INTERNATIONAL STANDARD

ISO 9959-2

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Numerically controlled draughting machines — Draughting test for evaluation of performance —

Part 2:
Monochrome raster plotters

Machines à dessiner à commande numérique — Essai de traçage pour l'évaluation des performances —

Partie 2: Traceurs à quadrillages monochromes

Reference number
ISO 9959-2:1999(E)

Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

International Standard ISO 9959-2 was prepared by Technical Committee ISO/TC 10, *Technical drawings, product definition and related documentation*, Subcommittee SC 9, *Media and equipment for drawing and related documentation.*

ISO 9959 consists of the following parts, under the general title *Numerically controlled draughting machines — Draughting test for evaluation of performance:*

— *Part 1: Vector plotters*

— *Part 2: Monochrome raster plotters*

Annex A of this part of ISO 9959 is for information only.

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Numerically controlled draughting machines — Draughting test for evaluation of performance —

Part 2:
Monochrome raster plotters

1 Scope

This part of ISO 9959 specifies a draughting test for plotters based on raster image technology for evaluating the quality of the graphic output, independently of the machine type. It is applicable to monochrome raster plotters.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 9959. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 9959 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3098-1:—[1)], *Technical product documentation — Lettering — Part 1: Latin alphabet, numerals and marks.*

ISO 9179-1:1988, *Technical drawings — Numerically controlled draughting machines — Part 1: Vocabulary.*

3 Terms and definitions

For the purposes of this part of ISO 9959, the terms and definitions given in ISO 9179-1 and the following apply.

3.1 General physical terms and definitions

3.1.1
dot
smallest image element

3.1.2
dot density
number of dots per unit length or area

NOTE It is expressed in dots per millimetre or square millimetre.

1) To be published. (Revision of ISO 3098-1:1974)

3.1.3
dot size
size of the smallest element which can be drawn

NOTE The shape may be circular, square or irregular.

3.1.4
dot overlap
overlapping percentage of a nominal dot with an adjacent dot

NOTE Dot overlap may be different in the X, Y and off-axis directions of the machine.

3.1.5
image density
reflection or transmission density of the plotted image

3.1.6
transmission density
logarithmic measure of the amount of light transmitted through the image

3.1.7
reflection density
logarithmic measure of the amount of light reflected from the image

3.1.8
X axis
direction parallel to the motion of the media through the machine

3.1.9
Y axis
direction perpendicular to the motion of the media through the machine

3.1.10
grey scale
ability to image different levels of grey

3.1.11
resolution
ability to resolve fine closely spaced lines

3.1.12
addressable resolution
addressability
number of addressable dots per unit length in X and Y axes

3.1.13
image margins
distance from the maximum image to the edge of the medium along X and Y axes

3.1.14
fixing
adhesion of the image to the medium

3.1.15
light resistance
ability of a line written on specified testing paper to remain visible after exposure to specified light for a specified length of time

[ISO 12756:1998]

3.1.16
water resistance
ability of a line written on specified testing paper to remain visible after immersion in distilled or deionized water for a specified length of time

[ISO 12756:1998]

3.2 Terms and definitions concerning operation

3.2.1
imaging speed
plotting speed
rate of image generation along the X axis

NOTE Definition different from that given in ISO 9179-1.

3.2.2
imaging time
time required to make a standard plot

3.2.3
warm-up time
time required for the machine to achieve thermal equilibrium or those conditions necessary to produce output

3.2.4
environmental operating condition
temperature and humidity ranges necessary for proper operation

3.3 Terms and definitions concerning image quality evaluation

3.3.1
positional accuracy
worst-case percentage error in the distance between two parallel lines, defined in both X and Y axes, over a length sufficient to eliminate effects due to resolution and cyclic errors

3.3.2
diameter variation
difference between the maximum and minimum diameters of a circle, sufficiently large to eliminate effects due to resolution and cyclic errors

3.3.3
linearity
constancy of scale over the entire plotting area

3.3.4
ability to image a 90° angle
deviation from 90° of intersecting lines intended to be perpendicular

3.3.5
skew
angle formed by the edges of the medium and the margins of the image in the X axis of the plotter

3.3.6
usable plot width
maximum plottable width

3.3.7
usable plot length
maximum plottable length

3.3.8
minimum line width
average width of the smallest line that can be imaged along X and Y axes of the plotter

3.3.9
banding
cyclic optical density variation in either X or Y direction of the plotter

3.3.10
uniformity
evenness of the image density within a given plot

3.3.11
line ends
shape and positional variance of the ends of the obtained line from the end points

NOTE Line ends may be butt (square and terminating at the end point), square (square and terminating one-half line width beyond the end point), round (with a radius equal to one-half the line width).

3.3.12
line join
appearance of connected line ends when line segments meet at an acute angle

NOTE A line join may be bevelled, rounded, triangular or mitred.

3.3.13
waves
periodic perturbation affecting line straightness (e.g. measurement of deviation and frequency)

3.3.14
staircasing
jaggy
stepped appearance of a line or curve composed of discrete line segments

3.3.15
jitter
cyclic misregistration of dots along X and Y axes

3.3.16
feathering
diffusion of ink outside the intended dot area, giving a woolly and feathered appearance to the image

3.3.17
smear
imaged line where one side of the line is sharply defined and the other side of the line is not sharp and is diffuse

3.3.18
flare
defect resulting in a larger distorted shape of a dot

3.3.19
smudging
blurring of lines over some areas of the image

3.3.20
inadvertent marking
unintentional spots or lines on the drawing

3.3.21
ghosting
unforeseen appearance of spurious images

3.3.22
media background
difference in coloured space between processed and unprocessed unimaged areas

3.3.23
dropout
missing dot or sequence of dots

3.3.24
white spot
inadvertent white or transparent area in a black-field image

3.3.25
legibility
ability of a character to be properly recognized

3.3.26
contrast
difference in reflection or transmission density between plotted areas and unplotted areas

3.3.27
microvibration
high-frequency variation of line width along a line

3.3.28
grey-scale linearity
constancy of density differences between adjacent grey levels

3.3.29
registration
dimensional deviation of the actual location of the image from its intended location

3.3.30
skip
non-constant line spacing resulting in the appearance of a white band or bands

4 Drawing test

4.1 Principle of the test

Standard test patterns are imaged at a 1/1 scale and the image is stepped to fill the maximum output format of the raster device. Images are placed at the extreme edges of the imageable area to permit measurement of maximum usable plot width and usable plot length. The images are evenly placed across the width and length of the usable plot area. The manufacturer's recommendations for operation, media and environmental constraints should be consulted for optimum test results.

The evaluation of the test images permits comparison of the performance characteristics of different plotters.

4.2 Test information

4.2.1 The following information shall be included in the test pattern identification block:

— plotter manufacturer;

— plotter model and serial number;

— plotting technology (electrostatic, direct thermal, thermal transfer, ink jet, etc.);

— plotting media and supplies (paper, toner, ink, ink ribbon, film, etc.);

— imaging speed, in millimetres per second (mm/s);

— processor type and speed;

— contrast adjustment (if selectable);

— quality level (if selectable, several levels to be indicated: high, draft, etc.) and the resolution;

— atmospheric conditions [temperature, in degrees Celsius (°C); relative humidity, as a percentage (%)] (see ISO 554);

— date of the test;

— raster plotter test pattern (1 or 2); and

— identification number.

4.2.2 The process time consists of the following:

— warm-up time (start-up time);

— CPU (Central Processing Unit) time to generate a plot file;

— time to transfer the file to the controller;

— time to rasterize the plot, if applicable;

— imaging time;

— drying time, if applicable.

Not all of the above times apply to all of the imaging technologies, and some of the times may overlap.

4.3 Test pattern description

4.3.1 General

The draughting test is based on two patterns of A4 size, one dealing with line drawings (Test Pattern No. 1), the other dealing with filled areas and shades of grey (Test Pattern No. 2). Each pattern consists of several pattern elements, numbered from zone 1 to zone 23, which are described below.

4.3.2 Raster test pattern No. 1 (zone 1 to zone 16)

a) **Zone 1:** Outer frame

Straight lines drawn parallel to the edges. Each straight line shall be 10 mm from the edge of the plotting media. Nested squares, with 1 mm intervals, serve as registration marks on all four corners.

The following test criteria are used:

— usable plot width

— usable plot length

— skew

b) **Zone 2:** Graduation

Plot the graduation with an interval of 1 mm.

The following test criterion is used:

— accuracy

Note See ISO 9960-1.

c) **Zone 3:** Lines at regular intervals (direction of shorter length)

Lines drawn perpendicular to the horizontal line of the outer frame, having a regular interval of approximately 0,5 mm consistent with an integer dot spacing. The lines shall be 10 mm in length.

The following test criteria are used:

— microvibration

— jitter

— smear

— dropout

— flare

d) **Zone 4:** Lines at regular intervals (direction of longer length)

Lines drawn perpendicular to the vertical line of the outer frame, having a regular interval of approximately 0,5 mm consistent with an integer dot spacing.

The following test criteria are used:

— microvibration

— jitter

— smear

— dropout

— flare

e) **Zone 5:** Inner frame

Pairs of lines drawn with a 0,5 mm interval.

The following test criteria are used:

— waves

— jitter

— dropout

— ability to image a 90° angle

— microvibration

f) **Zone 6:** Diagonal lines

Two diagonal lines drawn at right angles, at + 45° and −45°.

The following test criteria are used:

— linearity

— jitter

— dropout

g) **Zone 7:** Concentric squares

21 concentric squares, with the outermost square having a side of 40 mm and the innermost square having a side of 1 mm. Beginning next to the innermost square, a 2 mm square is plotted. From the 2 mm square to the outermost square, the length of the side of each square is increased by 2 mm.

The following test criteria are used:

— ability to image a 90° angle

— line joins

h) **Zone 8:** Diagonal lines

Diagonal lines drawn at + 45° and −45°. The line spacing shall be 1 mm when measured along the X and Y axes.

The following test criteria are used:

— jitter

— smear

— dropout

— waves

i) **Zone 9:** Resolution patterns

40 sets of evenly spaced parallel lines, each set filling a 4 mm × 4 mm area with spacing between the lines starting at 1 mm and decreasing by one addressable dot position. Sets of parallel lines shall be spaced so that the upper left points of each set are 5,5 mm apart, with 8 sets in each of 5 rows. Lines shall be 4 mm long, with rows separated by 3 mm to allow for labels below each set of lines that indicate the number of lines per millimetre. Lines shall be imaged parallel to the X and Y axis.

Note When spacing is less than or equal to the dot size, the pattern becomes solid.

The following test criterion is used:

— resolution

j) **Zone 10:** Radial lines

Radial lines drawn with regular intervals of 5° using the point of intersection of the diagonal lines (zone 6) as centre. The radial lines shall not touch the central point.

The following test criterion is used:

— staircasing/jaggy

k) **Zone 11:** Grid pattern, butt ends

Grids are drawn using vertical and horizontal lines with butt ends. The width of the lines shall start at 1 dot in the upper left corner and increase to 2, 3, 5, 7, 9, 11 and 13 dots from top to bottom and from left to right. A border shall surround the pattern to align the end points of the lines. The spacing between the lines shall be 5 mm.

The following test criteria are used:

— ability to image a 90° angle

— line width

— flare

— line ends

l) **Zone 12:** Concentric circles

21 concentric circles, with the outermost circle having a diameter of 40 mm and the innermost circle having a diameter of 1 mm. Beginning next to the innermost circle, a 2 mm circle is plotted. From the 2 mm circle to the outermost circle, the diameter of each circle shall be increased by 2 mm.

The following test criteria are used:

— diameter variation

— staircasing/jaggy

m) **Zone 13:** Alphanumeric symbols

Alphanumeric symbols of 2,5 mm, 1,8 mm, 1,5 mm, 1,3 mm, and 0,7 mm in height plotted horizontally and vertically. Symbols smaller than 2,5 mm need not strictly conform to ISO 3098-1. Symbols 2,5 mm or larger shall conform to ISO 3098-1.

The following test criterion is used:

— legibility in X and Y axes

n) **Zone 14:** End and join of wide lines

Angles at 30°, 90° and 120° consisting of two line segments drawn using the widest available line (up to 2,8 mm).

The end and join of the lines can be

1) butt end with mitre join,

2) round end and round join, or

3) square end and bevelled end with bevelled join,

according to line type available.

The following test criteria are used:

— line end

— line join

o) **Zone 15:** Free zone

A zone available for additional designations, for example special letters, company logo.

p) **Zone 16:** Test pattern identification block

Field intended for general data (see 4.2.1).

4.3.3 Raster test pattern No. 2 (zone 17 to zone 23)

a) **Zone 17:** Outer frame

Straight lines drawn parallel to the edges. Each straight line shall be 10 mm from the edge of the plotting media. Nested squares, with 1 mm intervals, serve as registration marks on all four corners. A 10 mm wide inside border shall also be provided.

The following test criteria are used:

— usable plot width
— usable plot length
— skew
— dropout

b) **Zone 18:** Chequered pattern

Chequered pattern with squares of 10 mm length.

The following test criteria are used:

— image density
— ghosting
— contrast
— feathering
— skips
— uniformity
— smear
— white spot

c) **Zone 19:** Lines at regular intervals/grey scale

1) Vertical lines having a length of 20 mm are drawn, at intervals beginning at 1 mm and decreasing evenly over the 160 mm of the pattern to contiguous lines, or

2) a grey scale of 128 levels from lightest to darkest, each patch measuring 20 mm × 0,125 mm, or 256 levels each measuring 20 mm × 0,625 mm, or the number of resolved levels of grey.

The following test criterion is used:

— grey scale

d) **Zone 20:** Chequered pattern

Chequered pattern with squares of length 10 mm, 20 mm and 40 mm.

The following test criteria are used:

— image density

— ghosting

— contrast

— fixing

— uniformity

— water resistance

— white spot

— skips

e) **Zone 21:** Horizontal lines at regular intervals

Horizontal lines drawn with a length of 160 mm in a block 40 mm high. Spacing between lines shall begin at an integer number of dots approximating two lines per millimetre and decrease by one addressable dot at regular intervals down to a solid fill.

The following test criterion is used:

— resolution

f) **Zone 22:** Free zone

A zone available for additional designations, for example special letters, company logo.

g) **Zone 23:** Test pattern identification block

Field intended for general data (see 4.2.1).

4.4 Evaluation of results

The quality of the test drawing shall be evaluated using the test criteria given in 4.3. Zones are examined with a magnifying glass (×10) and compared with reference patterns or patterns printed by competitive plotters.

Shades of grey and media background are checked with a densitometer. Plotting technology will affect the obtained performance, and characteristics of the technology should be taken into consideration when evaluating the results.

In addition to the above test criteria, other image characteristics may need to be evaluated such as handling, smudge resistance, long-term image stability, light resistance and reproducibility.

Annex A
(informative)

Raster plotter test patterns No. 1 and No. 2