres.

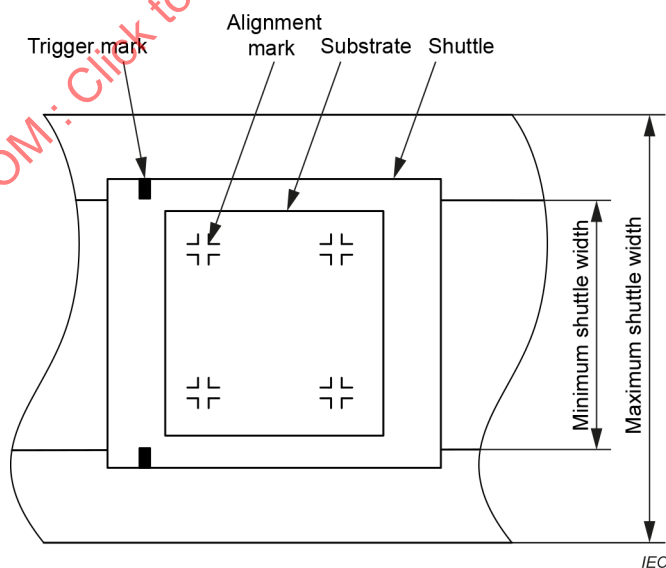


Figure 5 – Example of mechanical dimensions of shuttle

4.7 Shuttle, gap and repeat lengths

4.7.1 General

Figure 6 illustrates the relationship among shuttle, gap, and repeat lengths, showing how these three aspects interact within the system.

4.7.2 Shuttle length

Figure 6 also details the mechanical dimensions related to the shuttle length. The parameters include the minimum and maximum shuttle lengths, signifying the shortest and longest shuttles that the equipment can accommodate. These lengths are uniformly measured in millimetres.

4.7.3 Gap length

This section delineates the minimum and maximum gap lengths, representing the shortest and longest gaps that can be managed by the equipment. The gap length is also measured in millimetres.

4.7.4 Repeat length

The minimum and maximum repeat lengths are defined here, signifying the shortest and longest allowable distances between consecutive shuttles, encompassing both the shuttle length itself and an intervening gap length. Like the other parameters, these lengths are measured in millimetres.

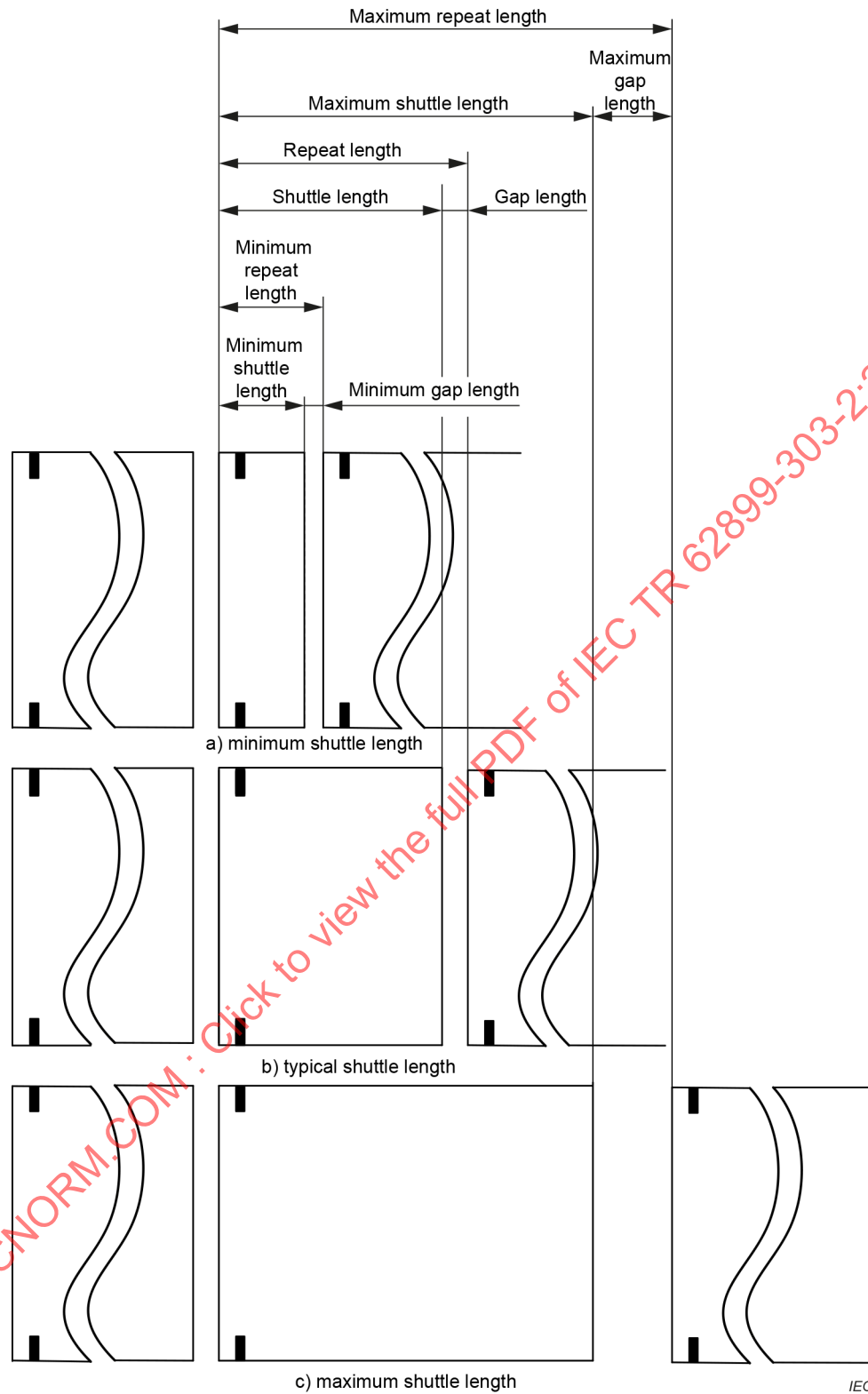


Figure 6 – Examples of shuttle length

4.8 Thickness

Figure 7 illustrates the specifications for both shuttle and substrate thickness within the equipment's operational capabilities. The parameters include the minimum and maximum shuttle thickness, representing the thinnest and thickest shuttles that the equipment can accommodate, as well as the minimum and maximum substrate thickness, signifying the thinnest and thickest substrate materials that can be handled. These thickness measurements are uniformly expressed in millimetres.

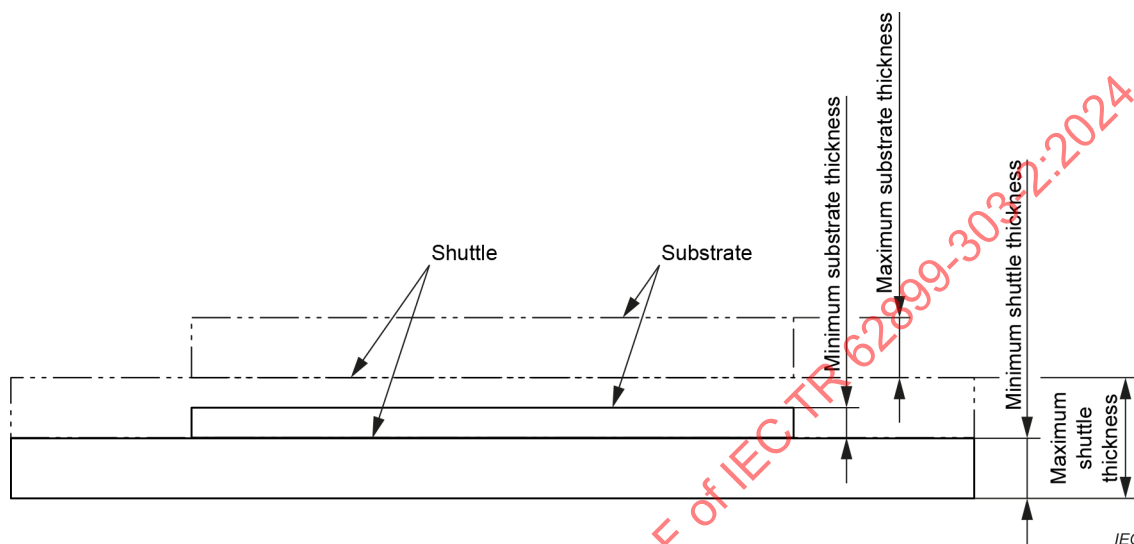


Figure 7 – Example of shuttle thickness

4.9 Maximum substrate length and width on shuttle

Figure 8 depicts the mechanical dimensions of a shuttle, specifically focusing on the length and width, as well as the constraints for maximum substrate width and length. As indicated in Figure 8, the maximum substrate length refers to the size of the longest substrate that the shuttle can accommodate, while the maximum substrate width pertains to the size of the widest substrate that can be handled by the shuttle. Both these length and width measurements are consistently expressed in millimetres.

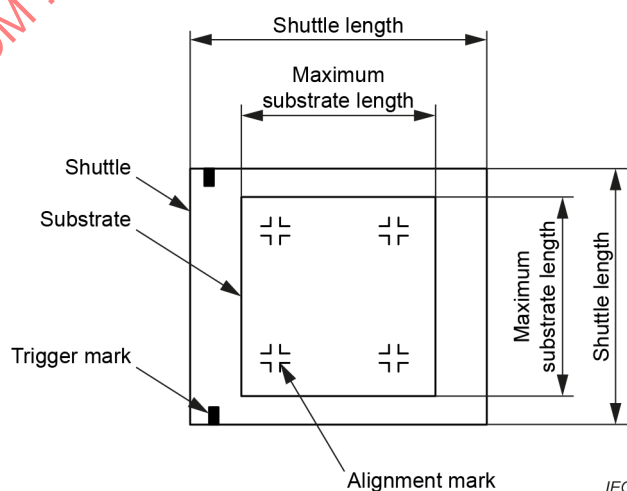


Figure 8 – Example of shuttle width and length, and maximum substrate width and length

4.10 Minimum substrate length and width on shuttle

As Figure 9 illustrates, the minimum substrate length refers to the dimensions of the shortest substrate that a shuttle can accommodate, while the minimum substrate width represents the dimensions of the narrowest substrate that the shuttle can handle. Both these length and width measurements are uniformly expressed in millimetres.

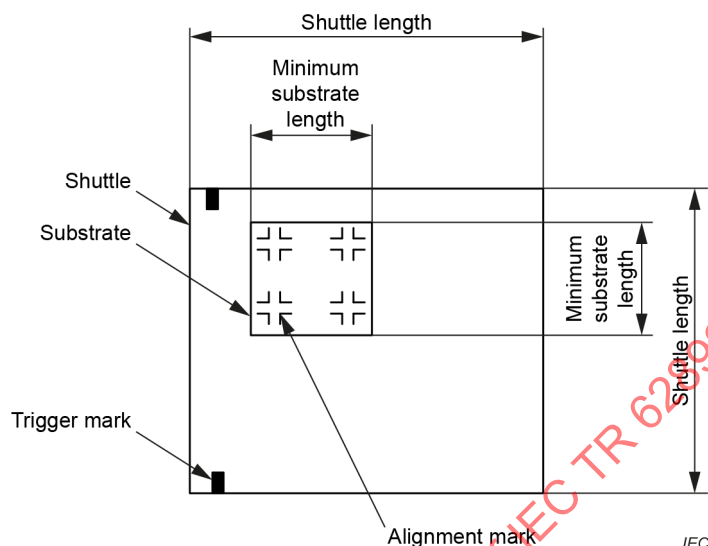


Figure 9 – Example of shuttle width and length, and minimum substrate width and length

4.11 Maximum printable length and width

Figure 10 delineates the constraints for the maximum printable dimensions within the equipment's capabilities. The maximum printable length defines the size of the longest printable length that the equipment can achieve, and the maximum printable width specifies the dimensions of the widest printable area that the equipment can produce. Both these length and width measurements are consistently expressed in millimetres.

NOTE Neither the term 'minimum printable length' nor 'width' are defined in this context as they can vary significantly based on the printing system, substrate type, and other process parameters. Standardizing this term could inadvertently limit or misrepresent the capabilities of different S2S printing systems. Hence, it has been left open to interpretation based on the specific requirements and constraints of each individual application.

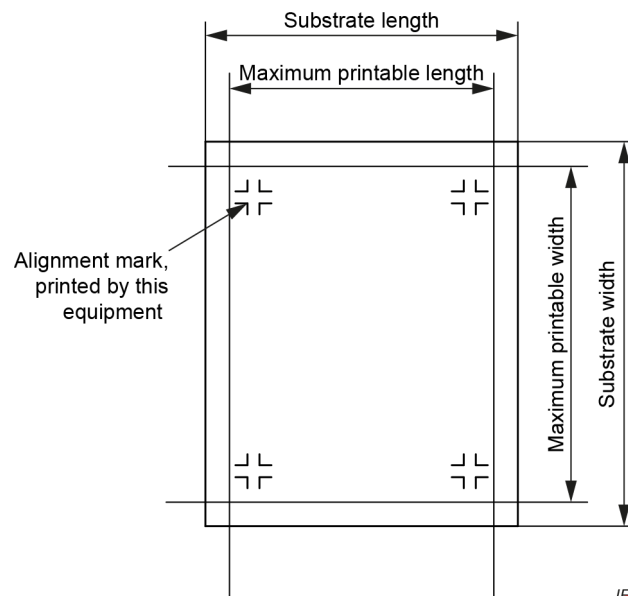


Figure 10 – Example of maximum printable width and length

Non-functional matter, including elements that can be printed by other equipment or non-printed components for various applications such as trigger marks, is permissible anywhere on the substrate. This includes locations even beyond the specified maximum printable width or length.

5 Example of the specification of the printing equipment

Table 1 provides an illustration of the specific attributes of the printing equipment. For supplementary comparison, Annex A includes dimensions that are analogous and serve as a reference.

Table 1 – Example of the specification of printing equipment

Items			Parameters
Name of equipment			'abcdef' (mm)
Shuttle	width	minimum	400
		maximum	600
	length	minimum	200
		maximum	1 100
	thickness	minimum	5
		maximum	20
Substrate	width	minimum	390
		maximum	590
	length	minimum	190
		maximum	1 050
	thickness	minimum	0,1
		maximum	10
Repeat	length	minimum	300
		maximum	500
gap	length	minimum	10
		maximum	200
Printable area on shuttle	width	minimum	50
		maximum	550
	length	minimum	50
		maximum	1 000

The specification is applied unless there is an agreement between supplier and customer.

Annex A (informative)

Examples of similar dimensions

A.1 Examples of Si-wafer

Figure A.1 and Table A.1 present an illustration of analogous mechanical dimensions for a substrate used in a different application: the Si-wafer (where "Si" represents silicon).

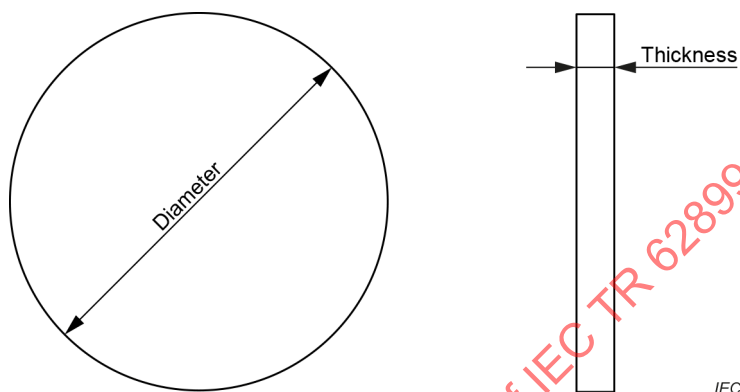


Figure A.1 – Example of mechanical dimensions for Si-wafer

Table A.1 – Example of mechanical dimensions

Wafer size [inch]	Diameter [mm]		Thickness [μm]	
	JEITA [1] ¹	SEMI [2]	JEITA [1]	SEMI [2]
2"	-	50,8 ± 0,38	-	279 ± 25
3"	76 ± 0,5	76,2 ± 0,63	380 ± 15	381 ± 25
4"	100 ± 0,2	100 ± 0,5	525 ± 15	520 ± 20
5"	125 ± 0,2	125 ± 0,5	625 ± 15	625 ± 20
6"	150 ± 0,2	150 ± 0,2	675 ± 15	675 ± 20
8"	200 ± 0,5	200 ± 0,2	725 ± 25	725 ± 20
12"	300 ± 0,2	300 ± 0,2	775 ± 25	775 ± 20

¹ Numbers in square brackets refer to the Bibliography.