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EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

NOTES ON INSTRUMENTS AND MEASURING METHODS RELATED TO THE ECHA STANDARD FOR PRINTING SPECIFICATIONS FOR OCR (ECHA-15)

August 1968
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AND MEASURING METHODS
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STANDARD FOR PRINTING
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These notes are written to provide some guidance on practical methods of making the tests required by the Standard. They are not intended to specify a complete list of approved instruments and closely defined test procedures. The omission of a manufacturer's instrument does not necessarily imply that it is unsuitable for test purposes.

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1. **Average Reflectance (Section 3.2.1)**

The specification for average reflectance of paper has purposely been framed so as to allow the use of different kinds of measuring instruments, from elaborate and expensive spectrophotometers to simple devices using filters and solid state photocells. For this reason, the illumination conditions are not precisely defined. It is recognized that measured reflectance values will be to some extent a function of the geometry of the instrument. A system using oblique illumination and normal viewing, for example, may give slightly different results from one using normal illumination and oblique viewing. In most instances these differences will not be great enough to cause trouble, but where they do, an instrument using completely diffuse illumination, supplied by an integrating sphere, is to be taken as the primary standard. The instruments marked X in the list below can be supplied with this facility.

All the instruments in the list are suitable for measurements in the two essential bands B425 and B530/B570 (see section 3.2.1.2 of the specification). The cheaper instrument will not be suitable for measurements in the B900 range, but, as the specification explains, these are seldom required.

The band B400 presents some difficulty, since the special conditions as defined in section 2.2 cannot be satisfied by the instruments listed below. A cathode-ray tube light source and photomultiplier detector are necessary.

Measurements in this band are not required, however, unless it is known that the paper will be submitted to OCR equipment working in the UV region. In such cases it is recommended that the manufacturer of the OCR equipment concerned be approached for guidance.

**Instruments.**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Supplier</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Beckman Model DK</td>
<td>Beckman Instruments</td>
<td>Dispersing spectrophotometer</td>
</tr>
<tr>
<td>X Elrepho</td>
<td>Carl Zeiss (Oberkochen)</td>
<td>Interchangeable filters</td>
</tr>
<tr>
<td>Eel</td>
<td>Evans Electroelenium</td>
<td>Interchangeable filters</td>
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</table>
2. Variation in Paper Reflectance

At the present time, no instrument suitable for rapid measure-
ments of reflectance variability as defined in 3.2.2, is com-
ercially available. A paper manufacturer wishing to assess the
suitability of his product in this respect is recommended in the
first instance to consult manufacturers of OCR equipment. Since
OCR scanning systems in general provide conditions similar to
those specified in 3.2.2 these manufacturers will frequently
be in a position to make the necessary measurements easily and
quickly.

Anyone wishing to build his own measuring instrument is advised
first to read the paper by C.J. Jones and A.B. Badinger (TAPPI
Journal 54, 48 (1965), which describes the results of a very
thorough investigation into reflectance variations. The equipment
described is more expensive and elaborate than one needed for
routine measurements, however. For such measurements the
essentials are:

a) A means of illuminating the sample.

b) A device with appropriate filters for the bands B425, B530,
   B570 and B900, for measuring the light diffusely reflected
   from an area of the specified size; this area, 0.2 mm in
diameter, is much smaller than that used for the measurements
   of average reflectance.

c) A means of traversing the sample so as to scan different area
   in succession.

2.1 One suitable form of measuring equipment is shown in the
diagram. It is based upon a binocular microscope with one
eyepiece replaced by a fibre-optic bundle leading to a
photocell and filters. The aperture at the entry to the
bundle is made of such a size as to provide an effective
scanning aperture of 0.2 mm diameter, due to allowance being
made for the magnification of the objective.

The paper sample should be mounted on some form of travers-
ing mechanism (not shown).
Instrument for Measurement of PCS and Uniformity of Paper Reflectance (Aperture 0.2 mm)
3. Dirt Count (Section 3.3)

Full instructions are given in the TAPPI paper to which reference is made.

4. Paper Opacity (Section 3.4 and App. 1.3)

The instrument used for measurements of Average Reflectance will be suitable for Opacity measurements as well. An instrument – the Opacimeter – made by Bausch and Lomb, (625 S. Paul Street, Rochester 2, New York, USA) is also suitable and convenient to use.

5. Printed Image

Visual examination of a character is greatly facilitated if there is available an optical device which can project an enlarged image of the character on to a screen. Suppliers of suitable equipment are:

J.E. Baty and Co. Ltd,
Lamson Paragon Ltd (see below)
Burgess Hill, Sussex, England

It is a matter of experience that a relatively low magnification (10 x or 20 x) makes for easier working and more reproducible results than a high magnification.

6. Print Contrast Signal Measurements

The Print Contrast Signal (Section 4.7) is defined in terms of reflectance, so some photometric instrument is required for its measurement. An instrument of the type shown in figure 1 above is suitable although it does not allow tests to be made very quickly.

Two instruments are available from manufacturers.

6.1 The Kidder Model 081 Optical Character Tester (Marketed in Europe by Lamson Paragon Ltd, Paragon Works, London E.16). This provides a projected image of the character, twenty times enlarged, on a viewing screen for visual and photometric examination. Any area 0.2 mm (0.008") in diameter (as required for the PCS test) can be examined by moving the image under a fixed photometer attachment. The instrument incorporates traversing controls (max. movement 25.4 mm) for the document to facilitate this. In its standard form the Tester has a spectral response corresponding approximately to the B425 band in the specification, but a response nearer to the B530 band is available as an alternative. Measurements can also be made in the near infra-red region, but when switched to this range the standard instrument has a different viewing area (0.5 mm in diameter) and is unsuitable for PCS measurements.
6.2 The ICT Print Quality Monitor (obtainable from ICT Ltd, Cavendish Road, Stevenage, England).

This instrument also presents an enlarged image of the character under examination. The image is not produced by purely optical means, however, but by electronic scanning and application of the resulting signal to the control grid of a display cathode ray tube. The signal is applied to a threshold which can be set by the operator to any required value. A threshold setting of 0.4, for example, ensures that only those areas with a PCS of 0.4 or greater will appear in the display. The advantage of this arrangement is that the response of the whole character to the chosen threshold is available at once.

As normally supplied, the instrument has a spectral response in the B530 band. A spectral response approximating to B425 can be supplied as an alternative, but working in the infrared is not possible.

7. Character Positioning Measurements

A suitable instrument for this work is a travelling microscope with two traversing directions at right-angles to each other. The document under examination should be placed so that one of these directions coincides with a reference edge.

Provided that the cross-wires in the eyepiece are accurately aligned with the traverse directions, it will then be a simple matter to determine the character boundaries, as defined in 5.10. Any projector provided with a micrometer table can also be used, either displaying a group of characters at a low magnification or, at a higher magnification, using the table to bring the character into alignment with the references lines.

8. Line Spacing

(As distinct from line separation) will not need to be measured except when it is near the limit of 4 mm.

Measurements of Line Separation are easily made when the character boundaries have been located.

9. Character alignment reference line

It is convenient to take this as the lower edge of the character boundary. In some applications, however, where the stroke width is very variable it may be more appropriate to use the alternative definition "horizontal central line of character boundary". Only if the simpler procedure shows the sample to be somewhat outside the character misalignment specification is it necessary to use the central line.
10. Character Spacing

Determinations of character spacing are made complicated by the fact that the measurable quantities—the vertical centerlines—are not necessarily equally spaced even in perfect print, because of typographical considerations. Character spacing will need to be measured only when the limits given in the Standard are approached and when the nature of the printing mechanism makes variations possible.

11. Character Misalignment

The measurements specified in 5.14.1 and 5.14.2 are easily made once the alignment reference lines have been located.