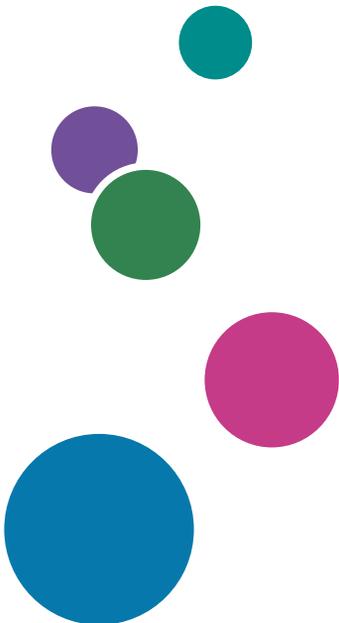




Operating Instructions

# Paper Fundamentals





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# Introduction

This manual explains paper characteristics and methods for handling paper to get favorable print quality and consistent performance from the machine. For more information about paper types, weights, and sizes that are supported by the machine, see the manuals supplied with the machine.

The machine supports regular and coated paper, as well as a variety of other types of paper. However, the characteristics and conditions of certain types of paper may result in low print quality. In addition, the characteristics and conditions of the paper may vary even with the same product. Therefore, we recommend evaluating paper before using the paper with the machine. For details, consult your sales representative or service representative.



# 1. Characteristics and Conditions of Paper

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This chapter describes the characteristics and conditions of paper.

## Characteristics of Paper

This section describes how the characteristics of paper affect the quality of printing and the movement of paper in the machine.

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### Composition of Paper

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**★ Important**

- **Do not use acidic paper because it accelerates the deterioration of the photoconductor unit and surrounding parts.**

Many types of paper used for printing contain calcium carbonate ( $\text{CaCO}_3$ ) and other natural impurities. Paper whose calcium carbonate ratio is high may reduce the life of machine components such as the OPC drum and fusing unit. For the values for the calcium carbonate ratio, see page 8 "Paper Specifications".

Do not use coated paper that contains components that dissolve or vaporize when exposed to high temperatures.

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### Friction Characteristics

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The friction characteristics of paper are important to transfer the paper correctly from the paper tray through the inside of the machine.

If the force of the friction (coefficient of friction) acting on stacked paper is too large or too small, the paper may not be fed correctly through the machine. If coefficients of friction are not uniform, it is possible to feed multiple sheets at one time.

Use printing paper with uniform friction characteristics to print from the machine. For the values for the friction coefficients, see page 8 "Paper Specifications".

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### Surface Smoothness

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The smoothness of the surface of the paper is important to get high print quality and also stable paper feeds.

If an area has solid printing, it may not be uniform when using paper with a rough surface. On the other hand, the toner may not fuse to the paper properly if the surface of the paper is too smooth. In addition, if paper has a smooth surface, each of the sheets is likely to stick together, and therefore the paper may not feed correctly inside the machine.

Printing on embossed paper may produce irregularities in print quality or deterioration in the ability to fuse toner. Moreover, the paper may not feed correctly in the machine.

For the values for the surface smoothness of paper, see page 8 "Paper Specifications".

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## Resistance to Heat

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Paper is exposed to high temperatures inside the machine when toner is fused to the paper. Because of this, it is necessary for the paper to maintain the same qualities even when exposed to high temperatures.

Use a paper that does not dissolve, vaporize, change color, or cause set-off printing when exposed to high temperatures during the fusing process. Also, do not use paper that peels off in layers.

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## Moisture Content

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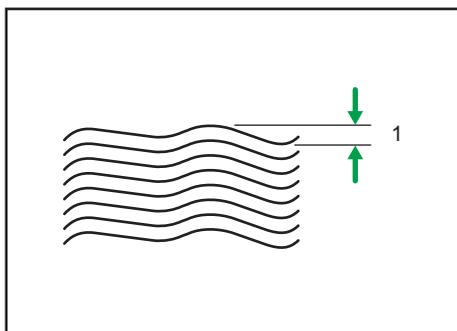
The moisture content of paper affects the condition of the paper and print quality.

If the moisture content ratio is too high, the edge of the paper may warp and become wavy. In addition, the paper may wrinkle during printing and reduce print quality, such as decreasing print density.

### Wavy paper

If the humidity is high in the place where the paper is stored, paper that is exposed to air may absorb moisture and the edges may become wavy. The paper may not feed through the machine, or feed at an angle because the heights of the edge and the center part of wavy paper are different. Also, wrinkling, and curling may occur during printing.

Use paper that has a difference of 2 mm (0.08 inches) or less between the top sheet's highest and lowest point when the maximum number of sheets of paper is loaded in the paper.



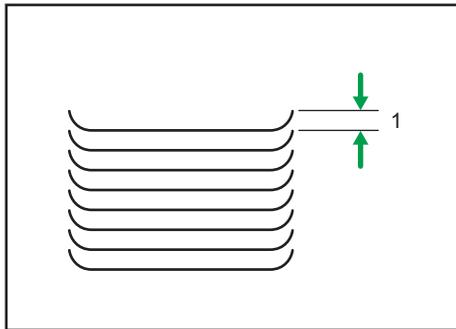
CEL001

### 1. 2 mm (0.08 inches) or less

#### Warped paper

If the humidity is low in the place where paper is stored, paper that is exposed to air may lose moisture and the edges may shrink. Paper with wavy edges feeds at an angle and may cause paper jams.

Use paper that has a difference of 6 mm (0.24 inches) or less between the stack's central area and the edge when the maximum number of sheets of paper is loaded in the paper.



CEL002

### 1. 6 mm (0.24 inches) or less

For the values for moisture content of paper, see page 8 "Paper Specifications".

## Clark Stiffness

Represents the flexibility of paper.

If the Clark stiffness is low, paper is easy to bend. It is also susceptible to moisture content and heat, so paper with a low Clark stiffness may shrink at its edges or curl during printing. In addition, soft paper is likely to twine around the paper rollers or belts, which may cause paper jams.

For the values for the Clark stiffness of paper, see page 8 "Paper Specifications".

## Bending Stiffness

Represents the flexibility of paper.

Hard paper has a high bending stiffness. If paper has a high bending stiffness, it is difficult to bend through the paper rollers and the pathways inside the machine and may cause paper jams.

For the values for the bending stiffness of paper, see page 8 "Paper Specifications".

## Surface Resistivity

Represents the electrical resistance on the paper's surface.

It may affect the quality of printing and the movement of paper in the machine.

For the values for the surface resistivity of paper, see page 8 "Paper Specifications".

## Paper Specifications

Use the following tables as a guide when you select paper.

### Uncoated paper

Item	Specifications
Ash content (%) *1	15% or less
Calcium carbonate (CaCO <sub>3</sub> ) ratio (%)	15% or less
Cut edge	Height of burrs: 0.05 mm (0.002 inches) or less
Cutting tolerance	Length: ±0.5 mm (0.02 inches) Angle: 90° ± 0.1°*2
Clark stiffness	40 or more
Bending stiffness	Less than 1800
Smoothness (s)	80 or more
Static friction coefficient	0.35 to 0.67
Moisture content (%)	3.7 to 5.5%
Surface resistivity (Ω)	5×10 <sup>9</sup> to 1×10 <sup>12</sup>

\*1 Measured by combustion at 900°C (1652°F)

\*2 If you want to improve the image position accuracy, applying "90°±0.02°" is recommended.

### Coated paper

Item	Specifications
Ash content (%) *1	22% or less
Calcium carbonate (CaCO <sub>3</sub> ) ratio (%)	20% or less

Item	Specifications
Cut edge	Height of burrs: 0.05 mm (0.002 inches) or less
Cutting tolerance	Length: $\pm 0.5$ mm (0.02 inches) Angle: $90^\circ \pm 0.1^{\circ *2}$
Clark stiffness	40 or more
Bending stiffness	Less than 1800
Air permeability (s)	5000 or less
Static friction coefficient	0.35 to 0.67
Moisture content (%)	3.7 to 5.5%
Surface resistivity ( $\Omega$ )	$5 \times 10^9$ to $1 \times 10^{12}$

\*1 Measured by combustion at 900°C (1652°F)

\*2 If you want to improve the image position accuracy, applying "90°±0.02°" is recommended.

# Condition of Paper

In addition to the characteristics of paper, the condition of the paper greatly affects the print results.

1

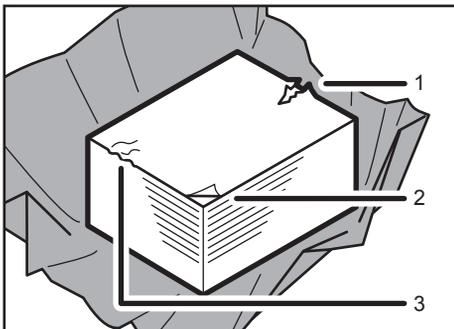
## Rips, Wrinkles, and Folds

Use clean paper in good condition that has no folds, rips, or wrinkles.

Check the condition of the paper before placing it in the paper tray, and remove any sheets that are not in good condition.

### Rips, Wrinkles, and Folded Corners

Use paper that has no rips, wrinkles, or folded corners. If sheets of paper have rips, wrinkles or the like, a paper jam in the paper rollers or surrounding mechanisms may occur or paper may be fed at an angle.

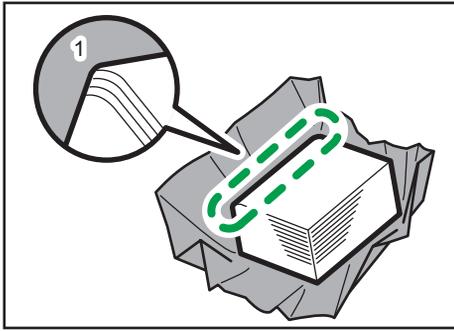


CEL003

1. Rip
2. Folded corner
3. Wrinkles

### Rounded Edges

When paper is placed in storage, the edge of the paper on the top or the bottom may become rounded from being stacked. This is called rounded edges. Using paper like this may cause a paper jam inside the machine or to be fed at an angle.



CEL004

### 1. Rounded edges

## Curls

Curled paper has a major effect on the print quality and end result.

Curled paper can cause such things as paper jams and wrinkles. Also, paper that is output may not stack evenly in the output tray.

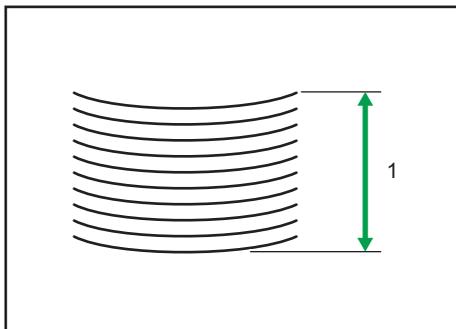
If heat is applied to the paper during the printing process, the entire sheet of paper may curl. Be sure to pay special attention to preprinted paper because it is likely to curl. Paper may also partially curl after printing if the moisture content is not evenly distributed.

Also, the extent of the curl may vary depending on the printing surface of the paper. If the paper curls after printing, turn over the paper in the paper tray and try again.

## How to Measure Curled Paper

You need to measure the extent of the curl of your paper before printing on it.

Use paper that has a maximum curl of not greater than 10 mm (0.39 inches).



CEL006

### 1. 10 mm (0.39 inches) or less

**1. Print on paper under the following printing conditions:**

- One-sided printing
- Print 10 sheets
- Output the paper with the printed side face down

**2. Place the curled paper on a table or flat surface with the curl facing up.**

**3. Measure the height of the tip of the curl at each corner of the stack of paper.**

Do this measurement within one minute after printing.

**Note**

- If the weight of the paper is 221 g/m<sup>2</sup> or more, measure one sheet of paper.

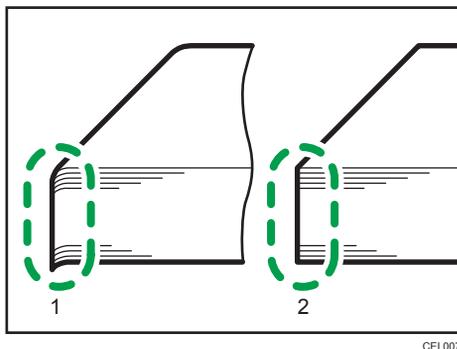
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## Cut Edge

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The condition of the cut edge of the paper affects print performance.

Cut paper is made by stacking many sheets together and cutting them. The cut edge of paper cut with a sharp cutter is straight, but if the cutter is dull, then the cut edge is uneven and has thin protrusions on the edge of the paper. These are called burrs.



**1. Cut edge from a dull cutter (burrs)**

**2. Cut edge from a sharp cutter**

Burrs may cause the paper to feed at an angle, feed multiple sheets at one time, or result in misfeeds through the machine. They may also cause paper jams in the machine and shorten the life of the fusing unit.

If a paper jam occurs, turn over the paper in the paper tray. Changing paper orientations will make burrs less likely to occur.

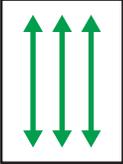
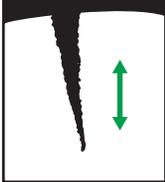
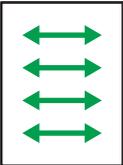
Remove as much of the paper dust particles caused by the burrs as possible. These particles may reduce the print quality.

## Grain Direction

Paper used for printing is produced with the grain of the paper in one direction. The paper's grain direction affects how paper curls or changes shape, as well as the movement of the paper in the machine.

Paper can be loaded in paper trays regardless of grain direction. If the paper curls or changes shape, or a paper jam occurs, change the direction of grain in relation to the paper feed direction by reloading the paper. This should help resolve the problem.

Tear a sheet of paper to check the direction of the grain. The tear in the paper is straight if it is in the same direction as the paper's grain direction. The tear in the paper is not straight if it is not in the same direction as the paper's grain direction.

Grain direction	Tear in paper
	
	



## 2. Handling Paper

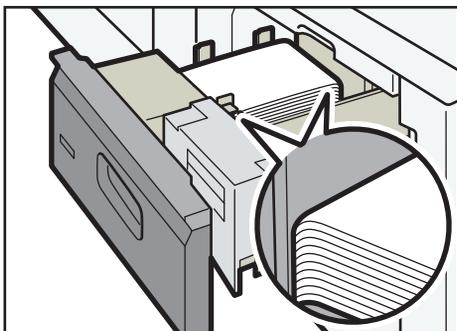
This chapter describes precautions regarding loading and storing paper, and important points about how to use special types of paper.

### Loading Paper

2

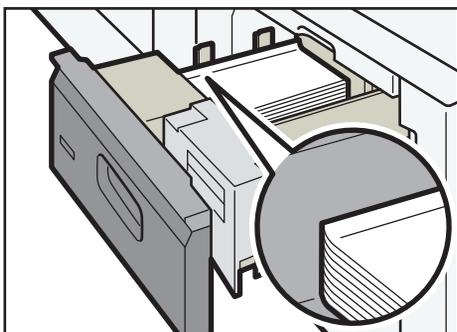
Note the following points for preventing problems related to paper, such as paper feeding at an angle or paper jams.

- Open the package and take out the paper immediately before using it. Do not store the paper in an open package for a long time. The package is moisture proof to prevent the paper from absorbing moisture.
- If you load paper when only a few sheets of paper remain in the tray, multiple sheet feeding may occur. Remove any remaining paper, stack it with the new sheets of paper, and then fan the entire stack before loading it into the tray.
- When loading curled paper, if the top and bottom edges of the paper are curled, load it so they curl down. If the left and right edges of the paper are curled, load it so they curl up.
  - The top and bottom edges of the paper are curled.



EAO601

- The left and right edges of the paper are curled.



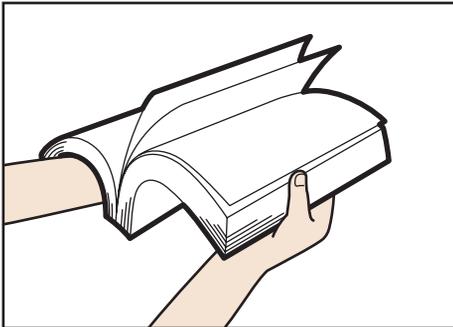
EAO602

- If printed sheets are curled, turn over the paper that is in the paper tray being used. By doing this, the amount of curl may be reduced.
- The paper in the paper tray may change shape if the air conditioner is turned off for a long period, such as at nighttime or on weekends. Check the condition of the paper in the paper tray before using the machine. If the paper has curled or become wavy, reload it correctly or remove the paper that has changed shape.
- Keep the temperature and humidity of the room in which the machine is located as constant as possible.
- If the machine you are using has a function to compensate for curled paper, you can specify curl compensation in the machine's settings. See the manuals supplied with the machine for details about how to configure this setting.

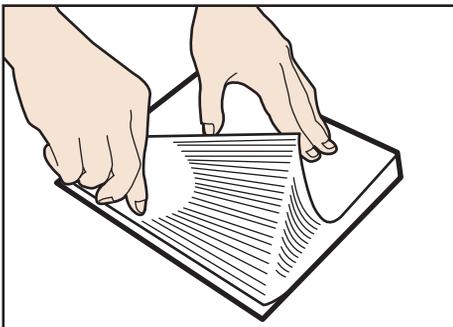
### How to Fan a Stack of Paper

Sheets of paper that stick together may cause multiple sheet feeding or paper jams. Fan the stack of paper before loading it in the paper tray.

Hold the stack of paper in both hands, shuffle the sheets of paper. Otherwise, place the stack of paper on a flat surface, place one hand on the side of the paper and shuffle the other side with your other hand.



CEL011



CEL012

Refer to the above methods, and select the easiest method for the type and size of paper that you are loading.

When fanning thin paper, handle it with care so you do not crease it.

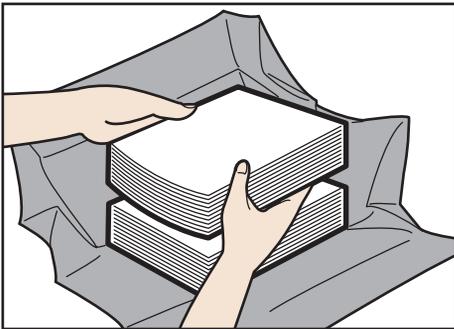
**Note**

- See the manuals supplied with the machine for the procedure to load paper in the paper tray.

## How to Hold Paper

When holding a large amount of paper, split it up into stacks of 200 to 500 sheets each.

The stack of paper may become uneven or parts may stick out if you pick up a large amount of paper at one time. Paper that sticks out will be folded when it is placed in the paper tray and may cause paper jams.

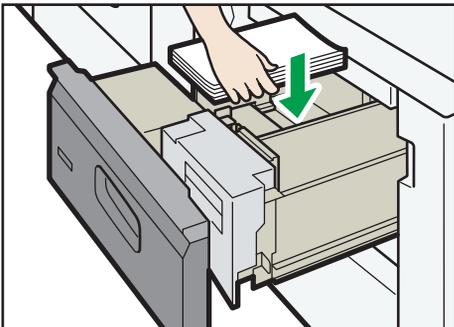


CEL013

## How to Place Paper

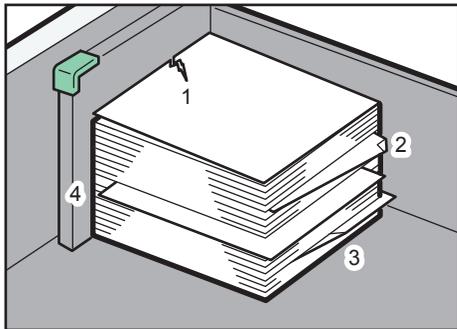
To load paper into the tray, face the paper directly downward and slowly put it into the paper tray.

Do not put paper into the tray by placing a large amount at one time and sliding it along the side of the tray. Some sheets may fold and cause a paper jam.



EAQ603

After placing the paper in the paper tray, make sure it is loaded correctly. Remove any paper that is torn or folded. Make sure that no paper is sticking out of the stack. If any paper is sticking out, remove it.



CEL015

2

- 1. Rip
- 2. Folded corner
- 3. Inside fold
- 4. Sticking out

# Storing Paper

Temperature, humidity, other environmental factors, and the method of paper storage all greatly affect the paper's condition.

The moisture content of paper changes as the temperature changes, causing the paper to curl and become wavy. The changes in the paper's conditions may cause paper jams and wrinkles generated during printing. Pay attention to the following points when storing paper:

- The temperature of the storage area must be between 20 and 25°C (68 and 77°F) and the humidity must be between 30 and 65%.
- If there is a large temperature difference between the storage area and the area near the machine, keep some paper near the machine for a few days before you use it, so it can adjust to the temperature near the machine.
- Once a package of paper is open, seal it completely in a plastic bag or moisture-proof paper to prevent it from absorbing moisture from the air.
- Do not expose the paper to direct sunlight.
- If stacking directions are indicated on paper boxes, stack the boxes according to the directions. Do not stack paper on end, even if it is still in the box.
- Do not place paper on the floor. Keep paper on a surface such as a palette, table, or cabinet in a temperature and humidity controlled room.

## Precautions during Transport

Note the following points when transporting paper:

- Use a palette if you are transporting many boxes. Do not throw or hit boxes while transporting them. Stacking many boxes may reduce the condition of the paper in the boxes, either because the shape of the lower boxes may change or the upper boxes may fall and become damaged. Therefore, do not stack boxes higher than necessary.
- If you wrap the paper in paper, use wrapping paper that is strong enough to not rip during transport. We recommend using wrapping paper that is moisture proof.

# Using Special Types of Paper

## ★ Important

- Refer to the tables on page 8 "Paper Specifications" as a guide when you select special types of paper to use with the machine.

While this machine supports coated and special types of paper, the characteristics and conditions of certain types of paper may result in low print quality.

We recommend evaluating special types of paper before using them in the machine. It is impossible to confirm the consistency of feeding, and the effect on consumable parts and components without long-term testing, but you can determine the basic characteristics, such as print quality and toner adhesion, by printing around 500 sheets.

## ↓ Note

- The special types of paper that you can use with the machine depend on the machine. For details, see the manuals supplied with the machine.

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## Coated Paper

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In terms of density and surface conditions, coated paper is very different from regular paper. Coated paper may not feed correctly and the print quality may not be very good because of the low toner adhesion and image quality. For the characteristics of coated paper that can be used with the machine, see page 8 "Paper Specifications".

Thinly coated paper may cause paper jams in the machine and thickly coated paper has poor toner adhesion that may damage the machine. Also, many coated papers cannot endure the heat and pressure that occur during printing, and may wrinkle during printing.

Fan coated paper before loading it in the paper tray. For details about fanning coated paper, see the manuals supplied with the machine.

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## Recycled Paper

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Recycled paper is made from a mixture of new pulp and pulp made from old paper, such as newspapers and magazines. Because of this, the characteristics of recycled paper vary greatly depending on the brand and manufacturer. We recommend evaluating recycled paper before using it.

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## Preprinted Paper

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When printing onto preprinted media from Offset or any Press that uses Anti-Offset Powder, Ricoh recommends the use Two-tray wide Large Capacity Tray (Two-tray wide LCT) for feeding of this media.

Other media feeding systems may result in poor system performance due to contamination caused by use of Anti-Offset Powder. Consult your sales or service representative.

When printing on preprinted paper, note the following:

- Toner may not adhere to preprinted images as well as it does to plain white paper. Check the print quality in advance.
- Before using preprinted paper, check that the ink is completely dry.
- Preprinted media should use ink that is heat resistant\* and designed for paper used in high speed copy machines and laser printers.
- The machine does not support prints using toner. However, prints created on the same model can be used.
- Fan media thoroughly before loading into Paper drawers. page 6 "Resistance to Heat".
- Printing on colored paper or preprinted media may result in problems that may cause a paper jam. If this is the case, consult your service representative.
- We recommend using a print environment where the temperature is between 20 and 25 °C and the relative humidity (RH) is between 40 and 50 %.
- We recommend storing paper in an environment where the temperature is between 20 and 25 °C and the relative humidity (RH) is between 40 and 50 %.

\* Use a non-volatile oil based and heat resistant ink for preprinted paper. Do not use ink that melts, vaporizes, dissolves, or delaminates when exposed to heat. For details, see page 6 "Resistance to Heat".

Major precautions about ink used for preprinted paper are as follows:

- Minimize the use of ink for preprints (we recommend Coverage of 30% or lower). Use screen printing to print on large areas.
- Minimize the use of powder to prevent offset of ink or blocking.
- Do not use the following types of ink on preprinted paper:
  - Evaporative drying ink
  - Cold set ink
  - Precipitation drying ink
  - Soy ink
  - Metallic ink

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## Colored Paper

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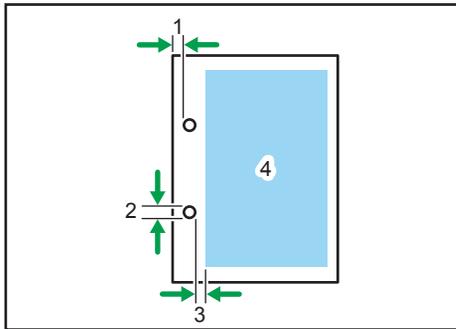
Colored paper is paper that is treated lightly with colorant throughout. Some colors of paper cannot be used. For details, contact your sales representative or service representative.

## Prepunched Paper

Prepunched paper must be smooth and flat to be used in the machine. Prepunched paper that is warped or torn cannot be used. Before printing on prepunched paper, remove any dust or trimmings that were produced during the punching process.

To print on prepunched paper, print in an area 3 mm (0.12 inches) or more from the edge of the hole.

The holes in the paper must be within the following conditions:



1. 5 mm (0.20 inches) or more
2. 8 mm (0.31 inches) or less
3. 3 mm (0.12 inches) or more
4. Acceptable print area

The conditions for using prepunched paper depend on the machine and its configurations. For some typical conditions for prepunched paper, see page 27 "Prepunched Paper That Can Be Used".

## Transparencies

Transparencies is made from polyester and specially coated so toner adheres to it. A transparencies has one printable side. Printing cannot be done on both sides.

Fan transparencies before loading it in the paper tray so the sheets do not stick together. For details about how to fan paper, see page 15 "Loading Paper".

## Label Paper, Pressure-sensitive Paper

Some labels and pressure-sensitive paper have use-by dates. Purchase only as much as you can use within the time limit. Contact your paper retailer regarding use-by dates and storage methods.

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## Carbonless Paper

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When using carbonless paper, note the following:

- Carbonless paper can be used only when Two-tray Wide LCT is used along with Finisher SR5110 or Booklet Finisher SR5120 for post-processing.
- When using carbonless paper, only the stacker can be connected between the machine and Finisher SR5110 or Booklet Finisher SR5120.
- Some types of carbonless paper have expiration dates. Purchase the amount you can use within the time limit. Contact your paper retailer regarding the expiration dates and storage methods.

# 3. Appendix

The chapter describes the specifications for prepunched paper and provides a paper weight conversion table.

## Paper Weight Conversion Table

The weight of paper is measured as basis weight or ream weight.

Basis weight is the weight of one square meter of a sheet of paper, measured in units of g/m<sup>2</sup>. Ream weight is the weight in pounds of 500 sheets of the paper. The basic size varies depending on the type (grade) of paper.

The basic sizes for each grade are as follow:

- Bond, Ledger: 17" × 22"
- Offset, Text: 25" × 38"
- Cover: 20" × 26"
- Index: 25<sup>1</sup>/<sub>2</sub>" × 30<sup>1</sup>/<sub>2</sub>"

Ream weight can be calculated using the following equation:

$$\text{Ream weight (lb)} = \text{basis weight (g/m}^2\text{)} \times \text{dimension of paper (m}^2\text{/sheet)} \times 500 \text{ (sheets)}$$

The following table shows the relationship between basis and ream weight.

Basis weight (g/m <sup>2</sup> )	Ream weight			
	Bond / Ledger (lb.)	Offset / Text (lb. text)	Cover (lb. cover)	Index (lb. index)
52	14	36	20	29
60	16 *	40 *	22	33
75	20 *	50 *	28	42
90	24 *	60 *	33	50
105	28 *	70 *	39	58
108	29	73	40 *	60
118	31	80 *	44	65
120	32 *	81	45	67
135	36	90	50 *	75

Basis weight (g/m <sup>2</sup> )	Ream weight			
	Bond / Ledger (lb.)	Offset / Text (lb. text)	Cover (lb. cover)	Index (lb. index)
148	39	100 *	55	82
162	43	110	60 *	90 *
176	47	120	65 *	97
199	53	135	74	110 *
216	58	146	80 *	120
244	65	165	90 *	135
253	67	171	94	140 *
256	68	173	95	142
270	72	183	100 *	150
297	79 *	201	110 *	165
307	82	208	114	170 *
325	87	220	120	180 *
351	94	237	130 *	194
398	106	269	147	220 *
405	108	274	150	224

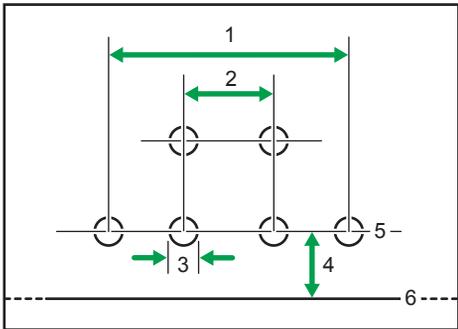
Asterisks (\*) indicate the most common weights for that category.

# Prepunched Paper That Can Be Used

The following are typical conditions for using prepunched paper in the machine.

Contact your service representative if you want to use prepunched paper not described below.

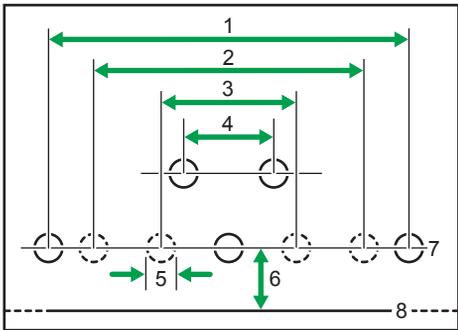
## Europe (2/4 holes) and Northern Europe (4 holes)



CEL016

1. Europe: 240 mm (9.45 inches) / Northern Europe: 112 mm (4.41 inches)
2. Europe: 80 mm (3.15 inches) / Northern Europe: 70 mm (2.76 inches)
3. Europe: 6 mm (0.24 inches) / Northern Europe: 6.5 mm (0.26 inches)
4. 12 mm (0.47 inches)
5. Punch hole
6. Paper edge

## North America (2/3/7 holes)



CEL019

1. 216 mm (8.50 inches)
2. 178 mm (7.01 inches)
3. 108 mm (4.25 inches)
4. 70 mm (2.76 inches)
5. 8 mm (0.31 inches)

6. 2 holes: 12 mm (0.47 inches) / 3 and 7 holes: 9.5 mm (0.37 inches)
7. Punch hole
8. Paper edge

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