

JIS

JAPANESE INDUSTRIAL STANDARD

**Printing Specifications
for Optical Character
Recognition**

JIS X 9004—1983

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Printing Specifications for
Optical Character Recognition

X 9004-1983

1. Scope

This Japanese Industrial Standard specifies the following prescriptions for printing the set of characters to be used for optical character recognition, hereinafter referred to as the "OCR". Here, "characters" shall be as defined in JIS X 9001 and JIS X 9003.

- (1) Optical characteristics of the paper to be used.
- (2) Optical and dimensional characteristics of printed individual OCR characters.
- (3) Basic specifications for the position of OCR characters printed on documents.

2. Definitions

The definitions of main terms used in this Standard shall be as follows:

- (1) document An input medium to OCR.
- (2) spectral bands Spectral wavelength ranges provided to specify optical characteristics of OCR paper, ink and printed image. There are several spectral bands ranging from near ultraviolet to near infrared wavelengths.
- (3) reflectance The ratio of reflected quantity of light from the measured matter and the perfect reflecting diffuser⁽¹⁾ both of which are set under the same optical conditions.

Note ⁽¹⁾ In the measurement, a white plate is employed as the white standard, for which, in practice, barium sulfate (BaSO₄) and others are used.
- (4) stain A portion in the paper used with a reflectance of remarkably lower than its circumference.

Applicable Standards:

JIS X 9001-Alphanumeric Character Sets for Optical Recognition

JIS X 9003-KATAKANA Character Set for Optical Recognition

Corresponding International Standard:

ISO 1831-1980 Printing Specifications for Optical Character Recognition

- (5) backing method A method used at the time of measuring the reflectance and opacity of the paper.

A sufficient backing method is a method by which, when the measuring sample is backed with sheets of paper of the same quality, the change of measured value is no more recognized even if the number of sheets of paper is further doubled. A black backing method is a method using a black plate of reflectance 0.5 % or under for backing the sample.

- (6) printed image A pattern formed by printed characters together with the surrounding blank spaces of the document.
- (7) stroke A segment of line with a certain thickness that comprises an individual character.
- (8) centre line Centre line of the stroke forming the frame of a standard character.
- (9) range Grade of tolerance limits of print quality. Three kinds of X, Y and Z are provided.
- (10) COL (Character Outline Limits) Outline indicating the tolerance limits for the deviation from standard stroke width. The maximum COL indicates the maximum limit and the minimum COL indicates the minimum limit.
- (11) COL gauge The gauge to measure the dimensional characteristics of printed image. Maximum COL, minimum COL and the centre line character sets are indicated on a gauge.
- (12) cutoff A state in which part of stroke at one side of character is asymmetrically lacking. This is apt to occur in the high speed printing equipment.
- (13) limit line of cutoff Border line indicating the limit of tolerances on cutoff. This exists only in COL gauge for range Z.
- (14) cutoff centre line Segment of line formed by the locus of the centres of circles circumscribed between the limit line of cutoff and the minimum COL. This is used in place of the centre line in the measurement of printed image accompanied by a cutoff.
- (15) best fit Relative position of COL gauge and the character image adjusted so as to make the character fill up the inside of the minimum COL as much as possible and at the same time bulge out of the maximum COL as little as possible.
- (16) PCS (Print Contrast Signal) A value expressing the optical contrast between the paper and the printed images.
- (17) basic PCS A series of PCS measured along the centre line of COL in one character. This is used for the instrumental measurement of printed images.
- (18) PCS 80 % The smallest values out of the selected larger 80 % of PCS values measured on the centre line of COL.

- (19) contrast variation ratio Ratio of PCS value for the darkest portion and the lightest portion of ink density in characters as measured on the centre line of COL.
- (20) void A portion with reflectance evidently higher than the remaining parts of characters within the minimum COL.
- (21) stroke edge Border line between the stroke part and the back ground part.
- (22) irregularities of stroke edge The parts where the stroke edges intrude into the minimum COL or extrude from maximum COL.
- (23) spot A portion outside the maximum COL with reflectance evidently lower than the background.
- (24) subject area of inspection Range of measurement for optical characteristics of a printed image. A rectangular area including a character and the blank spaces surrounding it.
- (25) reference edge of documents The edge of documents as the reference of printing position.
- (26) character territory The smallest rectangle of which one edge is parallel to the reference edge of documents and which includes all strokes of one character inside it.
- (27) line territory The smallest rectangle of which one edge is parallel to the reference edge of documents, and which includes all character territories situated on the line.
- (28) character separation The horizontal distance between two adjacent character territories within the same line territory.
- (29) character spacing Horizontal distance between the perpendicular bisectors of two adjacent character territories within the same line territory.
- (30) character alignment Perpendicular distance between the base lines of two adjacent character territories within the same line territory.
- (31) printing area A predetermined area of rectangle of which one edge is parallel to the reference side of documents set up for printing one set of recognition subject characters on one line.
- (32) clear area A rectangular area of which one edge is parallel to the reference edge of documents and which includes the printing area and its circumferential blank spaces.
- (33) margin from edge Distance from each edge of documents to the printing area.
- (34) line separation Perpendicular distance between the two consecutive line territories.
- (35) line spacing Perpendicular distance between the perpendicular bisectors of two consecutive line territories.

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3. Spectral Bands

The spectral bands shall be as shown in Table 1.

Table 1. Spectral Bands

Nomination	Peak	Unit: nm
		Band width at 50 % level
B425	425 ± 5	50 or less
B460	460 ± 5	60 or less
B490	490 ± 5	60 or less
B530	530 ± 5	60 or less
B570	570 ± 10	100 or less
B620	620 ± 10	100 or less
B680	680 ± 10	120 or less
B900	900 ± 50	400 or less

- Remarks 1. Table 1 shows the general characteristics of the light source, filter and light-receiving device.
2. These spectral characteristic curves of each band shall be smooth and of single hump.
3. Total sum of the magnitude of energy distribution within the range of wavelength under 400 nm shall be within 5 % of the energy within the subject frequency area for measurement.

4. Characteristics of Paper for OCR

4.1 Optical Requirements for OCR Paper The papers used for OCR documents shall satisfy the following requirements in order to provide high contrast and uniform reflectance to the subject characters for recognition.

- (1) Shall have white colour, high opacity, high reflectance and low luster.
- (2) Shall be finished flat and free from irregular composition and stains.
- (3) Shall have no watermark printing or mixture of colouring agent or fluorescent substance.

4.2 Opacity of Paper

4.2.1 Opacity Opacity (C) shall be defined as follows:

$$C = \frac{R_B}{R_I} \times 100 (\%)$$

where R_B : reflectance of paper measured with the black backing method

R_I : reflectance of paper measured with the sufficient backing method

Remarks 1. Measurement shall be carried out for both of the surface and the back. When the difference of 0.5 % or more exists, both values shall be adopted.

2. Measurement shall be conducted in accordance with the spectral band given in Table 1.

4.2.2 Grade of Opacity Grades of opacity shall be as given in Table 2.

Table 2. Grade of Opacity

Grade	Opacity
High opacity paper	85 % or over
Medium opacity paper	70 % or over

4.3 Reflection Characteristics of Paper

4.3.1 Reflectance of Paper Reflectance of paper shall be as given in Table 3.

Table 3. Reflectance of Paper

Num- ber	Spectral band	High opacity paper	Medium opacity paper
1	B 425	60 % or over	50 % or over
2	B 530, B 570 or one having peak between these and band width within 100 nm.	70 % or over	60 % or over
3	B 900	70 % or over	60 % or over

Remarks 1. For normal white paper, measurement may be carried out for two classes of spectral band corresponding to No. 1 and No. 2. Measurement with No. 3 shall be carried out only when confusion in the reflection of infrared lights is anticipated. However, particular strictness is required for the spectral characteristics, measurement shall be performed for all spectral bands given in Table 1.

2. Measurement shall be made by the black backing method.

4.3.2 Uniformity of Reflectance Variation of reflectance on the same paper face shall be as given in Table 4.

Table 4. Variation of Reflectance

Grade	Standard variation/mean value of reflectance	Maximum reflectance/minimum reflectance
High opacity paper	Within 3.5 %	1.2 or under
Medium opacity paper	Within 5.0 %	

- Remarks 1. Measurement shall be carried out with the circular aperture of diameter 0.20 mm.
2. Spectral band shall comply with Table 3. However, in case that the strictest spectral band is apparent, measurement may be carried out with only that spectral band.
3. Sufficient number of sample points shall be selected without bias and inclination so as to ensure reproducibility of measurement results.

4.3.3 Stain in Paper Stains in paper shall be dealt with as shown in Table 5. However, only when the measurement of stains with Table 5 is impossible, Table 6 may be applied.

Table 5. Stain in Paper

Dimension of stain	Specified value	Specified condition
Diameter 0.10 mm or over	250 points/m ² or under	Mean value of 20 sheet samples shall satisfy the specified value.
Diameter 0.20 mm or over	25 points/m ² or under	19 out of 20 sheet samples shall satisfy the specified value.

Remark: Dimension of sample should preferably be about 1 m², and shall not be 0.125 m² (A 3 equivalent) or under.

Table 6. Simple Inspection of Stain

Dimension of 1 section	Inspection area	Specified value	Inspection condition
0.10 m x 0.10 m	6.0 m ²	Total number of sections with stains: 200 or under	Under the bright indirect illumination, visual inspection from 0.5 m distance shall be made for 1 min per section.

Remark: Remarkable individual difference shall not be produced in the measurement results.

5. Characteristics of Printed Image

5.1 Requirements for Securing Print Quality The print quality shall satisfy the following requirements:

- (1) The printed character shall possess as high a contrast as possible to the document as background.
- (2) Stroke width shall be as close the standard value as possible.

- (3) Voids shall not exist inside the stroke outline. When this rule cannot be observed, the number and size of voids shall be minimized and the distance between them maximized.
- (4) Spots must not exist within the clear area. When this cannot be avoided, the number and size of spots must be minimized and the distance between them must be as large as possible.
- (5) Stroke centre lines of the printed image shall be as near to the standard centre line image as possible.

5.2 Ranges

5.2.1 Classification of Ranges Print quality shall be classified into the following three ranges according to the degree of tolerance on print quality.

- (1) Range X (High print quality)
- (2) Range Y (Medium print quality)
- (3) Range Z (Low print quality)

Remark: In case a set of characters include small characters of KATAKANA, small English letters, and symbols #, %, @, range X shall be applied.

5.2.2 Applicable Scope of Range Z Range Z may be applied only for the following case:

- (1) Only the characters included in the numeral subset specified in 6. of JIS X 9001 are objects of recognition.
- (2) Printed images are to be measured by means of electronic computers.

5.3 Tolerances on Stroke Width Tolerance on stroke width shall conform to Table 7.

Table 7. Tolerance on Stroke Width

Unit: mm				
Font	Size	Standard stroke width ⁽²⁾	Range X	Ranges Y, Z
OCR-A, B, K	I	0.35	± 0.08	± 0.15
OCR-A, B	III	0.38	± 0.08	± 0.18
OCR-A	IV	0.51	± 0.13	± 0.25
OCR-B		0.50		

Note (2) For the details of stroke width with respect to OCR-A and OCR-B, refer to Appendix 1 and 2 of JIS X 9001, and in respect to OCR-K, refer to 8. of JIS X 9003.

5.4 COL Gauge

5.4.1 General Rule Pertaining to COL gauge, the centre line, maximum COL and minimum COL shall be denoted. Details of construction shall be as described in the Appendix.

5.4.2 COL Gauge for Character Sets of Indefinite Stroke Width For the measurement of character sets of indefinite stroke width, the COL gauge of range X, size I shall be used.

Remark: Deviation from COL due to the character set of indefinite stroke width may be permitted.

Reference: Maintenance of excellent printing quality is a prerequisite for the apparatus for printing indefinite stroke width.

5.4.3 COL Gauge for Range Z As the COL gauge for range Z, the centre lines, the maximum COL and minimum COL, the cutoff limit lines and cutoff centre lines stored in an electronic computer shall be used. Construction of this type of COL shall be as described in the Appendix.

5.5 Measurement of Printed Image

5.5.1 Classification of Measuring Methods Measuring method shall be divided into the following three classes according to technical convenience and required precision.

- (1) Visual measurement
- (2) Instrumental measurement
- (3) Measurement utilizing electronic computers

Remark: In case the inspection result is different according to measuring methods, the higher precision method (the larger item number) shall take precedence.

5.5.2 Visual Measurement

5.5.2.1 Measurement Conditions Measurement with the eye shall be carried out using COL gauge and magnifying glass under the condition of best fit⁽³⁾.

Note ⁽³⁾ The positions of printed image and COL gauge shall be adjusted with the eye (refer to Fig. 1).