



# ColorStream 6000 series

## Media specifications



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# **Chapter 1**

## **General**

# General

## Introduction

This document is valid for the high-speed high-performance Inkjet printing systems ColorStream 6000 series.

These printing systems allow a multi-colored print over the whole printing width of paper webs defined within this specification. The paper web can be a paper roll or stack with tractor holes (pinfed) or a paper roll without tractor holes (pinless).

This document contains the valid standards for paper.

Also, it provides recommendations for paper types and design of continuous forms which should be considered, when using these printing systems.

Where possible, standard paper industry technical properties have been referenced. These properties are familiar to paper suppliers. However, the mere use of specific data is not always sufficient to describe all complex paper processing methods. In those cases this document is intended as a guideline both for customers and suppliers of printing material.

## General

This document details the functional requirements and test procedures for paper which is processed according to state-of-the-art technology on high-speed high-performance inkjet printing systems. The requirements described in this document refer both to the properties of the paper itself as well as 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 document we want to make sure that only materials that meet the specified requirements are used for our printing systems.

Only if these requirements are fulfilled by the paper suppliers, the expected quality standard can be achieved. Papers that do not comply with this document can cause damage to the printing system and may, in addition, result in the release of substances from the paper which can have a detrimental effect on health, safety and/or the environment. Canon accepts no liability for such damages.



### NOTE

We recommend that the user performs a paper calibration and conducts appropriate suitability tests for their specific applications and equipment prior to ordering large quantities of a paper. This applies in particular to large users who make contracts on an annual basis. The tests and paper setups should be made with representative samples. It is the responsibility of the paper supplier to guarantee a constant quality and to actively inform the paper user of changes in the paper quality which might affect the print quality and paper calibration. It is highly recommended to perform recalibrations of the paper at regular intervals and especially when being informed of changes in the paper recipe or specifications.

## Media Laboratory

Furthermore, Canon runs a Media Laboratory with highly qualified experts who will be glad to give advice to you, and who will carry out paper investigations, if requested.

We would appreciate any information and suggestions on this document. Please direct your suggestions to:

Canon Production Printing Germany GmbH & Co. KG  
Media Laboratory  
PO Box 1260  
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## **Chapter 2**

### Paper Types

# Paper Types

## Introduction

With ColorStream 6000 high-speed inkjet printing systems, documents in full color can be produced as well as black-and-white documents for different markets, e.g. mailer, transpromo or book printing.

## Classification of Paper Qualities

The following classification of the paper qualities should give support regarding cost-print quality ratio when searching for the appropriate paper:

- Uncoated standard papers are commodity papers produced for conventional offset or digital printing. The papers discussed here are uncoated commodity papers which are often wood-free. They do not necessarily have any specific product design for improving inkjet print quality. They are ideal for black-and-white printing, but printing with full-color printing is also possible. The print quality is limited to lower requirements.
- Treated and pigmented Papers have been specifically designed to have improved inkjet printing properties, typically through a surface treatment of the paper. The purchase prices are about 1.05 to 1.5 times higher compared to uncoated standard papers. They provide an excellent print quality cost-performance ratio and are ideal when using variable color images. Furthermore they typically provide better properties regarding water resistance, wet cockling, curl and ink adhesion.
- Coated inkjet papers allow very high print quality to be achieved. The purchase prices are typically 2 to 3 times higher compared to uncoated standard papers.
- Other papers are papers which do not fit into one of the above categories. These papers can be high production volume, low cost papers or papers used for specialty applications. Examples of these papers in regard to production inkjet printing are light weight newsprint paper, high bulk book print paper as well as glossy coated photo paper. Some of these papers have no specific design for improving inkjet print quality, but some are optimized for inkjet printing by surface treatment or coating.



### NOTE

It should be noted that most surface coated papers which have been designed for printing using offset printing technology are not suitable for printing in ColorStream high-speed inkjet printing systems.

## General Paper Requirements

In addition to the properties listed in [Standard Paper Properties on page 12](#), good print quality and trouble-free paper transport for the high volume inkjet printing systems requires the following paper properties:

- The paper may not raise dust, bear traces of glue, slime, grease or dirt. There may not be any loose fibers at the edge of the paper since this could contaminate the inkjet print heads and therefore impair both the print quality and paper transport.
- Inclusions or thick spots in the paper may lead to paper web tearing or damage the printing system.
- The paper must not release toxic fumes when heated.
- The moisture content of the paper must be distributed evenly across the form or web to prevent uneven tension.  
Folds, bulging and unevenness of the paper web lead to uneven distances to the inkjet print heads and may impair the print quality.
- The paper must not contain any abrasive components that would subject the printing system to increased wear and tear. Also, the paper must not produce any dust deposits.

- Inkjet properties such as colorant fixation/barrier/absorption ability must be distributed evenly across the paper web. This is, among others, a prerequisite for uniform print image quality.
- The main fiber direction must be aligned so as to prevent any diagonal stresses after the paper has been processed in the printing system.
- Among other factors, the paper curl is decisive in ensuring problem-free post-processing of the paper. The paper must not curl permanently as a result of the inkjet print.
- 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.

### **Paper Colors**

The inkjet printing systems process white and colored paper. Colored paper may impair the function of the sensors within the printing system. It is recommended to test the interaction between colored paper and sensors in the paper laboratory before proceeding.

# Standard Paper

## Introduction

The term 'standard paper' covers all types of paper used in standard applications and processing methods (paper roll, with or without tractor holes).

## Standard Paper Properties

The following table lists the standard paper properties in detail:

Properties	Unit / Requirement	Test Method	
1	Grammage <sup>1)</sup>	<ul style="list-style-type: none"> <li>Roll to Roll: 55 - 160 g/m<sup>2</sup> Grammages above 160 g/m<sup>2</sup> are permitted provided the maximum allowable caliper is not exceeded</li> <li>Z-fold stacker: 64 - 120 g/m<sup>2</sup></li> </ul>	DIN EN ISO 536 Tappi T410
2	Thickness caliper	61 – 290 µm 2.4 – 11.4 mils (1/1000 inch)	Tappi T411
3	Relative humidity	45 ± 10 % at 21°C (70°F)	Sword-type hygrometer, Tappi T502
4	Dimensional stability	% change in length When subjected to a 10 % change in relative humidity: <ul style="list-style-type: none"> <li>Machine Direction (MD): max. 0.06%</li> <li>Cross-machine Direction (CD): max. 0.14%</li> </ul>	DIN 53130 ISO 8226-1:1995
5	Water absorption <sup>2)</sup>	> 50 g/m <sup>2</sup>	DIN EN 20535 ISO 535:1991 Tappi T441
6	Volatile components	mg lowest possible sublimation	DIN 54354 ISO 624:1974 Tappi T204
7	Linting propensity	< 20 mg The paper should be as free as possible of lint and loose fibers. It should have smooth cut edges and release as little dust as possible during processing	DIN 53109 (Taber) Tappi T476
8	Writing properties	Writing with an appropriate instrument such as a ball-pen, pen, felt-tipped pen, pencil or crayon must be possible	DIN 53126
9	Static discharge	< 10 V < 4 sec	Monroe Static Charge Analyzer

Properties		Unit / Requirement	Test Method
10	Stiffness / Bending resistance (MD)	mNm specific static bending resistance as per DIN 53121	DIN 53121

<sup>1)</sup> After positive release performed by an authorized Canon testing site, higher or lower grammages can be processed.

<sup>2)</sup> After positive release performed by an authorized Canon testing site, paper with lower water absorption can be accepted.

### Shrinkage Behavior of the Paper

After the paper has passed the dryer of the first printer, it will shrink due to the temperature influence. The print image printed in the second printer keeps its original size. Accordingly, the first print image is smaller than the second print image. The deviation of the front side from the back side is called 'register accuracy'. The shrinkage gradient should be low. Limit value CD: max. 0.8 % (after 20 minutes heating in a convection oven at 115°C (239°F)).

### Low grammage Paper

Any printing material with a grammage of < 70 g/m<sup>2</sup> is a 'low grammage paper'. This paper category has shown the following behavior in processing:

- Thickness and high flexural strength favor runability and stacking. The threshold value for flexural strength (for paper types with feed holes) is 0.3 mNm in grain direction.
- 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).

# Paper for Character Readers

## General Requirements

The requirements for paper to be processed by automated reading devices are defined in the specifications published by the device manufacturers. The properties that matter most are:

- Runability properties of the paper in the reader. Relevant parameters:
  - Paper strength
  - Paper stiffness
  - Paper surface
  - Finish paper
  - 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):
  - Colorant fixation/barrier/absorption ability
  - Surface finish/smoothness (edge sharpness)
- Abrasion resistance

The abrasion resistance is important in order to comply with standard operating requirements and to avoid the color rubbing off in the reading device. In addition to the type of color (ink) and the printer's fixing method (drying), the surface quality of the paper is important for the abrasion resistance.

The paper properties required by manufacturers of reading devices do not conflict with the Canon Media specifications. However, the wide choice of paper suitable for Canon printing systems is limited by the requirements necessary for reading devices.

## OCR Paper

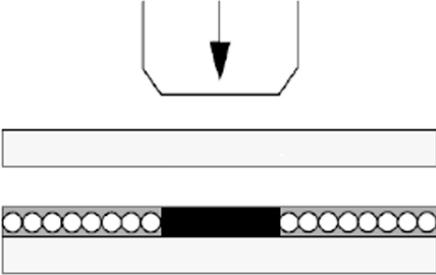
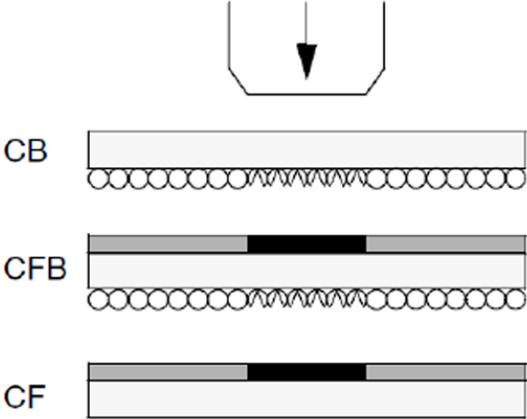
The requirements to be fulfilled by OCR (= **O**ptical **C**haracter **R**ecognition) papers are defined in the following standards:

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

# Carbonless Paper

## Single-sheet system / Multi-sheet system

In the case of carbonless paper, we differentiate between single-sheet and multi-sheet systems:

Single-sheet system	Multi-sheet system
 <p data-bbox="284 1010 847 1171">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.</p>	 <ul data-bbox="874 1010 1433 1270" style="list-style-type: none"> <li>• CB (Coated back) = top sheet Back coated with reactant microcapsules.</li> <li>• CFB (Coated front and back) = middle sheet Front coated with ink-absorbing acceptor layer, back with reactant microcapsules.</li> <li>• CF (Coated front) = bottom sheet Front coated with ink-absorbing acceptor layer.</li> </ul>

## Experience

Experience with carbonless paper in Canon printing systems:

- Some manufacturers provide carbonless paper suitable for inkjet printing systems. The temperature in the dryer does not impair the performance of the carbonless paper.
- Some manufacturers of carbonless paper warn that deposits could shorten the lifespan of the printing system when using carbonless paper. In this context, any damage that occurs is subject to the responsibility of the user.
- When multi-sheet systems – after having them processed with the Canon printing system – shall be combined with unprinted paper webs to form carbonless forms sets, different shrinkage behavior of the individual webs may cause problems.

# Printing Material that cannot be processed

## Introduction

There are some printing materials that cannot safely be processed by the Canon Inkjet printing systems because of their physical composition or product design.

## Examples

The following list should serve as a guide for the types of material which normally cannot be processed in the Canon Inkjet printing systems. It does not represent a complete listing of all materials which cannot be processed. Examples:

- Adhesive labels
- Plastic sheets
- Synthetic fiber products
- Some forms with plastic cards attached to them
- Aluminum-coated materials
- Multi-layer coated materials
- Self-adhesive (SESAM) labels with a release material
- Closable forms with partial glue strips or full thermo-seal coating, etc.

## Tests

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 local service. We will also test materials for our customers in one of our paper laboratories, in particular prior to bulk orders.

## **Chapter 3**

# Continuous Forms and their Conditioning

# Dimensions and Tractor Holes

## Introduction

In addition to the selection of appropriate printing materials, the conditioning of the printing material is also important. The conditioning covers all steps which convert paper into continuous forms that can be used in Canon Inkjet printing systems and which are the prerequisites for its later use. This can contain punching feed holes for paper transport, filing holes and perforations required for stacks and reels as well as pre-printing and other related processes. The following sections specify the quality requirements for continuous forms.

## Dimensions

Printing system	Forms width	Forms length	Dimensions
ColorStream 6000 series (Roll to Roll)	Minimum: 165 mm (6.5 inch) Maximum: 560 mm (22 inch)	Minimum: 76 mm (3 inch) Maximum: 1520 mm (60 inch)	Maximum roll diameter: 1270 mm (50 inch)
ColorStream 6000 series (Z-fold stacker)	Minimum: 165 mm (6.5 inch) Maximum: 495 mm (19.5 inch)	Minimum: 178 mm (7 inch) Maximum: 356 mm (14 inch)	Maximum stack height: 300 mm (12.6 inch)

## Tractor Holes

Tractor holes are a prerequisite for the paper transport and for the precise paper processing in some pre- or post-processing units. Tractor holes are standardized according to world-wide standards (ISO 2784, DIN 9771).

Refer to section [Tractor Holes on page 32](#) for dimensions and tolerance values.

Both tractor holes with smooth edges and with milled edges are allowed.

Table of requirements and tolerance values using standard measuring methods (Bundesverband Druck):

Criteria	Requirements
Longitudinal tractor holes	0 – 2.0 mm (0.08 inch) longitudinal tolerance over 2 m (78.74 inch) of web
Vertical displacement of tractor holes	max. 1 mm (0.04 inch) tolerance over 2 m (78.74 inch) of web
Space between the middle of the tractor holes and the web edge	6.0 ± 0.7 mm (0.24 ± 0.03 inch)

The tractor holes must be neatly punched to avoid additional lint. The hole punching debris 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 side of the paper (this is the side that receives the print or, in duplex mode, the first print side) to the back side.

# Perforations

## Introduction

Continuous forms can have both horizontal and vertical (margin) perforations. These perforation types 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 perforation of the edge strips with the tractor holes as well as internal fold perforations.

## 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.

Woodfree Papers		Tear resistance in N/cm FOGRA measuring instrument <sup>1)</sup>	Tie length in mm (inch)	Cut length in mm (inch)
Fold perforation		10 ± 2	0.8 – 1,0 (0.03 – 0.04)	2.0 (0.08)
Form perforation		> 12.5	0.9 (0.04)	2.0 (0.08)
Internal form perforation	vertical	> 16.0	0.8 (0.03)	1.2 (0.05)
	horizontal	> 16.0	0.8 (0.03)	1.2 (0.05)

Graphic Recycling Papers		Tear resistance in N/cm FOGRA measuring instrument <sup>1)</sup>	Tie length in mm (inch)	Cut length in mm (inch)
Recommended fold perforation		10 ± 2	0.8 – 1.2 (0.03 – 0.05)	2.0 – 3.0 (0.08 – 0.12)

<sup>1)</sup> FOGRA system perforation tester available from Gockel & Co GmbH

## Arrangement of 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.
- If forms are to be subdivided by internal vertical and horizontal perforation lines, the runability and stacking behavior of the web has to be tested.
- Forms which are under 150 mm (6 inch) 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 (1.97 inch) 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/m<sup>2</sup> to 90 g/m<sup>2</sup> paper is used.
- Margin perforations are to be attached on both sides of the paper (left and right), as vertical perforations on one side only may impair 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 (0.79 inch), there is an increased likelihood of printing and stacking problems.
- 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.
- Inappropriate perforation methods may cause a large number of paper pieces and dusts may cause jam or deterioration in print quality. Use a sharp cutter to perforate the forms, and remove paper pieces and dusts as needed.
- The ties must come at the ends of the forms and the intersections of the vertical and the horizontal perforations.
- If the cuts come at the ends of the forms or the intersections, the forms will more readily peel off. This cause jam or deterioration in print quality.
- Printing onto horizontal or vertical perforations is not permitted. A protection area of 2 mm (0.079 inch) distance from printing image to perforation has to be observed.
- Non-straight perforation lines, which can impair image quality in the area of the fold are not permitted.

# Preprinted Forms

## Introduction

The same rules apply to forms preprinted on the front and/or back as to unprinted forms. This refers to suitability for inkjet printing and heat resistance.

## Requirements for Preprinting Ink

Printing systems with dryer:

- The inks must be heat resistant with respect to contact with the dryer surface.
- The drying temperature is approximately 120 °C (248 °F) with a contact time of approximately 1 second.

No fumes should be emitted during the drying 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 dryer surface. These requirements also apply to any other additional substances used during processing.

## Requirements for Preprinting

- To avoid blistering during drying, the form to be printed must not have barrier layers impermeable for water vapor.
- The ink must have dried properly before the forms are processed in the printing system. If inks are not completely dry, there will be operational problems, e.g. ink deposition/dirt accumulation at the paper transport or print heads.
- The printing ink on the preprinted forms should be sufficiently abrasion-resistant to leave no traces in the inkjet printing system.
- It is not possible to print on regions of the paper which have been preprinted with hydrophobic inks such as offset and UV curable inks.
- On paper with tractor hole margins, the reference point for preprints is the center of the tractor hole. There is a horizontal and vertical tolerance for registration of  $\pm 0.2$  mm (0.01 inch).
- On paper without tractor hole margins, the reference point for preprints is the edge of the paper. There are vertical and horizontal tolerance values of  $\pm 0.2$  mm (0.01 inch), measured respectively from the start of the physical page and the edge of the paper.



### NOTE

Printing inks which dry by 'penetration' into the paper are not allowed.

# Requirements for Stack and Reel Quality

## Basic requirements for Stack Paper

Table of requirements and tolerance values using standard measuring methods (see Bundesverband Druck: Fehlerkatalog für den Endlosformulardruck / Wiesbaden 1994. ISBN 3-88701-162-7)

Criteria	Requirements
Stack curvature	maximum 20 mm (0.79 inch) with 225 mm (8.86 inch) batch height
Batch tilt	maximum 12 mm (0.47 inch) with 50 mm (1.97 inch) batch height
Angle of vertical perforation	maximum 0.5 tolerance with 2 m (6.56 ft) web length

The stack quality and processability depend on these items:

- Bending strength according to the table [Standard Paper Properties on page 12](#).
- Paper flatness (no waviness)
- Fold memory
- Appropriate tie/cut ratio for vertical perforations (see [Tractor Holes on page 18](#)).
- 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.
- Do not stack the forms high to prevent forms distortion. Even if the forms are stored in cartons, do not stack these cartons too high. For reference, avoid stacking the cartons 1 m (3.28 ft) high or more.

## Basic requirements for Reel Quality

- Even winding pressure and moisture profile in the reel across the entire web width
- Even reel sides
- Clean web cuts to avoid additional linting
- No contamination of the reel sides which could impair runability
- No damage or tears to the sides

## Additional requirements

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

- Outer reel diameter
- Inner core diameter
- Number and marking of gluing positions
- Position of top side and wire side of the paper on the reel
- Tolerance of reel width



## **Chapter 4**

# Shipment and Storage of Printing Material

# Shipment and Storage of Printing Material

## Introduction

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 affected 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 paper rolls 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.

To avoid problems during processing, the temperature of the paper has to be the same as the temperature of the processing room. Therefore, it would be of advantage to store a sufficient quantity of forms in the processing room to allow the temperature of the paper to adjust to that of the processing room. The climatic conditions in the store-room should not be subject to major variations.

- Recommended temperature: 20 °C to 26 °C (68 °F to 79 °F)
- Recommended relative humidity: 30 % to 60 %

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 storage room.

## Temperature Adjustment of Paper

If adverse climatic 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 to the room temperature. The protective packaging of the paper should not be removed during that period of time.

The following table indicates the time required for cold paper stacks or rolls to adapt to the temperature of the processing room.

Size of paper stack in m <sup>3</sup>	Temperature difference (°C) between store-room and processing room						
	5	7	10	15	20	25	30
Storage time in processing room in hours							
0.2	6	8	11	16	22	27	40
0.3	7	9	13	19	27	36	49
0.4	8	10	15	23	33	43	57
0.5	9	11	18	26	39	53	70
0.6	10	12	20	28	45	64	83
1.0	11	13	22	32	52	77	103
2.0	12	14	24	36	60	100	140

# **Appendix A**

## **Notes on Standards and Recommendations**

## Notes on Standards and Recommendations

No.	Standard / Recommendation	Title
(1)	—	Drying of continuous print colors with regard to further processing in laser printers. FOGRA Research Report no. 5.018.
(2)	—	H.R. Syre Measurement of continuous profiles of the fiber orientation by means of laser beams. Das Papier 42 (1988) part 3.
(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/m <sup>2</sup> paper uncoated, requirements, test.
(8)	DIN 53 105 Part 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 Part 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 Part 1	Test of paper and cardboard; basic measurements for determining the reflexion factor, measurement of non-fluorescent samples.
(18)	DIN 53 145 Part 2	Test of paper and cardboard; basic measurements for determining the reflection factor, measurement of fluorescent samples.
(19)	DIN 53 146	Test of paper and cardboard; determination of the opacity. ▶

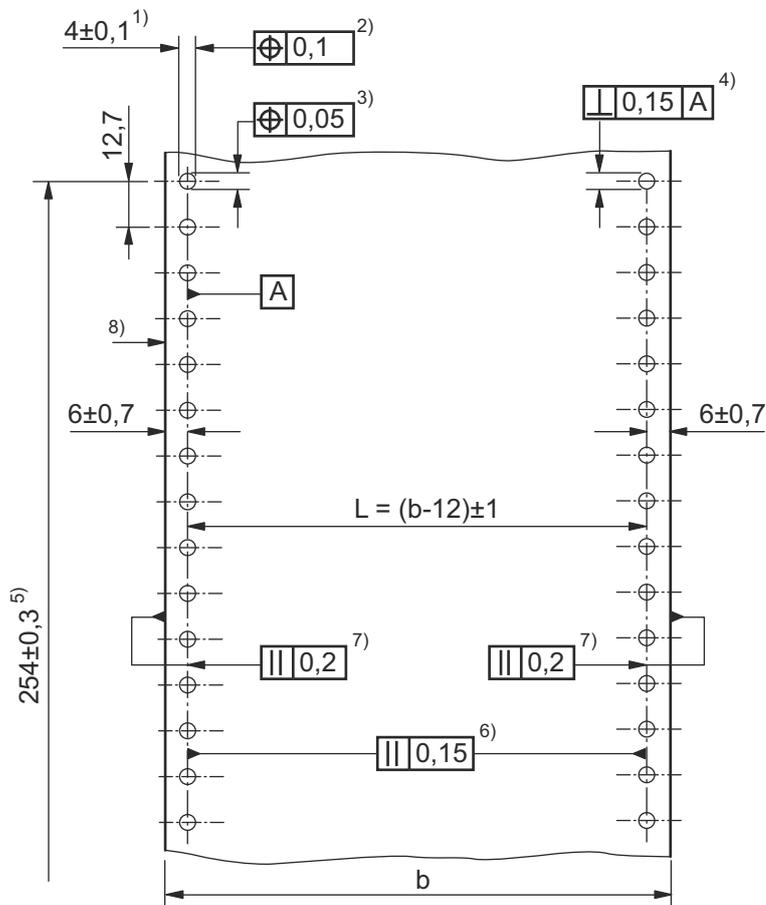
No.	Standard / Recommendation	Title
(20)	DIN 53 482/ VDE 0303 Part 3	Test of materials for electrical engineering; measurement of the electric resistance of nonmetal materials.
(21)	DIN 54 354	Test of cellulose; determination of the dichloromethane extract.
(22)	DIN 54 370	Determination of ash
(23)	DIN EN 20535	Liquid Absorption Cobb
(24)	DIN EN ISO 536	Paper and cardboard; determination of the grammage.
(25)	DIN IEC93 / DIN IEC167	Test methods for electrical insulating materials. Specific volume resistance and specific surface resistance of hard, electrically insulating materials.
(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	Liquid Absorption 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
(35)	ISO 4046 - 1978	Paper, board, pulp and related terms - Vocabulary.
(36)	ISO 5626 - 1978	Paper, determination of folding endurance.
(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 absorptiveness 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

No.	Standard / Recommendation	Title
(51)	Merkblatt V/17/80	<p>Test of paper, "Karton" and cardboard; electrometric measurement of the pH value of the paper surface (surface pH value).</p> <p>To be ordered from:                      Verein der Zellstoff- und Papier-Chemiker und –Ingenieure                      Berliner Allee 56                      64295 Darmstadt</p>
(52)	—	<p>General conditions of sale for graphic papers and cardboards used for printing.</p> <p>To be ordered from:                      Verband Deutscher Papierfabriken e.V.                      Adenauer Allee 55                      53113 Bonn</p>
(53)	—	<p>Göttsching, Lothar [publishers]:                      Papier in unserer Welt. Ein Handbuch.                      ECON Verlag Düsseldorf, 1990.                      (Paper in our World: A Handbook. Available in Germany.)</p>

# **Appendix B**

## Tractor Holes

# Tractor Holes



Dimensions in millimeters. The values are based on conditioned paper at a temperature of 23 °C (73.4 °F), with 50 % relative humidity.

Description	
1)	Larger tractor holes (required occasionally for special applications, e.g. filing) with a maximum diameter of 6.36 mm (0.25 inch) are permitted (consult with user). In the case of serrated tractor holes, the inside diameter must be 4.0 mm ± 0.1 mm (0.157 ± 0.004 inch) and the outside diameter: 4.4 mm ± 0.1 mm (0.173 ± 0.004 inch). Serrated tractor holes can produce inadequate results with some print devices when large-format, low caliper paper is used.
2)	The maximum center-of-hole deviation of all tractor holes from their common centerline is 0.1 mm (0.004 inch).
3)	The distance between the centers of two consecutive tractor holes should theoretically be exactly 12.7 mm (0.5 inch). The vertical distance between the theoretical center points of two holes may not deviate by more than 0.05 mm (0.002 inch) from this value.
4)	The maximum center-of-hole deviation of corresponding left and right tractor holes is 0.15 mm (0.006 inch).
5)	The distance between any 20 hole spacing may not deviate by more than ± 0.3 mm (0.012 inch) from the rated length 254 mm (10 inch).

Description	
6)	The maximum parallelism deviation for left and right tractor hole centerlines may not exceed 0.15 mm (0.006 inch).
7)	This tolerance must be adhered to when using preprinted forms and processing on pinless printing systems. Measured across 20 hole spacings.
8)	Reference edge



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