

INTERNATIONAL STANDARD



**Printed electronics –
Part 403-1: Printability – Requirements for reproducibility – Basic patterns for
evaluation of printing machine**

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Part 403-1: Printability – Requirements for reproducibility – Basic patterns for
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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	7
4 Abbreviated terms	8
5 General description of basic pattern	8
6 Basic pattern for evaluation	8
6.1 General.....	8
6.2 PMVT	9
6.3 PMHZ	9
6.4 PMAG	10
6.5 PMAR	11
6.6 PMCR.....	12
7 Register marks	13
7.1 General.....	13
7.2 Design of register mark.....	14
7.2.1 Square register mark	14
7.2.2 Circle register mark	14
7.2.3 Doughnut register mark	14
7.2.4 Triangle register mark.....	15
7.2.5 Diamond register mark.....	15
7.2.6 Cross register mark	15
7.2.7 Double cross register mark.....	16
7.2.8 X cross register mark.....	16
8 Requirements for evaluation.....	17
8.1 Evaluation items	17
8.2 Measurement methods and instruments	17
9 Evaluation pattern information	17
9.1 General.....	17
9.2 PMVT	17
9.3 PMHZ	17
9.4 PMAG	17
9.5 PMAR	18
9.6 PMCR	18
Annex A (informative) Examples of basic pattern layouts	19
A.1 Example 1.....	19
A.2 Example 2.....	19
Annex B (informative) Use case of basic pattern	20
B.1 General.....	20
B.2 Large variation of cylinder rotation speed with a normal plate	20
B.3 Out-of-roundness of cylinder with a normal plate.....	21
Annex C (informative) Other evaluation patterns	23
C.1 General.....	23
C.2 Example.....	23

Bibliography.....	24
Figure 1 – PMVT.....	9
Figure 2 – PMHZ.....	10
Figure 3 – PMAG.....	11
Figure 4 – PMAR.....	12
Figure 5 – PMCR.....	13
Figure 6 – Register marks.....	14
Figure 7 – Square register mark.....	14
Figure 8 – Circle register mark.....	14
Figure 9 – Doughnut register mark.....	15
Figure 10 – Triangle register mark.....	15
Figure 11 – Diamond register mark.....	15
Figure 12 – Cross register mark.....	16
Figure 13 – Double cross register mark.....	16
Figure 14 – X cross register mark.....	16
Figure A.1 – Example of basic pattern layout in a printing area and a margin area.....	19
Figure A.2 – Example of basic pattern layout in a margin area.....	19
Figure B.1 – Example of use case for PMVT.....	21
Figure B.2 – Example of use case for PMAR.....	22
Figure C.1 – Semi-arcs and circular doughnuts.....	23

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PRINTED ELECTRONICS –

**Part 403-1: Printability – Requirements for reproducibility –
Basic patterns for evaluation of printing machine**

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International Standard IEC 62899-403-1 has been prepared by IEC technical committee 119: Printed Electronics.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
119/214/FDIS	119/223/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

The IEC 62899-403 series contains basic patterns to evaluate the printability of a printing machine, plating, and applications for printed electronics. The printability is defined as both the quality of printed patterns and the reproducibility of printing designs as the result of the interaction of printing media, inks, and substrates. The documents from the IEC 62899-403 series provide commonly-utilized design patterns for evaluating printability. The quality of printed patterns is satisfied by accurate measuring, with a mechanical, physical, or optical apparatus, the patterns being two-dimensional or three-dimensional. On the other hand, the reproducibility of printing designs is achieved by estimating the reproducibility of replica.

The IEC 62899-402 series assumes a large role in the standardization of measuring methods for these printed patterns, and the IEC 62899-403 series has a key role in standardizing the estimation of the patterns' reproducibility.

In the business field, requests from industry to apply the printing technology to electronics manufacturing have been guarantees for both the quality and reproducibility that have helped facilitate international trade and enhanced user value in the field of printed electronics.

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PRINTED ELECTRONICS –

Part 403-1: Printability – Requirements for reproducibility – Basic patterns for evaluation of printing machine

1 Scope

This part of 62899-403 specifies commonly-utilized basic design patterns to evaluate printing machines with pattern reproducibility from the view point of printability in the field of printed electronics. These basic patterns consist of several evaluation patterns and register marks.

Printability is derived from the evaluation of the reproducibility of these printed patterns produced by the printed machine.

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 60050 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at www.electropedia.org)

IEC 62899-402 (all parts), *Printed electronics – Part 402-X: Printability – Measurement of qualities*

ISO 3, *Preferred numbers – Series of preferred numbers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050 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

basic pattern

set of two-dimensional figures, which consist of evaluation patterns and register marks, used to inspect the reproducibility of printed patterns

3.2

evaluation pattern

set of fundamental figures to evaluate the printability for printing machines in printed electronics

3.3

register mark

set of marks that correspond to each other's position

3.4

printed pattern

pattern which is printed by a machine

3.5

machine direction

one of the directions in which a substrate is carried by a printing or coating machine

3.6

printing area

imaging or drawing area on a page or substrate made by a printing machine

3.7

margin area

blank border around the printing area on a page or substrate

4 Abbreviated terms

For the purposes of this document the following abbreviated terms apply.

PMVT	Vertical evaluation pattern for printability on machine
PMHZ	Horizontal evaluation pattern for printability on machine
PMAG	Angle evaluation pattern for printability on machine
PMAR	Arrow evaluation pattern for printability on machine
PMCR	Corner evaluation pattern for printability on machine

5 General description of basic pattern

The basic pattern is a collection of two-dimensional graphical figures, which are basic and have various shapes according to the intended use but are kept to the minimum necessary, to estimate the printability for printing machines, plates, and applications. The collection is expected to be commonly-used, for any purpose, by relevant operators, engineers, scientists, and others in the field of printed electronics.

The basic pattern in this document has two types of pattern: evaluation patterns and register marks. Both of them are specified by graphical figures and dimensions.

The basic pattern for evaluation consists of straight lines, diagonal lines, and circular lines. The patterns are used to evaluate printability under the actual use of an electronic circuit.

The basic pattern for registration consists of square, circle, doughnut, triangle, diamond, cross, double cross, and X cross marks. The marks are used for the register.

6 Basic pattern for evaluation

6.1 General

The evaluation patterns consist of the following five patterns. These patterns shall be used for the evaluation of printing. These patterns are described in a uniform way.

- a) PMVT (see 6.2) for vertical printability

- b) PMHZ (see 6.3) for horizontal printability
- c) PMAG (see 6.4) for angle printability
- d) PMAR (see 6.5) for arrow printability
- e) PMCR (see 6.6) for corner printability

See Annex B and Annex C for use cases of evaluation patterns.

Values in 6.2 to 6.6 shall be selected from values specified in ISO 3.

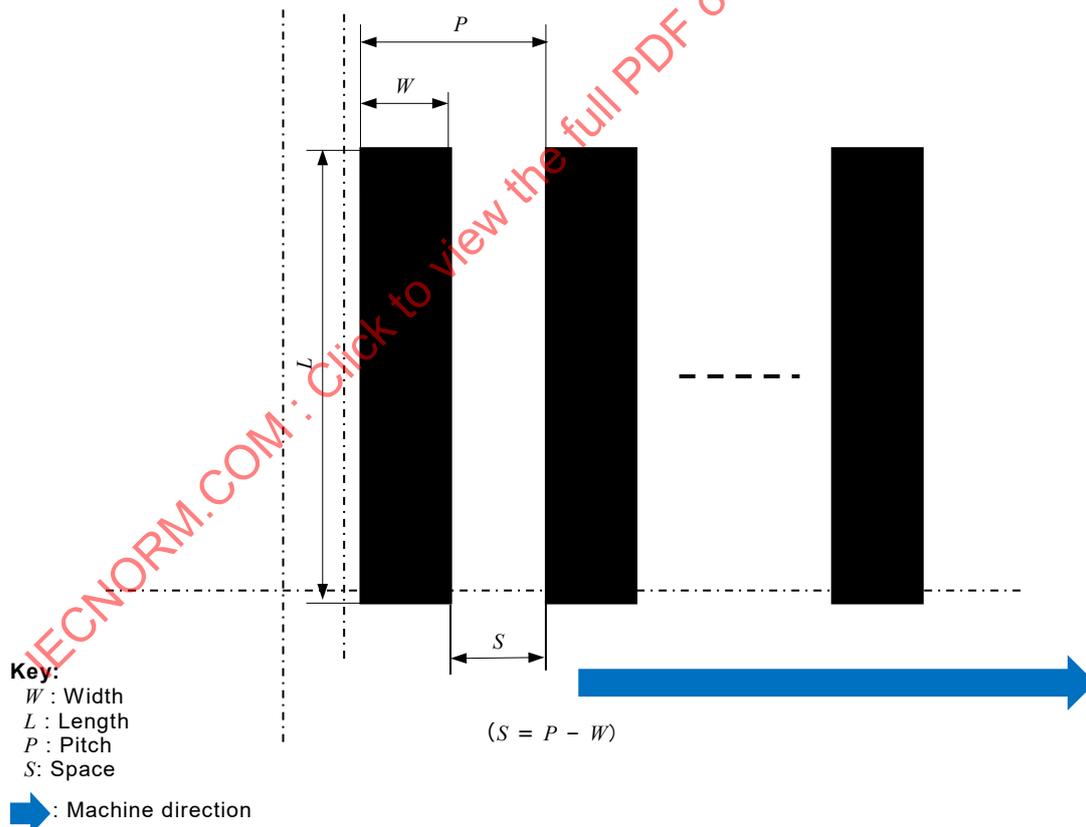
6.2 PMVT

PMVT shall be a set of straight lines perpendicular to the machine direction as shown in Figure 1.

The width may be selected from 3 µm, 5 µm, 8 µm, 10 µm, 20 µm, 50 µm, 80 µm, 100 µm, or 200 µm.

The pitch shall be twice the width.

The length shall be more than ten times the width. When the length is beyond the printing area, the length may be less than ten times.



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Figure 1 – PMVT

6.3 PMHZ

PMHZ shall be a set of straight lines parallel to the machine direction as shown in Figure 2.

The width may be selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm .

The pitch shall be twice the width.

The length shall be more than ten times the width. When the length is beyond the printing area, the length may be less than ten times.

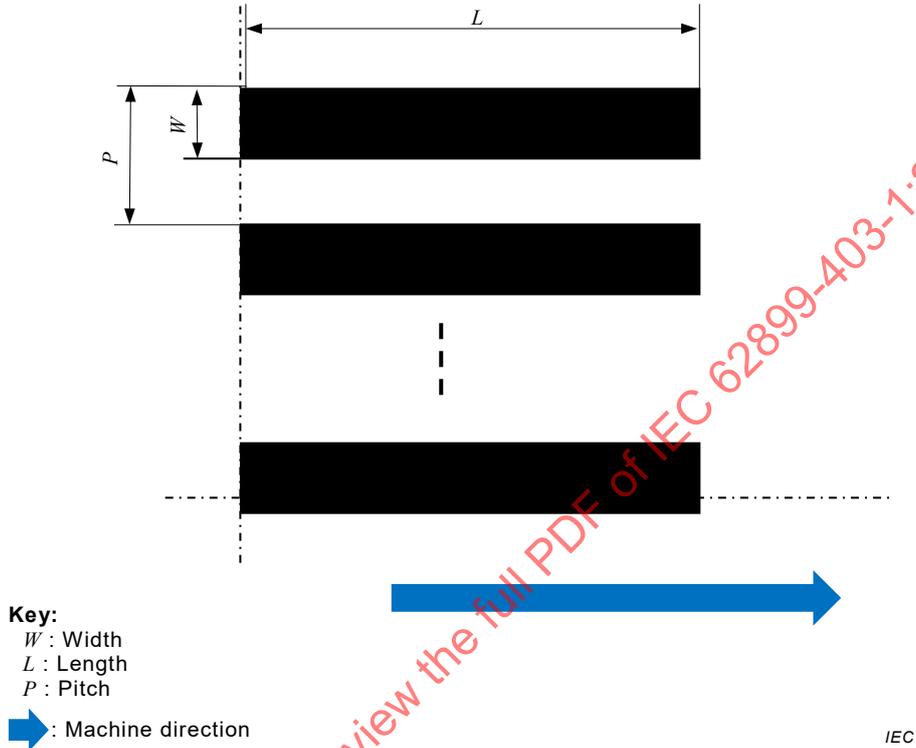


Figure 2 – PMHZ

6.4 PMAG

PMAG shall be a set of straight lines diagonal to the machine direction as shown in Figure 3.

The width may be selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm .

The length shall be more than ten times the width. When the length is beyond the printing area, the length may be less than ten times.

The angle θ shall be every 5° from 0° to 180°.

The space between two lines is at least the width of the line.

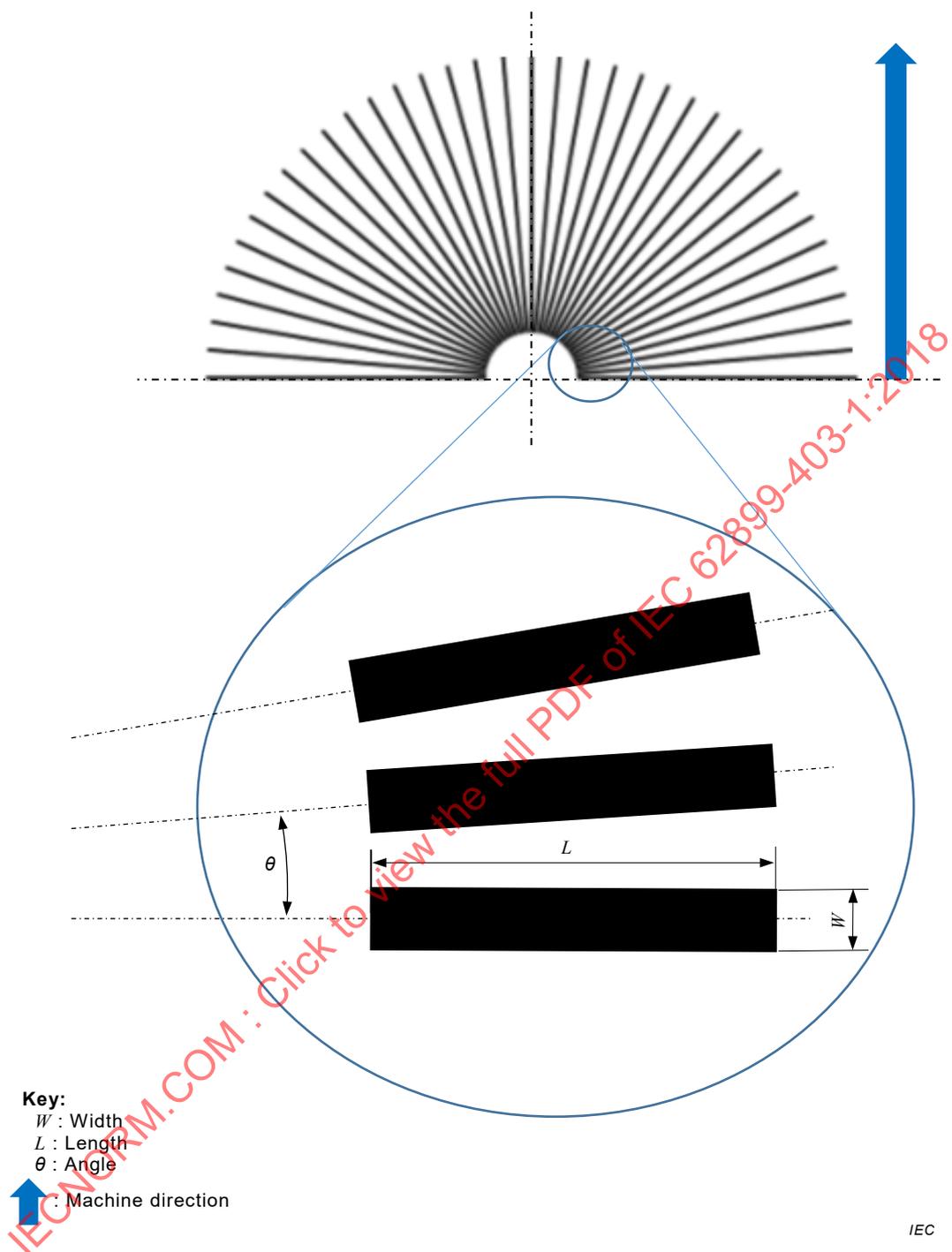


Figure 3 – PMAG

6.5 PMAR

PMAR shall be a set of arrows to the machine direction as shown in Figure 4.

The width may be selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm .

The pitch shall be twice the width.

The length shall be more than ten times the width. When the length is beyond the printing area, the length may be less than ten times.

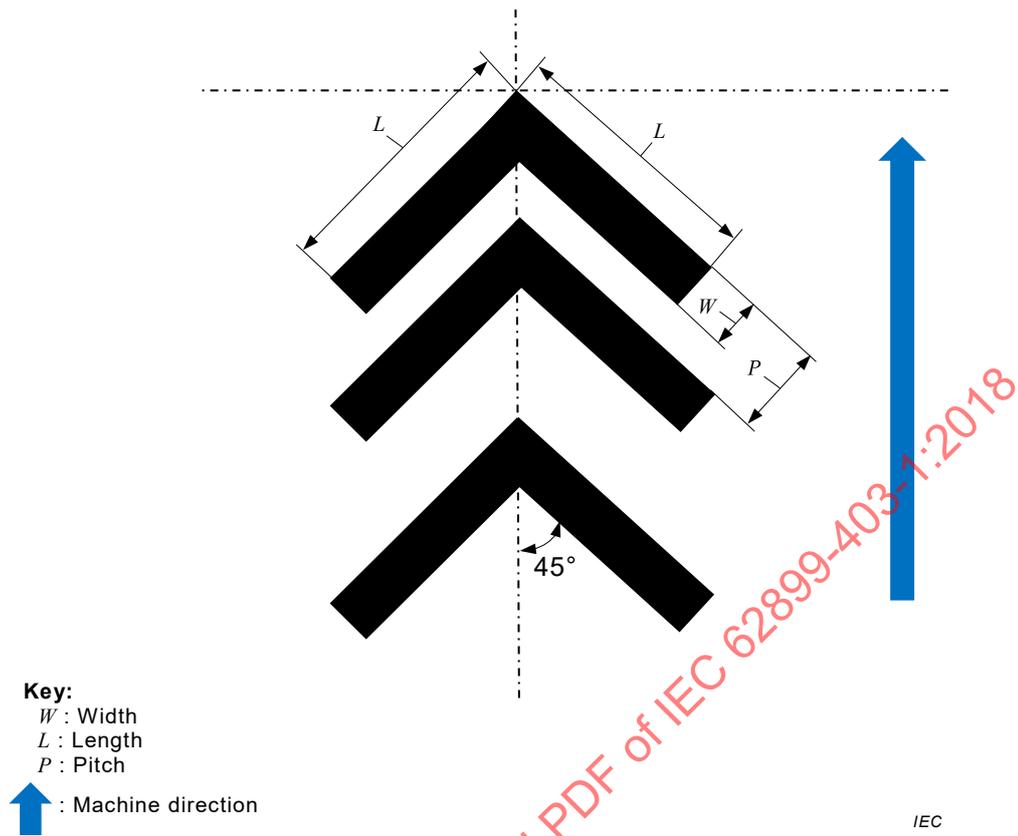


Figure 4 – PMAR

6.6 PMCR

PMCR shall be a set of perpendicular lines connected with an arc to the machine direction as shown in Figure 5.

The width may be selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm .

The pitch shall be twice the width.

The length shall be more than ten times the width. When the length is beyond the printing area, the length may be less than ten times.

The corner radius shall be one-and-a-half times the width.

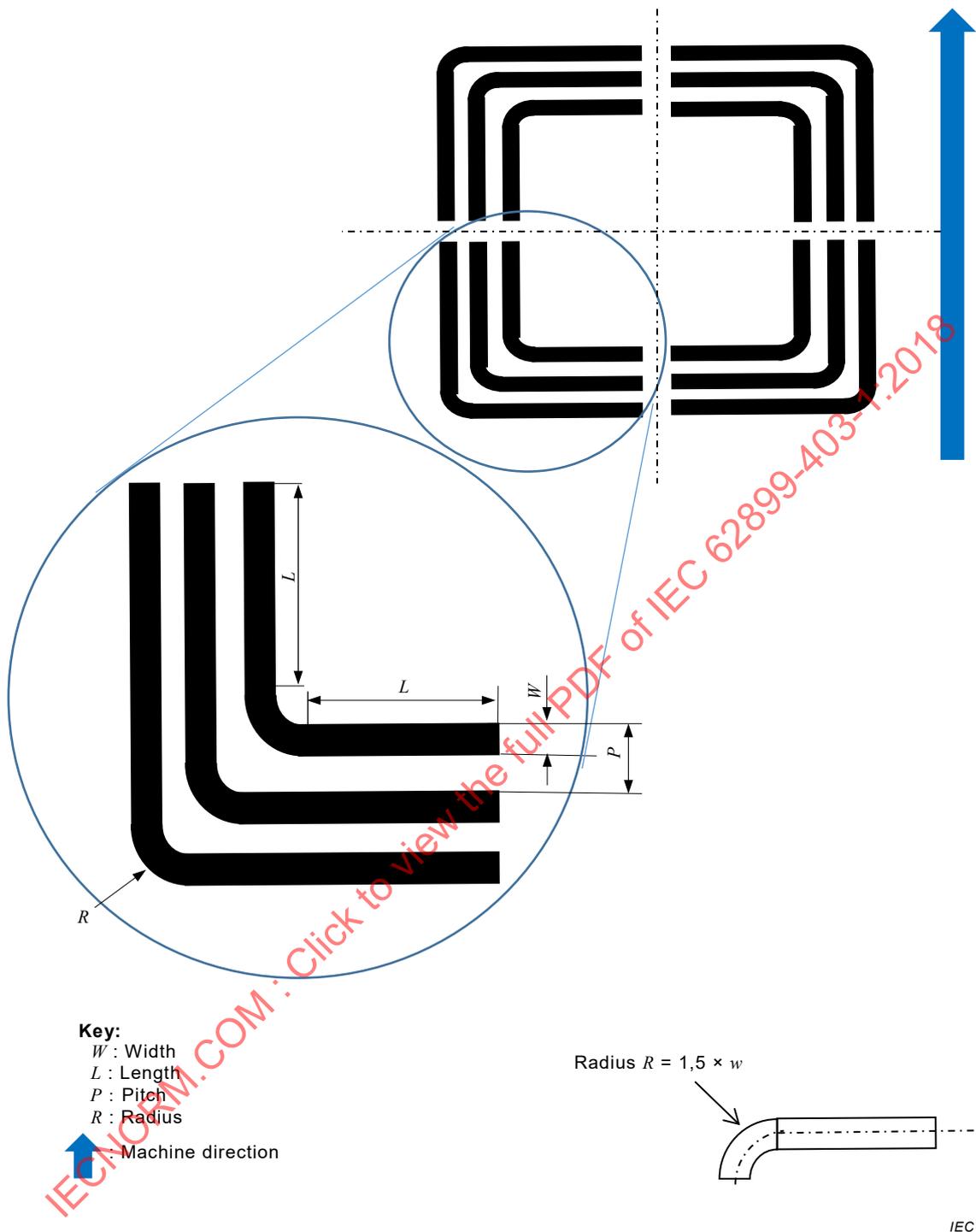


Figure 5 – PMCR

7 Register marks

7.1 General

Register marks consist of the following eight marks (see Figure 6). These patterns shall be used for evaluations.

Each mark shall be recognized when two marks overlap. Size should be agreed between the supplier and the customer.

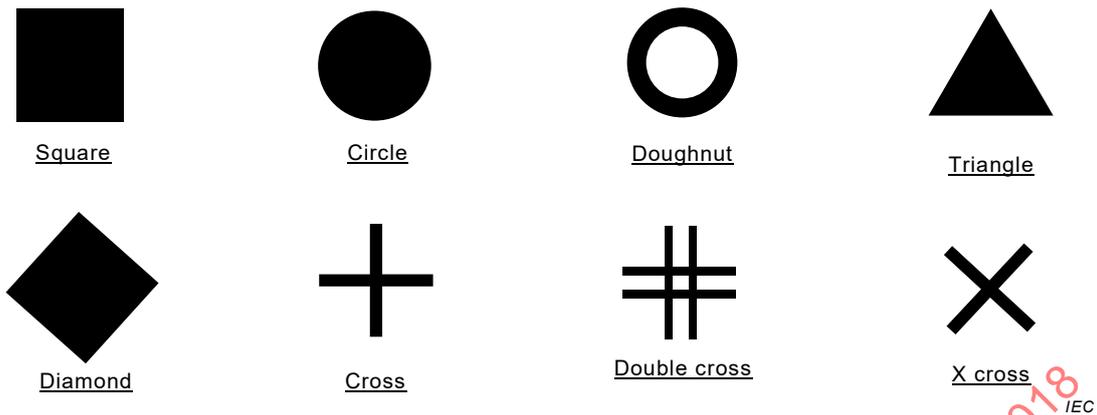


Figure 6 – Register marks

7.2 Design of register mark

7.2.1 Square register mark

A square register mark shall be a square with width W as shown in Figure 7.



Figure 7 – Square register mark

7.2.2 Circle register mark

A circle register mark shall be a circle with diameter D as shown in Figure 8.

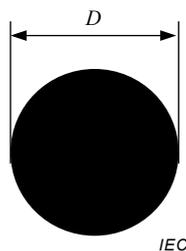


Figure 8 – Circle register mark

7.2.3 Doughnut register mark

A doughnut register mark shall be a doughnut shape with an outer diameter of D_1 and an inner diameter of D_2 as shown in Figure 9. D_2 should be 80 % of D_1 .

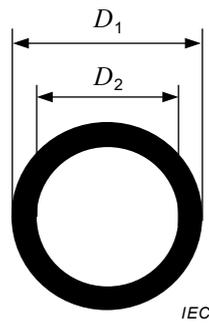


Figure 9 – Doughnut register mark

7.2.4 Triangle register mark

A triangle register mark shall be an equilateral triangle with width W as shown in Figure 10.

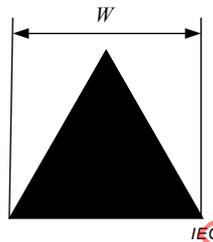


Figure 10 – Triangle register mark

7.2.5 Diamond register mark

A diamond register mark shall be an equilateral quadrangle with width W and length L as shown in Figure 11.

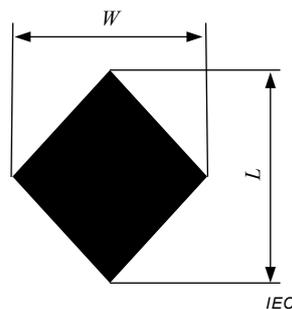


Figure 11 – Diamond register mark

7.2.6 Cross register mark

A cross register mark shall be two lines crossed at the centre of the lines with width W as shown in Figure 12.

The width should be 10 % of the length.

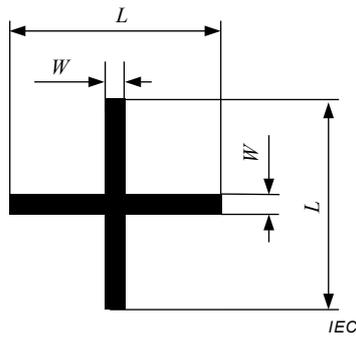


Figure 12 – Cross register mark

7.2.7 Double cross register mark

A double cross register mark shall be four crossed lines with width W and interval I as shown in Figure 13.

Interval I should be 20 % of length L . The width W should be 10 % of the length L .

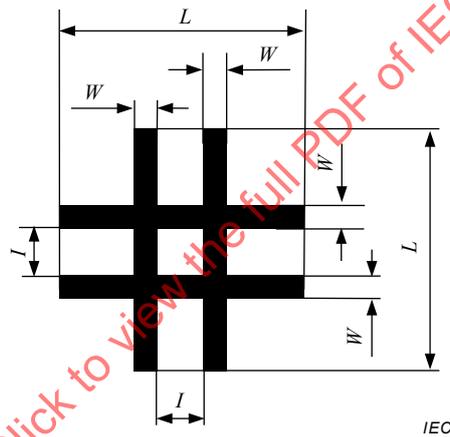


Figure 13 – Double cross register mark

7.2.8 X cross register mark

An X cross register mark shall be two lines crossed at the centre of the lines with width W and length L as shown in Figure 14.

The width should be 10 % of the length L .

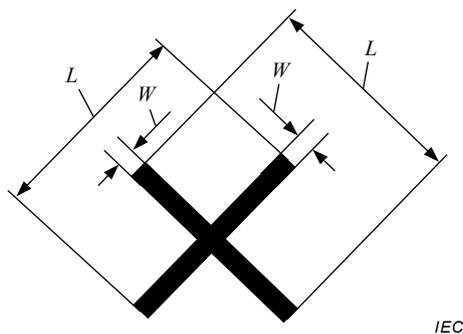


Figure 14 – X cross register mark

8 Requirements for evaluation

8.1 Evaluation items

Each evaluation item shall be agreed between the supplier and the customer.

See Annex A for examples of basic pattern layouts.

8.2 Measurement methods and instruments

Measurements and instruments shall be according to IEC 62899-402 (all parts). Other measurements and instruments should be agreed between the component supplier and the customer.

9 Evaluation pattern information

9.1 General

The reporting items should be agreed between the supplier and the customer. The report should contain the types of evaluation pattern and its parameters.

Values in 9.2 to 9.6 shall be selected from the values specified in ISO 3.

9.2 PMVT

PMVT shall be as follows:

- a) widths selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm
- b) number of lines for every width
- c) length for every width
- d) location

9.3 PMHZ

PMHZ shall be as follows:

- a) widths selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm
- b) number of lines for every width
- c) length for every width
- d) location

9.4 PMAG

PMAG shall be as follows:

- a) widths selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm
- b) number of lines for every width
- c) length for every width
- d) location

9.5 PMAR

PMAR shall be as follows:

- a) widths selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm
- b) number of lines for every width
- c) length for every width
- d) location

9.6 PMCR

PMCR shall be as follows:

- a) widths selected from 3 μm , 5 μm , 8 μm , 10 μm , 20 μm , 50 μm , 80 μm , 100 μm , or 200 μm
- b) number of lines for every width
- c) length for every width
- d) location

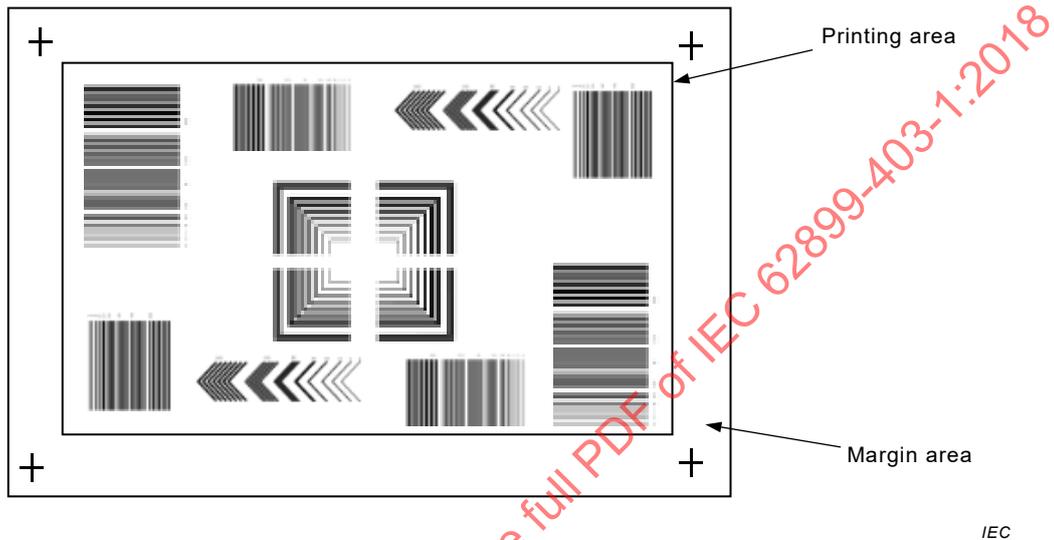
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Annex A (informative)

Examples of basic pattern layouts

A.1 Example 1

Evaluation patterns are layouts in a printing area of target, and register marks are layouts in a margin area (see Figure A.1).

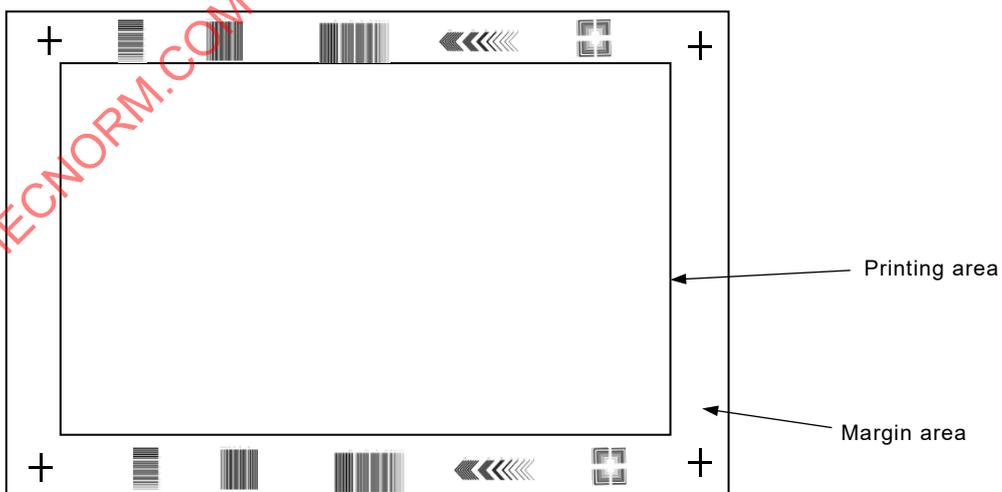


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Figure A.1 – Example of basic pattern layout in a printing area and a margin area

A.2 Example 2

All the evaluation patterns and register marks are layouts in a margin area (see Figure A.2).



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Figure A.2 – Example of basic pattern layout in a margin area

Annex B (informative)

Use case of basic pattern

B.1 General

As the motion of a printing machine is complicated, it is a time-consuming process to identify the specific cause for printing errors, but by reiteration of the hypothesis and test, it will be possible to interpret the specific cause through these kinds of phenomena as a result of the printing process. By using the basic patterns proposed in this document, collective intelligence and transparency for the errors can be accumulated by a user. There are two simple examples shown below.

B.2 Large variation of cylinder rotation speed with a normal plate

Light and dark contrast of the printing pattern are observed (see Figure B.1).

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