Océ Continuous Feed Printing Systems with Non-contact Fusing (Infra-red)

VarioStream 9000
ColorStream
Edition 2009-01
Order No. A29249-X5-X-2-7659

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1 Introduction

This specification is for all continuous forms printing systems from Océ Printing Systems GmbH with non-contact fusing (infra-red).

These printing systems allow a double-sided multi-colored print over the whole print width. For this
- transport hole free endlos papers
- papers with transport holes
  can be used.

The paper specification details the valid standards for paper and provides recommendations for paper types and for forms used on these printing systems.

In some cases, technical terms have been used. These terms will be familiar to paper suppliers.

However, the mere use of specific data is not always sufficient to describe complex paper processing methods. In those cases this paper specification is intended as a guideline both for customers and suppliers of printing material. Furthermore, Océ Printing Systems GmbH runs a paper laboratory with highly qualified experts who will be glad to consult you, should you have any questions and who carry out tests.

The applications for high-performance electronic printing systems are continually increasing, thus constantly extending the range of papers and print materials that can be used. We would therefore appreciate any information and suggestions on this paper specification. Please direct your suggestions to:

Océ Printing Systems GmbH
Paper Laboratory
Postfach 1260
85581 Poing
2 General

This paper specification details the functional requirements and test procedures for paper which is processed according to state-of-the-art technology on high-performance Electronic Printing Systems, using dry toner and subsequent non-contact fusing (infra-red).

The requirements described in this document refer both to the properties of the paper itself and to processing methods, such as manufacture and pre-printing, which should not have a negative effect on the suitability of the paper for further processing.

With this paper specification we want to make sure that only materials meeting the specified requirements are used in our printing systems. Consequently, this document may be regarded as a guideline for the suppliers of printing materials that defines the quality standards they should maintain.

Non-compliance with the paper specifications can cause damage to the printing system and may in addition result in the release of substances from the paper which can contaminate the environment or have a detrimental effect on health. Océ Printing Systems GmbH accepts no liability for such damages.

Note:
We recommend to conduct a usability test before ordering large quantities. This applies in particular to major account customers who conclude contracts on an annual basis. The tests should be made with reserved samples.

The paper supplier must guarantee a constant paper quality, i.e. the quality of the paper must not vary either within or between shipments.
3 Paper Types

3.1 General

The printing systems process various single-ply printing materials, provided that they fulfill the requirements of electrophotographic printing. The quality of print paper - its appearance, strength, printability and runability - depends largely on the raw materials of which the paper is composed.

The distinguishing features are:

Wood-free: Paper made from fine pulp
Slightly ligneous: Paper made from fine pulp with a small proportion of mechanical pulp
Ligneous: Paper made from fine pulp and mechanical pulp (medium grain)
Containing waste paper: Paper made from waste paper, fine pulp and mechanical pulp
Recycling paper: Paper made from waste paper
Chlorine free: Paper made from fiber material bleached without chlorine.
ECF (Elementary Chlorine Free)
TCF (Totally Chlorine Free)
3.2 General Paper Requirements

There are also other properties which the paper should have to ensure good print quality and trouble-free paper transport. These requirements apply in addition to those listed in table 1 on page 12.

- The paper must not give off toxic fumes when heated.
- The paper may not exhibit dusting tendencies, bear traces of glue, slime, grease or dirt. There may not be any loose fibers at the edge of the paper, since this impairs both the print quality and paper transport.
- Inclusions or thick spots in the paper may lead to the paper web tearing or the printing system being damaged.
- The moisture content of the paper must be distributed evenly across the form or web to prevent uneven tension. Any factors which prevent proper contact of the paper with the transfer station (such as folds, bulging and unevenness) have an adverse effect. Such paper faults are particularly serious when they are near the edge of the paper.
- Beside the importance for a lossless toner transfer, the paper flatness (no buckling or warping) is also a decisive factor for smooth paper transport.
- Abrasion according to DIN 53 109 (measured with a pressure of 5 N per abrasive disk) should normally not exceed 30 mg/100 revolutions.
- The paper may not contain any abrasive components that would subject the printing system to increased wear and tear. Nor may the paper cause any dusting.
- The specific volume resistance influences the transfer efficiency. A constant volume resistance over the entire surface of the form is a prerequisite for uniform print image quality. For values see table 1 on page 12.
- Most of the additives which are in general use in paper manufacture are appropriate for surface application. Experience has shown that the best processing and printability properties (e.g. toner adhesion) are obtained with surface-sized papers. However, the paper should not contain any additives which reduce its electrical surface resistance or impair its toner adhesion properties. The rated values for electrical surface resistance are given in table.
- The main fiber direction must be aligned so as to prevent any diagonal stresses from occurring after the paper has been processed in the printing system.
- Among other factors, the paper curl is decisive in ensuring problem-free processing of forms by post-print devices. The paper must not curl permanently as a result of the non-contact fusing (infra-red) process.
Key factors that have a major influence on toner adhesion include the surface structure of the paper and its composition. It is therefore extremely important to choose a type of paper that ensures good toner adhesion (complying with the recommendations of the Océ paper laboratory). Paper must not contain high proportions of extractable substances (pursuant to DIN 54354). In the fusing station, this can lead to undesirable sublimation and evaporation of volatile components from the print material (e.g. paper and/or print ink).

The roughness and smoothness of paper are important to many processing properties. As a rule, a high degree of smoothness makes for better printability in terms of toner adhesion and image quality. It is particularly important to use smooth paper when printing at 600 dpi (see table 1 on page 12 for roughness values).

When submitted to the influence of heat, the paper should show a low tendency to shrinkage, and it should not form blisters on the surface.

3.3 Paper Colors

The printing systems process white and colored paper. Dark paper may impair the functions of the sensors.

3.4 Standard Paper

3.4.1 General

The term "standard paper" covers all types of paper used in standard applications and processing methods (stack, reel, with or without feed holes).

3.4.2 Standard Paper Properties

The following table lists the standard paper properties in detail. Also recommended are paper types that comply with the DIN standards 6721 (from 70 g/m²), 6723 and 6724. (For further details on possible applications and the required properties of a more comprehensive paper range, refer to section 3.5 on page 14.)
<table>
<thead>
<tr>
<th>No.</th>
<th>Properties</th>
<th>Dimension</th>
<th>Requirement</th>
<th>Test per</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grammage</td>
<td>g/m²</td>
<td><strong>Standard range:</strong> VarioStream 9200 / VarioStream 9400 / ColorStream</td>
<td>DIN EN ISO 536</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9200 / VarioStream 9500 / VarioStream 9600 / VarioStream 9700</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Extended range for VarioStream 9200 / VarioStream 9400 / ColorStream:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>36-49 / 160-240 *</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Specific volume</td>
<td>cm³/g</td>
<td>1.3 ± 0.2</td>
<td>DIN 1306 (ISO 534)</td>
</tr>
<tr>
<td></td>
<td>Bulking number</td>
<td></td>
<td>Number of sheets in a stack of 25 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>f.i. 24 lb: 185-250 sheets</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Relative humidity</td>
<td>% r.H.</td>
<td>45 ± 7 at 21 ± 2 °C (also applies to preprinted forms)</td>
<td>Electronic sword-type</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>hygrometer / Tappi T502</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Dimensional stability</td>
<td>%</td>
<td>When subjected to a change in rel. humidity of 10 %: CD max. 0.14 / MD max</td>
<td>Tappi – DIN 53130 / ISO 8226-1:1995</td>
</tr>
<tr>
<td></td>
<td>under influence of heat/</td>
<td></td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stiffness/bending resistance</td>
<td>mN x m</td>
<td><strong>specific static bending resistance as per DIN 6721-1</strong></td>
<td>Tappi T489 (Taber) / DIN 6721-1 / DIN 53121 / ISO 5628:1990</td>
</tr>
<tr>
<td></td>
<td>(MD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Roughness (recommendation)</td>
<td>Sheffield</td>
<td><strong>at 240/300 dpi:</strong> 25 - 250 / at 600 dpi: 25 - 140</td>
<td>Tappi T538 (Sheffield)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>m/l/min (Bendtsen) at 240/300 dpi: 30 - 500 / at 600 dpi: 30 - 200</td>
<td>DIN 53108 (Bendtsen) / ISO 8791-2:1990</td>
<td></td>
</tr>
</tbody>
</table>

* Subject to satisfactory test results; grammatures above 160 g/m² at adapted speed. For printing systems VarioStream 9500 / VarioStream 9600 / VarioStream 9700 higher grammages than standard range are not possible.

Table 1 Properties of paper
<table>
<thead>
<tr>
<th>No.</th>
<th>Properties</th>
<th>Dimension</th>
<th>Requirement</th>
<th>Test per</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Air permeability</td>
<td>Sheffield Units (SU)</td>
<td>***</td>
<td>Tappi T547 (Sheffield) DIN 53120-1 (Bendtsen) ISO 5636-3:1992</td>
</tr>
<tr>
<td>8</td>
<td>Water absorption</td>
<td>g/m²</td>
<td>22 ± 7</td>
<td>Tappi T441 / DIN EN 20535 ISO 535:1991</td>
</tr>
<tr>
<td>9</td>
<td>Filler content calculated from the ash content</td>
<td>%</td>
<td>Must not cause premature wear and tear of the printing system.</td>
<td>Tappi T413 DIN 54370 ISO 2144:1987</td>
</tr>
<tr>
<td>10</td>
<td>Volatile components</td>
<td>%</td>
<td>Lowest possible sublimation</td>
<td>Tappi T204 / DIN 54354 ISO 624:1974</td>
</tr>
<tr>
<td>11</td>
<td>Abrasion</td>
<td>mg</td>
<td>&lt; 20</td>
<td>Tappi T476 DIN 53109 (Taber)</td>
</tr>
<tr>
<td>12</td>
<td>Writing properties</td>
<td>–</td>
<td>Writing with an appropriate instrument such as a biro, felt-tipped pen or pencil must be possible</td>
<td>Tappi – DIN 53126</td>
</tr>
<tr>
<td>13</td>
<td>Printability</td>
<td>–</td>
<td>Printing with a thermostable ink must be possible</td>
<td>–</td>
</tr>
<tr>
<td>14</td>
<td>Opacity</td>
<td>%</td>
<td>&gt; 60</td>
<td>Tappi T519 / DIN 53146 ISO 2471:1977</td>
</tr>
<tr>
<td>15</td>
<td>Electrical surface resistance</td>
<td>Ω</td>
<td>$10^8$ to $10^{11}$ at 50 % relative humidity</td>
<td>PTS-PP 101/84 Electrode A</td>
</tr>
<tr>
<td>16</td>
<td>Electrical volume resistance</td>
<td>Ω</td>
<td>$10^8$ to $10^{11}$ at 50 % relative humidity</td>
<td>DIN IEC93</td>
</tr>
</tbody>
</table>

* Subject to satisfactory test results; grammatures above 160 g/m² at adapted speed. For printing systems VarioStream 9500 / VarioStream 9600 / VarioStream 9700 higher grammages than standard range are not possible.

Table 1  Properties of paper (Continued)
3.5 Extended Paper Range

3.5.1 General

Many of our customers use our printing systems for a variety of applications that do not use standard paper types. Amongst these count plastic cards, adhesive and self-adhesive (SE-SAM) labels, carbonless paper, multifunctional forms with several perforation lines, high-quality products on special paper types, mass products with narrow cost margins, and particularly, Print on Demand (PoD) applications on product-oriented paper types. In many cases, it is quite impossible to specify the appropriate paper types. Practical experience or practice-oriented tests are therefore essential for determining the appropriate paper types. Section 3.5 specifies paper types and supplies threshold values and dependencies.

3.5.2 Low-grammage Paper

Any printing material with a grammage of < 70 g/m² is a "low-grammage paper". This paper category has shown the following behavior in processing:

- Due to the tractor-less paper transport with active paper edge control, low-grammage papers can be operated very well.
- Generally, stack processing is not possible. We recommend the use of reel paper that you then post-process.
- The risk of errors is increased with decreasing grammage and increasing web width.
- Thickness and high flexural strength favor runability. The threshold value for flexural strength (for paper types with feed holes) is 0.1 mNm in grain direction.
- The moisture content of the paper must be evenly distributed over the form or the paper web to avoid partial, uneven stresses.
- The paper should show a low tendency for shrinkage. The cross grain threshold value is < 0.8 %.
- The values specified for feed holes should be adhered to (vertical alignment of feed holes should not deviate more than 1.0 mm).
3.5.3 High-grammage Paper

Any printing material with a grammage of > 160 g/m² is a "high-grammage paper".

This paper category has shown the following behavior in processing:

- High grammage has an adverse effect on the fusing properties of the paper (toner adhesion).
- Thickness and flexural strength have an adverse effect on runability.
- No negative effects on printability (transfer printing) are known.
- With increasing grammage, the risk of paper tears at the transverse perforation of batch ware (less elasticity of the paper, fiber break at the perforation) is increased. The tendency to this property can partially also be seen at papers with a grammage below 160 g/m².

The suitability of such papers has to be guaranteed through prior tests.

3.5.4 Book Paper

As its name indicates, book paper is used in the production of books (incl. paperbacks) because of its thickness and stiffness. The major feature of this paper type is its volume. Paper with a thickness of 100 μm and a grammage of 50 g/m² is labeled "double volume" (\(\frac{100}{50} = 2\)), for instance. Beside these properties, book paper has a relatively rough surface and is extremely porous and opaque.

Experience with book paper processing in Océ printing systems:

- Better runability compared to "normal" paper.
- Its rough surface makes it less appropriate for printing images with 600 dpi.
- Toner adhesion deteriorates the rougher and more porous the paper is.

3.5.5 Coated Paper/Calendered Paper (for 600 dpi)

A smooth paper surface is needed to print high-quality, clear images with a resolution of 600 dpi. With uncoated paper, this can be achieved to a certain degree by calendering the paper, a process which follows actual paper production.

When paper is coated, any pores that might exist are sealed and the paper surface is covered and smoothed (data mailers are frequently produced on coated paper printed on offset rotary presses).
Coated and calendered paper is suitable for use in electronic printing systems, as is untreated paper, provided they fulfill the usual requirements. In the event of deviations from the properties specified in table 1 on page 12, printing tests should be performed to assess the paper's suitability.

A key factor is that the paper should not emit any volatile substances when heated (non-contact fusing (infra-red): 150 °C). Preprinted media must comply with the general requirements in terms of their printing ink and moisture content.

Experience with coated and calendered paper in Océ printing systems:

- Good print image quality at 600 dpi due to extremely smooth surface. The threshold value for roughness is at 200 ml/min (Bendtsen). Optimal image rendering (image definition) at 100 ml/min (Bendtsen).
- The smoother the paper surface the better the toner adhesion. In general, the binder in coated paper fuses extremely well with the toner.
- The smoother the paper surface the more easily it takes up an electrostatic charge. This may have an ill effect on the paper's processing properties. This is particularly the case with coated paper.
- If the fusing station in the printing system overheats, blistering may occur when coated paper with an especially thick, closed surface is used. For this reason, it is recommended that you test coated paper beforehand.

### 3.5.6 Adhesive Labels

#### 3.5.6.1 General

Adhesive labels consist of a silicon-treated backing sheet and the actual label (with an adhesive coating on its rear). The silicon treatment allows for easy separation of the label from the backing sheet. The adhesive effect may vary according to the application. A distinction is made between easy-to-remove and permanently adhering labels.

Many types of paper may be used for the label. In forms applications, mostly wood-free or ecology paper is used. For other applications, high quality recycling paper can also be used instead.

**Note:**

If adhesive labels are to be used, their suitability has to be guaranteed through prior tests. Due to the fuser technology and the friction drive, papers with formula-internal changes can not be operated. This concerns e.g. papers which are partially overlaid with labels.
### 3.5.6.2 Requirements for Labels

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammage:</td>
<td>≥ 65 g/m²</td>
</tr>
<tr>
<td>Specific Volume:</td>
<td>1.3 cm³/g ± 0.2 cm³/g</td>
</tr>
<tr>
<td>Specific static bending resistance:</td>
<td>Lengthwise: &gt; 0.16 mN x m</td>
</tr>
<tr>
<td>Tensile strength:</td>
<td>Lengthwise: &gt; 65 N</td>
</tr>
<tr>
<td></td>
<td>Crosswise: &gt; 40 N</td>
</tr>
<tr>
<td>Tear length:</td>
<td>Lengthwise: &gt; 5000 m</td>
</tr>
<tr>
<td></td>
<td>Crosswise: &gt; 2500 m</td>
</tr>
<tr>
<td>Dimensional stability:</td>
<td>Lengthwise: &lt; 0.06%</td>
</tr>
<tr>
<td></td>
<td>Crosswise: &lt; 0.14%</td>
</tr>
<tr>
<td>Writing properties:</td>
<td>Ink-stable according to DIN 53126</td>
</tr>
<tr>
<td>Surface roughness:</td>
<td>DIN 53108-compliant (Bendtsen):</td>
</tr>
<tr>
<td></td>
<td>at 240/300 dpi: 30 - 500 ml/min</td>
</tr>
<tr>
<td></td>
<td>at 600 dpi: 30 - 200 ml/min</td>
</tr>
<tr>
<td>pH value:</td>
<td>&gt; pH 5.0</td>
</tr>
<tr>
<td>Dust-freeness:</td>
<td>The abrasion after 100 revolutions at a load of 500 g as tested in accordance with DIN 53109 is less than 30 mg</td>
</tr>
<tr>
<td>Water absorption:</td>
<td>22 g/m² ± 7 g/m² according to DIN 53132</td>
</tr>
<tr>
<td>Opacity:</td>
<td>≥ 85%</td>
</tr>
<tr>
<td>Electrical resistance:</td>
<td>At a measuring voltage of 100 V and in a normal climate of 23 °C at 50% relative humidity, according to DIN 50014</td>
</tr>
<tr>
<td></td>
<td>Surface resistance 10⁸ to 10¹¹ Ω</td>
</tr>
<tr>
<td></td>
<td>Volume resistance &lt; 10¹⁰ Ω</td>
</tr>
</tbody>
</table>

### 3.5.6.3 Requirements for Silicon Backing Sheet

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammage:</td>
<td>85 g/m² ± 4%</td>
</tr>
<tr>
<td>Specific volume:</td>
<td>1.3 cm³/g ± 0.2 cm³/g</td>
</tr>
<tr>
<td>Tensile strength:</td>
<td>Lengthwise: &gt; 85 N</td>
</tr>
<tr>
<td></td>
<td>Crosswise: &gt; 40 N</td>
</tr>
<tr>
<td>Breaking length:</td>
<td>Lengthwise: &gt; 5000 m</td>
</tr>
<tr>
<td></td>
<td>Crosswise: &gt; 2500 m</td>
</tr>
</tbody>
</table>
Surface roughness:  200 ml/min to 500 ml/min according to DIN 53108 (Bendtsen)

3.5.6.4 Requirements for the Adhesive Compound

The labels must not peel off the backing sheet during processing in the printing system. Ensure that your labels use adhesives which are resistant to the fusing temperature in the printing system. The adhesive must to adhere to all metallic and nonmetallic, smooth, clean, dust-free and silicon-free surfaces without any extra activating process (e.g. using heat or solvents) and nor may the labels corrugate when they are affixed.

The label forms must have neatly cut edges and should be as fluff-free as possible. In addition, they should be resistant to abrasion.

Grammage: 150 g/m² to 180 g/m²

Adhesion of labels to backing sheet: 0.1 N per 15 mm of tape width

Equilibrium moisture content: 45% at 21 °C ± 2 °C
Definition of term DIN 19306

Dimensional stability: When subjected to a change in relative humidity of 10%:
Lengthwise: up to 0.06%
Crosswise: up to 0.14%
3.5.7 Carbonless Paper

In the case of carbonless paper, we distinguish single-sheet and multi-sheet systems.

**Single-sheet system**

Acceptors and reactant microcapsules are both contained in the top layer of the carbonless paper. Disadvantage: the carbonless paper remains sensitive to pressure after it has been printed.

**Multi-sheet system**

CB (Coated back) = top sheet. Back coated with reactant microcapsules.

CFB (Coated front and back) = middle sheet. Front coated with ink-absorbing acceptor layer, back with reactant microcapsules.

CF (Coated front) = bottom sheet. Front coated with ink-absorbing acceptor layer.

**Note:**

If carbonless paper is to be used, its suitability has to be guaranteed through prior tests.

**Experience with carbonless paper in Océ printing systems:**

- Carbonless paper suitable for use in laser printing systems is available on the market and can be employed in Océ printing systems. The pressure and temperature in the fusing station have no adverse effect on the performance of the carbonless paper.
Some manufacturers of carbonless paper warn you of a reduction of the useful life of the photo-conductor drum or of deposits in the printing system when using carbonless paper. Any damage that occurs is in the responsibility of the user.

Users frequently wish to combine multi-sheet systems with unprinted paper webs after having processed them with the Océ printing system to form carbonless forms sets. Note that in this case, different shrinkage behavior of the individual webs may cause problems.

3.5.8 Other Printing Materials

Apart from the paper types and adhesive labels described above, there are other printing materials that can be processed in Océ printing systems:

- plastic materials
- synthetic fibre products
- forms with plastic cards attached to them
- aluminum-coated materials
- multi-layer coated materials
- self-adhesive (SESAM) labels with a release material
- forms with punch holes
- closable forms with partial glue strips or full thermo-seal coating, etc.

In view of the great variety of printing material available, we cannot issue specifications for all of them. Some of our customers accept functional restrictions in their applications, in order to use the printing material of their choice. In any such case, we recommend our customers to consult the customer service. We will also test materials for our customers in our paper laboratory at Poing, in particular prior to bulk orders.

Paper with form-internal changes of thickness cannot be processed due to the fusing technology and the friction drive of the paper web.

Tests should be carried out for papers with apertures, e.g. filing holes cross to paper path direction, and holes / hole clearances.
3.6 Paper for Special Fields of Application

3.6.1 Paper for Character Readers

3.6.1.1 General Requirements

The requirements that automated reading devices make of the paper are detailed in the specifications published by the device manufacturers. The properties that matter most are these:

- Runability properties of the paper in the reader.
  Relevant parameters:
  - Strength
  - Stiffness
  - Surface finish
  - Flatness

- Print image quality
  The quality of the print image has a direct impact on the readability. The paper properties which influence this quality are (among others):
  - Electrostatic properties (transfer)
  - Surface finish/smoothness (edging sharpness)

- Fusing quality
  The quality of the fusing is important in order to comply with standard operating requirements and to avoid the toner rubbing off in the reading device. Alongside the type of toner and the printer's fusing method, the surface quality of the paper plays a key role in the fusing quality.

The paper properties required by manufacturers of reading devices do not conflict with the Océ paper specification. However, the requirements posed by the readers do lessen the wide choice of paper that is suitable for Océ printing systems.
3.6.1.2 OCR Paper

The requirements to be fulfilled by OCR* paper are defined in the following standards:

- DIN 6723-1 / DIN 6723-2
- DIN 6724-1 / DIN 6724-2
- DIN 66 223, Part 1 - 5

*OCR = Optical Character Recognition

3.6.1.3 MICR Paper

The requirements to be fulfilled by MICR* paper are defined in the following standards:

- ANSI / ABA X9.18-1993
  American National Standard for Financial Services
  Paper Specification for Checks
  American Bankers Association
  American National Standards Institute
  Publisher: Washington Publishing Company, 806 West Diamond Avenue, Gaithersburg, MD 20878

The VarioStream 9000 and ColorStream printers are not intended for MICR applications.

*MICR = Magnetic Ink Character Recognition
4 Continuous Forms and their Manufacture

4.1 General

Printing material will usually be selected based on its appropriateness for a specific task, but its manufacture is also of great importance. This process covers any steps which convert paper into continuous forms that can be used in Océ printing systems and which are the prerequisites for its later use, for instance punching feed holes for paper transport, filing holes and the perforations required for stacks and reels as well as pre-printing and other related processes. This section specifies the quality requirements for continuous forms.

4.2 Dimensions

<table>
<thead>
<tr>
<th>Océ Printing System</th>
<th>Paper width (operatable)</th>
<th>Forms width</th>
<th>Forms length</th>
</tr>
</thead>
<tbody>
<tr>
<td>VarioStream 9200</td>
<td>min. 165 mm/6.5 inch</td>
<td>min. 165 mm/6.5 inch</td>
<td>min. 76.2 mm/3 inch</td>
</tr>
<tr>
<td></td>
<td>max. 482.6 mm/19 inch</td>
<td>max. 482.6 mm/19 inch</td>
<td>max. 1371.6 mm/54 inch</td>
</tr>
<tr>
<td>VarioStream 9400 / VarioStream 9500 / VarioStream 9600 / VarioStream 9700 ColorStream</td>
<td>min. 165 mm/6.5 inch</td>
<td>min. 165 mm/6.5 inch</td>
<td>min. 76.2 mm/3 inch</td>
</tr>
<tr>
<td></td>
<td>max. 495.3 mm/19.5 inch</td>
<td>max. 495.3 mm/19.5 inch</td>
<td>max. 1371.6 mm/54 inch</td>
</tr>
</tbody>
</table>

Table 2  Forms dimensions

(further information to forms dimensions: see Product Data Sheets

* In special cases, a switch to 1524 mm (60 inch) is possible after successful testing by Service. Forms lengths between 762 - 1016 mm (30 - 40 inches) are not supported.)
4.3 Feed Holes

4.3.1 General

Feed holes are a prerequisite for paper transport and precise printing of continuous form in printing systems using form tractors. Feed holes have to conform to a world-wide standard (ISO 2784, DIN 9771). Refer to section A.3 on page 44 for dimensions and tolerance values. Both holes with smooth edges and with milled edges are allowed.

4.3.2 Requirements for Feed Holes in Continuous Forms

Table of requirements and tolerance values using standard measuring methods (Bundesverband Druck; see page 42):

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal feed holes</td>
<td>0 to +2.0 mm longitudinal tolerance over 2 meters of web</td>
</tr>
<tr>
<td>Vertical displacement of feed holes</td>
<td>Max. 1 mm tolerance over 2 meters of web</td>
</tr>
<tr>
<td>Space between the middle of the feed holes</td>
<td>6.0 ± 0.7 mm</td>
</tr>
<tr>
<td>and the web edge</td>
<td></td>
</tr>
</tbody>
</table>

Table 3  Requirements for Feed Holes in Continuous Forms

The feed holes must be neatly punched to avoid the accumulation of dust. The chad must be removed completely from the paper web. In addition, no serrated edges – caused, for example, by the use of worn tools – must be left when the feed holes are punched. The holes should be punched from the front or upper side of the paper (this is the side that receives the print or, in duplex mode, the first print side).
4.4 Perforations

4.4.1 General

Continuous forms have both horizontal and vertical (margin) perforations. These perforation lines can serve a variety of purposes.

- The horizontal perforations mark the sheet lengths within the continuous web. They allow the sheets to be separated either manually or by post-print processing devices. These perforations also ensure that the web is folded and stacked in fanfold format. There may also be additional horizontal perforations within a form, allowing for easy separation of sections of the web of paper. Depending on their function, the horizontal perforations can thus be termed either fold perforations, form perforations or internal horizontal perforations.

- The vertical perforations include the left and right margin perforation and internal fold perforations.

4.4.2 Rules for Perforations

The type of perforation, i.e. the tie/cut ratio, depends on the quality and caliper of the paper. The values given in the following table are recommended to ensure optimum paper transport and stacking. If the fold perforation values are lower than those stated, the paper may tear. If the recommended values are exceeded, stacking problems may arise.

<table>
<thead>
<tr>
<th></th>
<th>Tear resistance (N/cm) FOGRA measuring instrument</th>
<th>Tie length (mm)</th>
<th>Cut length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Woodfree papers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended fold perforation</td>
<td>10 ± 2</td>
<td>1.0</td>
<td>3.0 to 4.0</td>
</tr>
<tr>
<td>Form perforation</td>
<td>&gt; 12.5</td>
<td>0.9</td>
<td>2.0</td>
</tr>
<tr>
<td>Internal form perforation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vertical</td>
<td>&gt; 16.0</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>horizontal</td>
<td>&gt; 16.0</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Graphic recycling papers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended fold perforation</td>
<td>10 ± 2</td>
<td>0.8 to 1.2</td>
<td>2.0 to 3.0</td>
</tr>
</tbody>
</table>

1) FOGRA system perforation tester available from Gockel & Co GmbH

Table 4  Recommended guidelines for fold perforations
• Adherence to the tear resistance values takes priority over adherence to values for tie and cut length.

• The tie/cut ratios of the fold and form perforation should be different.

• The perforations should be arranged in such a way that at least one full tie is left at both outer edges. This guards the paper against inadvertent tearing during processing and prevents paper feed problems.

• Characters to be read by optical readers must not be printed within 10 mm of a perforation line.

• Forms which are under 150 mm in length should not contain internal horizontal perforation lines.
  One internal horizontal perforation line is permitted with longer forms, but the perforation line must be spaced at least 50 mm from the upper or lower edge (i.e. fold perforation). Up to three vertical internal perforations are permitted for these forms, provided that 80 g/m² to 90 g/m² paper is used.
  If forms are to be subdivided by several internal vertical and horizontal perforation lines, the runability and stacking behavior of the web should be tested.

• We recommend that margin perforations be cut on both sides of the paper (left and right), as vertical perforations on one side only may adversely affect the stacking action.

• Pinches along the cuts of the fold perforation (frequently due to blunt paper cutters) may cause the paper stack to be higher along the fold perforation than at the center. If the discrepancy exceeds 20 mm, there is an increased likelihood of printing and stacking problems.

• Non-straight perforation lines, which can impair toner transfer in the area of the fold.

• When using reel paper, it can be of benefit to set tear resistance values which deviate from the specification but which are more suited to the type of post-processing the forms will undergo. The processing properties should be verified by tests.
4.5 Preprinted Forms

4.5.1 General

Basically, the same rules apply to forms preprinted on the front and/or back as to unprinted forms. This refers to suitability for photo-electric processes, transfer printing and heat resistance.

4.5.2 Requirements for Print Ink

- Do not use print inks containing metal pigments.
- Printing systems with non-contact fusing (infra-red):
  The fusing temperature ranges from 120 °C to 150 °C. The reaction time is approx. 1 second. Prior tests have shown no restrictions in this range. We recommend preprinted paper to be tested in advance.
- No fumes should be emitted during the fusing process, which could cause irritations or other health hazards. Also, no other substances should be contained that might disperse, smoke or stick and leave a residue on the fusing roller. These requirements also apply to any other additional substances used during processing.

4.5.3 Requirements for Preprinting

- To avoid blistering, the form to be printed must not have any preprints with large areas which overlap on front and rear pages. This would generate barrier layers, impermeable for water vapor.
- Print inks must be allowed to dry properly before the forms are processed in the printing system. If colors are not completely dry, there will be operational problems, e.g. color deposition/dirt accumulation at the photoconductor drum, photo conductor belt or transfer belt.
- **Note:**
  Print inks, which only dry by “penetration” into the paper, are not allowed.
- For preprints with small areas (e.g. customer logos), UV color systems have stood the tests. With correct procedure of UV drying, an instant subsequent processing in electronic printing systems is possible.
When using print inks that dry through oxidation, a storage period (for drying) of 3 to 4 days should be considered. Print ink takes longer to dry on paper with low pH values than on neutral or slightly alkaline paper. This should be considered when selecting paper for preprinted forms.

If you wish to print on preprinted surfaces using electronic printing systems, there may be an adverse effect on toner adhesion. That is why preprinted surfaces are screened. Furthermore, they should not take up more than 50% of the surface.

To reduce overall inking, four-color prints should be produced using the achromatic method. Inking can then be kept under the maximum permitted 280% (with maximum inking being 400% when four colors are superimposed over 100% of the paper surface). In general, ink strength should be kept as low as possible.

The print ink on the preprinted forms should be sufficiently abrasion-resistant to leave no traces in the electronic printing system.

On paper with feed hole margins, the reference point for preprints is the centre of the feed hole. There is a horizontal and vertical tolerance of ±0.2 mm.

On paper without feed hole margins, the reference point for preprints is the edge of the paper. There are vertical and horizontal tolerance values of ±0.2 mm, measured respectively from the start of the physical page and the edge of the paper.
4.6 Printable Surfaces/Print-free Zones

Special sensing fields have to be present on the forms for printing toner marks, synchron marks, job separation marks, and data integrity marks. These fields must be kept free of any other print data. To minimize the restrictions posed by these sensing fields, there are different requirements in terms of the size and position of the fields that have to be kept free on each preprint, depending on the type of application and/or printing system:

- Pinfed printing system/pinless printing system
- Simplex/duplex/triplex
- One color/two colors

The front of the paper is the side which is printed first. The print-free zones on the back of the paper are presented as viewed from the front side of the paper. The following tables provide an overview of the figures.
4.6.1 Print-free Zones with Paper with Feed Hole Margin

Dimensions in millimeters

Figure 1  Paper with feed hole margin: 1-sided, 2-sided
4.6.2 Paper without Feed Hole Margin

Dimensions in millimeters

Figure 2  Paper without feed hole margin: 1-sided/2-sided
4.7 Requirements for Stack and Reel Quality

4.7.1 Requirements for Stack Paper

Table of requirements and tolerance values using standard measuring methods (Bundesverband Druck; see page 42)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack height external (standard)</td>
<td>maximally 600 mm</td>
</tr>
<tr>
<td>with option &quot;high stack input&quot;</td>
<td>maximally 1000 mm (+Europalette)</td>
</tr>
<tr>
<td>Stack curvature</td>
<td>Max. 20 mm with 225 mm batch height</td>
</tr>
<tr>
<td>Batch tilt</td>
<td>Max. 12 mm with 50 mm batch height</td>
</tr>
<tr>
<td>Angle of vertical perforation</td>
<td>Max. 0.5 mm tolerance with 2 meters web length</td>
</tr>
</tbody>
</table>

Table 5 Requirements for stack paper

The stack quality and processability depend on the following factors:

- Bending strength according to the table on page 12
- Paper flatness (no waviness)
- Fold memory
- Appropriate tie/cut ratio for vertical perforations (see section 4.4.2 on page 25)
- Clean cut of edges and perforations
- Appropriate packaging to protect the paper against moisture. Packaging should also be sufficiently stable to allow stacking without leaving marks on the forms. The paper should run smoothly from the box during printing.
4.7.2 Requirements for Reel Paper

Basic requirements:

- Even winding pressure and moisture profile in the reel across the entire web width
- Even reel sides
- Clean web cuts to avoid dust pollution
- No pollution of the reel sides which could have an adverse effect on runability and no damage or tears to the sides

The following factors are also important for processing, however, they depend on the specifications from the manufacturer of the unwinder and are a matter of agreements between the customer and the supplier:

- Outer reel diameter
- Inner tube diameter
- Number and marking of gluing positions
- Position of top side and wire side of the paper on the reel
- Tolerance of reel width
5 Shipment and Storage of Printing Material

5.1 General

Paper is a hygroscopic material and absorbs or gives off moisture very rapidly according to the prevailing ambient conditions. This may cause considerable dimensional variations, particularly with short grain forms. In addition, the feed properties may be effected by static electricity, reduced bending resistance and waviness. These tendencies should be taken into account when selecting a suitable place to store the paper.

Before the forms are processed, they should be kept as long as possible in the original packaging. The packaging itself must be adjusted to the moisture content of the paper; otherwise, the forms will absorb moisture from the packaging. In addition, the packaging must provide adequate protection against climatic variations. Ideally, temperature and humidity should be largely the same in the store-room and in the processing room. In any case, it would be of advantage to store a sufficient quantity of forms in the processing room before processing. The temperature of the paper should be allowed to adjust to that of the processing room.

Do not store paper in the vicinity of heating appliances, water pipes, open windows, moist walls, on the floor, or in direct sunlight. Ideally, the room should be used exclusively for the storage of paper. Chemicals or chemical vapors, plastics containing softeners, rubber parts, fats, etc. should be kept away from the store-room.

The climatic conditions in the store-room should not be subject to major variations.
- Recommended temperature: between 18 °C and 24 °C
- Recommended relative humidity: between 35% to 55%

To avoid problems during processing, the temperature of the paper should be the same as the temperature of the processing room.
5.2 Temperature Adjustment of Paper

If adverse conditions (e.g. transport during cold weather) have led to a difference in temperature of the paper and the processing room, the temperature of the paper must be allowed to adjust. The protective packaging of the paper should not be removed during that period of time.

Table 6 on page 36 indicates the time required for cold paper stacks or rolls to adapt to the temperature of the processing room.

<table>
<thead>
<tr>
<th>Size of paper stack in m³</th>
<th>Temp. difference (°C) between store-room and processing room</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>6</td>
</tr>
<tr>
<td>0.3</td>
<td>7</td>
</tr>
<tr>
<td>0.4</td>
<td>8</td>
</tr>
<tr>
<td>0.5</td>
<td>9</td>
</tr>
<tr>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>1.0</td>
<td>11</td>
</tr>
<tr>
<td>2.0</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 6  Storage time in processing room
6 Pre-Print and Post-Print Processing of Continuous Forms

6.1 General

Océ printing systems can be combined with a great many pre-print and post-print processing devices from different manufacturers in on-line mode. The objectives of the processes, some of which are extremely complex, are as follows:

- Paper feed from reel
- Automation of manufacturing processes
- Generation of a specific end product

Paper feed is generally realized from a reel (unwinder) or from large stacks. A device for manufacturing the feed holes and, if required, for horizontal and vertical perforation can precede the printing system in the processing line.

Depending on the user's requirements, on-line post-processing of the printed paper web can follow printing directly in four different processes:

- **Rewinding** the paper web using the appropriate rewinding device.
- **Cross cutting** the paper web using cutting and stacking devices (depending on requirements, center splitting the paper web and guiding the two web halves together before cross cutting) to create single sheet format, removing the feed holes, separating according to job size and depositing the single sheets in the device stacker.
- **Tearing** the paper web at the horizontal perforations into the desired single sheet format, removing the feed hole margins, separating according to job size and stacking the single sheets using tearing and stacking devices.
- **Folding/stacking** the paper web using a folding and stacking device, separating according to job size or according to a specified stack height.
In the next processing step, further post-processing devices from different manufacturers can follow, e.g. enveloping, binding, stitching/folding, banderoling or sleeve-wrapping. Depending on the specific situation, these processes can either run on-line or off-line with the electronic printing system.

6.2 Requirements

Smooth post-processing requires the paper to run flat from the printing system, i.e. no buckling or waviness. The prerequisite for this is the paper’s stiffness and low two-sidedness.

Using paper with better fusing quality reduces the toner abrasion that occurs in some post-processing systems.

In order to avoid uncontrolled electrostatic charging during printing in the printing system and while the paper is running through the post-processing devices, the electric conductivity and the moisture content of the paper should correspond to the values specified.

In general, paper types that meet the specifications for continuous form printing systems or the standards for continuous forms, can also be used in post-processing. Due to the great number of possible combinations this specification cannot cover all paper properties in detail. We recommend you also consult the paper specifications issued by the manufacturer of the device or devices you are using. In particular, it is important to take note of the maximum reel diameter, the inner tube diameter and the grammage.
A Appendix

A.1 Notes on Standards and Recommendations

(1) Drying of continuous print colors with regard to further processing in laser printers. FOGRA Research Report no. 5.018.


(3) Climate and paper FOGRA Praxis Report no. 23

(4) DIN 1306 Specific volume; Vocabulary

(5) DIN 6721 part 1 Paper for data processing Uncoated paper; requirements, test.

(6) DIN 6730 Paper and cardboard - Vocabulary

(7) DIN 19 309 Paper for copying purposes, 80 g/m² paper uncoated, requirements, test.

(8) DIN 53 105 Teil 1 Test of paper and cardboard; determination of medium thickness of cut sheets, of the bulk density and the specific volume.

(9) DIN 53 108 Test of paper and cardboard; determination of the roughness according to Bendtsen.

(10) DIN 53 109 Test of paper and cardboard; determination of the abrasion by means of the abrasive disk method.

(11) DIN 53 120 Teil 1 Test of paper and cardboard; determination of the air permeability, process for medium air permeabilities according to Bendtsen.
(12) DIN 53 121 Test of paper and cardboard, determination of bending resistance according to the beam test.

(13) DIN 53 124 pH of aqueous extracts

(14) DIN 53 126 Test of paper, test of writing properties with ink.

(15) DIN 53 130 Measurement of hygroexpansivity - 68 % r.H.

(16) DIN 53 132 Test of paper and cardboard; determination of water absorption according to Cobb.

(17) DIN 53 145 Teil 1 Test of paper and cardboard; basic measurements for determining the reflexion factor, measurement of non-fluorescent samples.

(18) DIN 53 145 Teil 2 Test of paper and cardboard; basic measurements for determining the reflexion factor, measurement of fluorescent samples.

(19) DIN 53 146 Test of paper and cardboard; determination of the opacity.

(20) DIN 53 482/ VDE 0303 Teil 3 Test of materials for electrical engineering; measurement of the electric resistance of nonmetal materials.

(21) DIN 54 354 Test of cellulose; determination of the dichloromethane extract.

(22) DIN 54 370 Determination of ash

(23) DIN EN 20535 Absorptioness Cobb

(24) DIN EN ISO 536 Paper and cardboard; determination of the grammage.


(26) DIN ISO 186 Paper and cardboard; sampling for test purposes.

(27) DIN ISO 287 Paper and cardboard; determination of the moisture content by means of the oven process.

(28) ISO 187 Paper and board - Conditioning of samples.

(29) ISO 534 Thickness

(30) ISO 535:1991 Absorptioness Cobb

(31) ISO 554-1976 Standard atmospheres for conditioning and/or testing - Specifications.

(32) ISO 624:1974 Dichlormethane soluble matter

(33) ISO 2144:1987 Determination of ash

(34) ISO 2471:1977 Determination of opacity diffuse reflectance method
(37) ISO 5628:1990  Bending stiffness by static method
(38) ISO 5636-3:1992  Determination of air permeance - Bendtsen method
(39) ISO 6588:1981  pH of aqueous extracts
(40) ISO 8226-1:1995  Measurement of hygroexpansivity - 68 % r.H.
(41) Tappi T204  Solvent extractives of wood and pulp
(42) Tappi T410  Grammage of paper and paperboard
(43) Tappi T413  Ash in paper and paperboard
(44) Tappi T435  pH of paper extracts (hot extraction method)
(45) Tappi T441  Water absorptiviness of sized paper and paperboard (Cobb)
(46) Tappi T489 (Taber)  Stiffness of paper and paperboard
(47) Tappi T500  Book bulk and bulking number of paper
(48) Tappi T502  Equilibrium relative humidity of paper and paperboard
(49) Tappi T509  pH of paper extracts (cold extraction method)
(50) Tappi T519  Diffuse opacity of paper
(51) Merkblatt V/17/80  Test of paper, "Karton" and cardboard; electrometric measurement of the pH value of the paper surface (surface pH value).

To be ordered from:
Verein der Zellstoff- und Papier-Chemiker und -Ingenieure
Berliner Allee 56
64295 Darmstadt

(52)  General conditions of sale for graphic papers and cardboards used for printing.
To be ordered from:
Verband Deutscher Papierfabriken e.V.
Adenauer Allee 55
53113 Bonn

A.2 Notes on Ordering Paper

Before ordering continuous forms, please consult the paper manufacturer to agree on the paper quality and paper type, taking into account the relevant DIN standards and the points listed below.

- **Sheet size:** Length in inches x width in mm (incl. feed hole margin)
- **Quantity:** Number of sheets
- **Feed hole margin:** Tear-off or fixed
- **Perforation:** Folded, non-folded and internal form perforation
- **Paper:** Paper type: Properties as per DIN 6721, Paper Specification for continuous forms
  - Basis weight in g/m²
- **Supply form:** Stack (stack height limit), jumbo stack, roll
- **Forms preprint:** Yes/no, forms layout
- **Packaging:** Type of box, no. of units per box, labeling

**Note:**

We urgently recommend that you conduct test runs with the intended paper before you enter into any contracts.
A.3 Feed Holes

The values are based on conditioned paper at a temperature of 23 °C, with 50% relative humidity.

Dimensions in millimeters

1) Larger feed holes (required occasionally for special applications, e.g. filing) with a maximum diameter of 6.36 mm are permitted (consult with user).

In the case of serrated feed holes, the inside diameter must be 4.0 mm ± 0.1 mm and the outside diameter: 4.4 mm ± 0.1 mm.

Serrated feed holes can produce inadequate results with some print devices when large-format, low-calliper paper is used.

2) The maximum center-of-hole deviation of all feed holes from their common centerline is 0.1 mm.

3) The distance between the centers of two consecutive feed holes should theoretically be exactly 12.7 mm. The vertical distance between the theoretical centerpoints of two holes may not deviate by more than 0.05 mm from this value.

4) The maximum center-of-hole deviation of corresponding left and right feed holes is 0.15 mm.

5) The distance between any 20 hole spacings may not deviate by more than ± 0.3 mm from the rated length 254 mm.

6) The maximum parallelism deviation for left and right feed hole centerlines may not exceed 0.15 mm.

7) This tolerance must be adhered to when using preprinted forms and processing on pinless printing systems.
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