

# **Paper Basics for Copiers and Printers**

By Dan Grove

While paper has many applications in our homes and businesses, the focus of this document is on paper used for printing with laser or inkjet copiers and printers commonly found around the office or light production environments. I will refer to this as digital printing.

Paper has many attributes and some can be confusing at times. This can not only cause frustration, but yield a less than desirable finished product. My goal is to help you produce the best possible printed piece with as little frustration as possible.

Paper should match the intended purpose of the printed piece. As we go through the attributes one by one, I will point out how each variable affects the printed piece and the desired result you may have. I will also point out any concerns that relate to the printing processes.

Before we start on the attributes, it is important to have a basic understanding of the laser (toner based) and inkjet printing processes. The laser process uses a dry powdered toner that is melted and pressed onto the surface of the paper, also known as fusing. You have probably felt the residual heat when retrieving a document right after copying or printing. The inkjet process uses liquid ink that is sprayed on the paper with microscopic nozzles. Typically there is very little or no heat applied to dry the ink on the paper. Whichever digital printing process, manufacturer or model of device you use, the paper is most likely going to be fed by rollers, pass through guides, possibly turn at angles or be flipped over. This is important to keep in mind as we proceed.

## Paper Descriptions

There are many terms used to describe paper and several tie directly to their intended use. For example: newsprint, text, cover, and index. Other terms are related more to the makeup of the paper. Coated or uncoated are two terms that are very important in digital printing.

Uncoated paper is typically composed of ground wood or paper pulp and fillers. By nature, the surface is a little porous and rough, making it good for writing and printing on without smearing. The down side is that the irregular surface will distort light reflection and the image applied to it.

Coated paper starts out as uncoated and then clay or other additives are applied to smooth out the surface. The finish is then created with rollers, pressure and perhaps heat. Coated paper can be made in various degrees of glossy or matte, and can be coated on one or both sides. Because of the additives, this type of paper is heavier than an uncoated sheet of the same size and thickness. With digital printing we must make sure the device we are using is capable of feeding and imaging on coated paper. This is typically listed in the machine specifications and may limit coated paper feeding only from the bypass tray or not at all. When it comes to imaging, the surface can cause issues with ink or toner adhering and staying adhered to the paper. With laser, extra heat is usually needed to fuse the toner completely. With inkjet, the paper may need a special surface treatment to control the adhesion and drying. On the positive side, coated paper can be more impressive with it's tactile feel, and being better at reflecting light it will yield a more vibrant image.

Coated and uncoated may have the additional description of Inkjet, Laser, or Digital Printing. The inkjet papers are of course designed for printing with inkjet devices. As I mentioned, they are treated to increase image quality. The chemicals used in this process may have adverse effects on laser devices so it is not advisable to use inkjet paper in any laser device. Laser or Digital Printing paper is designed to optimize the toner transfer process and resist curling caused by heat during fusing, thereby reducing misfeeds and jamming.

Another paper that causes concerns is carbonless paper. This type of paper is used to make multi-sheet forms that when written on the front sheet, will duplicate the image on the following sheets as well. This is accomplished by treating the back, front or both sides of the paper with micro capsules of reactive chemicals. When the pressure is applied, the capsules are broken and the chemicals react to form a colored image. This coating can react with the rollers in laser devices, causing them to swell and fail. If you must run this type of paper, it is advisable to produce short-run lengths with plain paper being used in between to clean up the rollers.

## Finish

The finish of paper is best described as the texture of the surface. Paper terms often overlap or mean two different things altogether. Coated and uncoated are often used to describe the finish of paper. Both have variations of texture for different needs and use, thereby necessitating further description which we will explore as we go along. The term coated is part of the finish description and tells us a lot about the composition of the paper also. Often causing confusion, the term vellum can describe a finish that has a fine tooth or roughness to it or it can describe a type of paper. Vellum paper is a translucent paper which is typically used for drawing (tracing), wedding invitations, announcements, and crafts. To help keep things a little clearer, the following covers some of the basic properties of paper finish.

### **Bond**

Bond is another term that describes a paper and the finish. It is the most common paper used in offices because it is inexpensive and readily available. Good for general uses, the finish is much like wove but considered a lower grade.

### **Wove**

With more texture, tooth, or roughness than a smooth paper, wove is a very common description of uncoated paper.

### **Smooth**

Smooth and Super Smooth are self-evident descriptions of the paper surface. It is produced by additional rollers that smooth the surface out as the paper is manufactured. A smooth sheet will typically yield a better image when printed by any process. This is especially true when producing photographs and artwork with varying tones.

### **Vellum**

As we mentioned earlier, vellum has a fine tooth on the surface but feels smooth and can have a lustrous appearance.

### **\*Laid**

Used for fine stationary and other formal uses, laid has horizontal textured lines across the surface. With a somewhat course look, it resembles handmade papers and may have vertical watermark lines, known as "chain lines". Being a high end paper it is most likely to have a manufacturers watermark in it as well.

### **\*Linen**

Like laid, linen has lines on the surface; however, they are more fine and resemble linen cloth. Linen is often used for wedding invitations and greeting cards.

\* Because of the textured surface of Linen and Laid papers, you may experience problems fusing the toner when utilizing digital printing. Most printing devices are not designed with a fusing system that can heat and press the toner down into the low parts or valleys in the surface of these papers. The end result may be missing image areas or areas that flake off easily.

## **Glossy**

The surface of coated paper can be made to different degrees of gloss by adding clay and other materials before smoothing the surface with rollers. The roller process is known as calendaring, contributing to the description of super calendared papers. To avoid confusion, I must explain that uncoated paper can also be calendared; however, without the addition of other materials, the surface just becomes smooth to the touch and not glossy.

## **Matte - Satin - Dull**

Coated papers can also be made in various degrees of non-glossy finishes that are described in many ways. These papers provide the ability to control ink absorption and produce a constant, smooth surface to improve print quality without producing a glossy surface when it is not desired. Uncoated papers naturally have these non-glossy properties in varying degrees.

## **Weight**

Paper weight can be confusing, but it does not have to be. Forget about 28 pound bond, 80 pound index, or the caliper of a sheet. Just look at the GSM or grams per square meter. This may also be expressed as g/m<sup>2</sup> on the ream label or in specifications.

Two examples to give you reference points: a. 20 pound bond, the most common paper for printing and copying, is equal to 75 GSM and the default settings of most machines handle this weight very well. b. 80 pound cover, a common paper for brochures or promotion sheets is 218 GSM. This weight of paper will require default settings to be changed to obtain optimum quality.

Why do we care about paper weight?

Appearance, feel, and purpose - The paper weight should match the use of the printed piece. A business card on 75 GSM would not be very impressive or durable. A training document on 270 GSM would be heavy and very difficult to use.

The printing process - If you use a toner-based copier or printer and want to use any paper different than the basic 75 GSM, you may need to adjust settings to achieve high quality results. The number one reason for this is, toner-based machines heat the toner and paper after the image is applied to the paper, therefore melting or fusing it onto the paper. Heavy paper absorbs more heat. Basically the machine needs to know how much heat to apply to correctly fuse the toner.

The copier or printer capabilities - All printing devices are limited to the weight of paper they can image. This limitation is not only with fusing the image, the device may not be able to print both sides automatically (duplex) due to the weight of paper. Finishing options such as folding or stapling may also be affected. To avoid problems, please check your machine specifications before starting a project.

## Caliper

The caliper or thickness of paper is related to but not exactly determined by the weight of the paper. Coated papers weigh more in relation to their thickness than uncoated paper. Special high bulk papers are produced with a loose fiber structure and low amount of fillers making them light for their relative thickness. High bulk paper is often used to meet the thickness standards for postcards while controlling costs.

## Sizes

Standard paper sizes:

### United States and Canada

Statement/Memo	5.5" x 8.5"
Letter	8.5" x 11"
Legal	8.5" x 14"
Ledger/Tabloid	11" x 17"

### International

A5	5.83" x 8.27"
A4	8.27" x 11.69"
A3	11.69" x 16.54"

Digital printing devices for general office use are designed in two major classes referred to in the industry as A3 or A4. The A4 devices are limited to a maximum paper size of A4 or Legal. The A3 device can work with any of the paper sizes listed above. The minimum paper size a device can work with varies by model. To avoid problems you should check the specifications of the devices you have available.

## Brightness

In the United States, the brightness of paper is measured on a scale from 1 to 100 with 100 being the brightest. This number can often be found on the label of many types of office paper, but not always. Some manufacturers use less specific terms such as bright or ultrabright. These descriptions lacking creativity, but very subjective, leave us a little in the dark.

Brighter paper reflects more light and adds brightness to the image printed on the paper. This is particularly true when printing photos and artwork with varying tones. These varying tone images are printed with assorted forms of dots and these dots often have gaps between them that allow the paper to shine through. The human eye, without the aid of magnification, does not see the dot and space as separate entities. Rather it groups them together and averages

the color value. Inkjet printed materials may benefit the most from brighter paper because most ink is transparent and therefore the light reflects through the ink. On the other hand, toner is opaque and blocks reflection under the dots that it forms.

In relation to feeding and imaging with any particular device, brightness has very little or no affect on how the paper may perform in the digital printing process. The only exception to this would be dark colored paper that may cause problems with sensors in some devices. When this happens, the sensor can not “see” the paper and can cause the process to stop to avoid damage from what it thinks is a misfeed.

Brightness should be considered when evaluating the intent of the work being printed. Extremely bad examples of this would be reproducing a historical document or photo on 98 white glossy paper. It would appear rather strange, as would printing an ad for teeth whitening strips on 86 bright bond paper. For general documents and books, keep in mind that bright sheets will increase eye strain while reading. This is why the text in most books are printed on paper with brightness in the 80’s and any photo or art sections are on a brighter sheet.

## **Opacity**

The paper industry has a measuring system for opacity, but unlike weight and brightness, you will not likely find this information when buying paper. Here is where a little planning and testing will increase the quality of your printed piece. Opacity typically is a concern when printing on both sides of a sheet. This is also known as duplexing and the lack of opacity in the paper can cause show-through of the image from the opposite side of the paper. Since this detracts from the quality, we want to avoid this as much as economically and practically as possible. Typically any attribute that enhances opacity will also add cost.

Increasing the weight of the paper will increase the opacity because more fiber and fillers are used to bulk up the paper. Coated papers naturally are more opaque due to the fillers and clay added to the sheet. Calendaring uncoated paper tends to decrease opacity.

A watermarked paper has a pattern or image in which the opacity has been decreased. This image is formed while the pulp is wet in the production process. By smashing the wet pulp fibers together, they increase their ability to transmit light. Watermarked paper is generally used for stationery and formal correspondence so show-through is generally not an issue.

## **Grain**

When paper is made, many of the cellulose fibers align parallel to each other. This forms a particular grain direction. Typically, a quality paper, especially those designed for digital printing, will not cause a problem when you feed them in either direction through a digital device. The grain may cause a problem when the paper has a humidity level that is too high. High humidity levels may cause the paper to curl before, during, or after the imaging process. This may cause misfeeds in the system, or unruly output creating a mess in the output tray.

The grain direction has more impact if the final product is to be folded. Folding with the grain will produce a smoother crease, while folds against the grain can produce a crease that looks and feels rough. This is especially true with heavier weight paper, where the fibers of the paper are being fragmented or broken. If the printed piece has an image in the fold area, the broken fibers will degrade the image. To help avoid this problem, run the spine with the grain of the paper. When using very heavy weight paper, it is advisable to score the paper on the spine before folding. A score is basically enough pressure applied, in a thin line, to soften the fibers but not cut through the sheet, this is accomplished by a variety of methods.

The grain direction is not typically identified on the package and not always easy to determine by traditional methods. Making this difficult at times, modern paper making processes can produce a product with very little grain alignment. Luckily, heavy weight papers, the ones we really need the identify the most, are easier to test. There are several methods for testing grain. For a non-destructive test you can simply balance the sheet on top of your vertically held hand. Turning it in both directions, you may notice more sagging when the grain is aligned with your hand. This works best with larger sheets, and square sheets, because of the equal weight. There are three destructive tests that I have used, and the least effective I feel, is tearing the sheet in both directions. The idea is that against the grain is more ragged, but I find this hard to determine with certain papers. Easier to do, simply fold in both directions and the fold will be smoother when it goes with the grain, and that is what we want anyhow, smooth folds. Finally, you can cut a small square sample and place on top of water. The paper will curl in the direction opposite of the grain direction. If you are testing light papers, spritzing the paper with water may work better.

## **Virgin & Recycled**

Even virgin paper will more than likely contain pre-consumer recycled materials. Known as “broke”, trimmings and other waste from the paper making process are valuable material and not likely wasted. The same is true of clean waste created during the production process at commercial printing facilities. This waste is known as “hard white” and is worth a premium price because it contains no coated paper, ink, or toner and is easily re-pulped and used to make new paper.

Recycled paper that contains post consumer waste is considered by many a good way to cut down on environmental impact. There are many factors that weigh for and against this concept. My intent is not to lean you in either direction, but have you decide for yourself. So here are a few things to consider.

- Paper fibers should only be reused 5 to 7 times because they weaken and break down with each use. This ultimately causes structural issues and excessive dust or lint in paper.
- Recycling paper is a good way to lower the impact on landfills.
- Post consumer waste must be de-inked before it is used to produce most grades of recycled paper.
- Paper can be produced from more than just trees. Many varieties of vegetation contain cellulose that is acceptable for making paper.

- The infrastructure to recycle paper in the United States makes it easy for post-consumer recycling.
- Trees are a renewable resource, and most paper manufactures are involved in sustainable activities like replanting.
- Recycling paper may actually produce more waste water, air pollution, and consume more energy than producing virgin paper. This is dependent on the processes and transportation of materials over longer distances. Paper mills are typically located near raw materials rather than consumers who recycle.

## **Synthetic & Specialty Paper**

Some will say that synthetics are not really paper, so let us just call it a substrate to avoid any confusion or tribulation. This substrate is made mostly from polypropylene or polyethylene, with water proof and tear resistant properties that you may need for your project. The downsides are the cost, this stuff is way more expensive than paper, and finding the right device to print on it. Most digital office devices will not handle this substrate very well. Digital production devices, usually found in commercial or in-house print shops, are better suited to image synthetic substrates. It is important to find a product that is compatible with your system, or a system capable of running the product you want to use.

Metallic and special coated papers are typically a poor match for digital devices. Digital laser devices use a sequence of static charges to create the image on the paper; therefore, papers that are electrically conductive do not perform well. Digital production devices, or other methods of printing are better suited for these type of papers.

## **Labels & Envelopes**

Good quality labels that have been stored properly will usually perform well in digital devices. Labels should be stored away from heat and kept wrapped in their original box. Labels that have not been stored correctly, or are of low quality, may stick to rollers or drums in digital laser devices due to glue reaching the print surface.

Envelopes present numerous variables that may effect final quality when imaging on a digital device. Size, style, paper, glue, and how they have been stored, all play into how the end product turns out. Two important processes that may help are: a. Choose a digital device with a short paper feed path, one with the least rollers, guides, plates, and turns is best. b. Always keep the envelopes stored tightly together in the box, and in a low humidity. Allowing envelopes to relax or gain moisture will distort them, and possibly cause premature sealing.

## **Paper Storage and Handling**

The fibers that provide the base structure of paper also make it like a sponge. The moisture content, and rapid changes to it, can be the root cause of many printing and copying problems. Therefore, paper is best kept in moisture resistant wrappers until used. Even wrapped paper will slowly pick up moisture over time. For this reason, paper should always be stored in moderate conditions. Ideally paper is best stored between 40% - 55% relative humidity. Before paper is to be used, it is highly recommended that it be allowed to acclimate in the printing locality for 24 - 48 hours. When humidity is too low, static is likely to cause issues such as misfeed and double sheet feed, if too high, paper curling may occur.

When paper is loaded into printing device trays, Care should be taken to keep the paper together in a stack, and not bent or damaged. If paper seems to be sticking together, airing or fanning the paper may help. The easiest way to perform this is by placing the stack standing up with the long edge on a table, firmly hold the stack with one hand and twist slightly toward you while supporting with your other hand on the opposite end, grasp the other end tightly and create a wave in the paper by moving your hands, one at a time, toward or away from you. Air should separate the sheets as you do this, and be less likely to cause a misfeed.