digitalphotography
the complete course

New York Institute of Photography

How To Choose A Scanner

Unit Two
Lesson Six

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Why Use A Scanner?

As you will recall from Lesson One, there are two basic ways to acquire a digital image—with a digital camera or with conventional film materials and a scanner.

We've discussed digital camera capture in the previous lessons. Now let's discuss scanners and how they can convert existing printed material or film into digital information.

Scanners serve many different purposes, especially today, while we are still in the transitional period from film to digital technology. Many people continue to use film but want, or need, to have their photographic images digitized. Just consider the amount of photographs and slides in your own collections and albums. Regardless of whether or not you make the switch from film-based to digital cameras, odds are that you will want to be able to manipulate your existing work in the digital darkroom, archive the images electronically, or share them online. Images that represent our history are being scanned, archived, and shared because scanner technology is now fairly simple and affordable. When you want to digitize any two-dimensional item—like printed artwork, pages from a book, photographic prints, or even photographic film–you can use a scanner. Scanners can also be used to convert printed words into

- *Print digitized with a digital camera.*
- *If lens plane and subject plane are not perfectly parallel keystoning can occur.*

Print digitized with a flatbed scanner is sharp and perfectly "square".

editable word processing text through the use of OCR (optical character recognition) software.

Of course, you could use a digital camera to make a copy of a piece of flat art. But you would have to contend with lighting issues such as ambient light that might cause reflections or color shifts. And, if the lens plane is not perfectly parallel with the copy surface you might see image distortion such as keystoning. A flatbed scanner eliminates all of these problems and allows you to preview your scan and make adjustments in contrast, brightness, and saturation, among other things.

Basic Scanner Types.

There are four basic types of scanners that will be useful to you as a photographer:

1. Flatbed scanner

2. Flatbed scanner with transparency adapter

3. Dedicated film scanner

4. Drum scanner

©Agfa

Flatbed scanners are designed to scan prints or other types of flat-art. By "flat art" we mean any artwork or image that can be made reasonably flat—for example, photographic prints, drawings, and illustrations. A flatbed scanner can also be used to reproduce 3-D items, like a book or a watch or your eyeglasses.

In other words, you can use a flatbed to scan just about anything you could copy with a regular photocopy machine.

You should realize that a flatbed scanner is designed to handle originals up to a certain size. For example, the most common type of flatbed scanner can handle prints up to 8½" x 11". You'll be able to scan smaller prints—for example, 4" x 6" –but you'll need a scanner with a larger scanning surface to handle anything over 8½" x 11". However, the bigger the print a scanner can handle, the more expensive it will be! For most of us, fortunately, 8½" x 11" will be more than adequate.

Unless you only shoot slide film or have unlimited amounts of money, we recommend that you start with a flatbed scanner. It will produce excellent scans from your existing photographic prints and allow you to begin experimenting in the digital darkroom for a reasonable amount of money.

©Chuck DeLaney

Flatbed Scanners with transparency adapters are scanners that are designed to handle not only flat art, but film negatives and slides as well. Technology on these dual purpose units is getting better and better and the newer machines have solved many of the problems that were inherent in the earlier models. For instance, separate drawers and scanning areas for 35mm slides have eliminated the dark scans that used to be caused by placing a very small slide on a large illuminated plate of glass. If you decide to purchase a scanner that can handle both prints and film, make sure to buy one of these that scans the film in a separate drawer. Because the primary function of these units is to scan prints, if you tend to shoot a lot of a slide film, you're better off purchasing a dedicated film scanner.

Film Scanner *©Olympus*

Film Scanners are designed specifically for digitizing film originals. These scanners are significantly more expensive than flatbeds for a few reasons. First of all, the high–quality CCD (charged coupled device) necessary to capture information from a piece of film as small as a 35mm frame of film (24mm x 36mm) is expensive to manufacture. Film scanners also require a light source and some sort of optical lens to focus that light, further increasing the cost. The software that comes with a film scanner is also more sophisticated than the software that comes with a flatbed since scanning both positive and negative film is considerably more complicated. This is due to the small size of the slides and negatives, the need to reverse the colors in a negative to get a positive image and the fact that slide film tends to be more contrasty than print film.

Finally, the lack of wide-scale demand for these scanners results in higher prices for consumers.

Drum Scanner *©Fuji*

Drum Scanners produce the highest quality scans—the best resolution and the best color—but these devices are prohibitively expensive and are usually found only in digital service bureaus and commercial photo labs. A drum scan is made by attaching a print or a piece of film to a drum-shaped roller that spins past a CCD head. By keeping the CCD head steady and having the item to be scanned move, the highest optical resolution can be achieved. Drum scans may cost a lot, but when high-quality reproduction or very large output is required, a drum scan from a service bureau or custom lab is really the best option.

How Scanners Work.

Scanners work by moving a CCD sensor on a scan head across a stationary piece of art. The basic construction of a flatbed scanner is a lot like the common copy machine. A hinged cover is lifted, the original is placed face down on a glass platen and the cover is then lowered to hold the original in place and to block any extraneous light. When the scanning process begins, the glass plate is lighted. Then the CCD captures the information as the scan head moves across the print one line of pixels at a time, then drops down to read across the second line, the third, then the fourth…and so on until the entire print has been read. If the scanner has been set to capture a resolution of 300 pixels per inch, the scan head moves down and across 300 times for every inch of the original. The CCD essentially converts the color and tone from the print or slide into digital information. That information is then transferred through a cable into a computer that stores it in memory as a digital file.

How is the color information captured by a scanner? As with a digital camera, the information is captured with a CCD. The main difference between the two is that the scanner's sensor is also known as a line sensor. That's because the CCD sensors in a scanner are lined up in a row, allowing it to digitize information one line at a time.

Modern scanners—print or film—record color information in one pass, utilizing a tri-linear array. A tri-linear CCD array is basically three CCDs that filter the Red, Green and Blue light simultaneously which results in a single pass across the original. A single pass of the CCD array means better color because of accurate alignment of the three color channels. Some older models read only one color in each pass, so they require three passes to read the three RGB colors. Mis-registration (layers that do not align) is a common problem with these types of scanners, so we strongly recommend that you don't buy a used three-pass model.

The type of scanner you choose to buy for this Course is up to you. You should determine which type of scanner best suits your needs. If you predominately shoot slide film, the extra money needed for a film scanner will make some sense. If you shoot primarily print film, you can buy a good flatbed scanner for well under $200. For that reason, we expect that most of you will consider purchasing a flatbed scanner, at least for now. So, how do you determine what constitutes a good flatbed scanner? Since new models are constantly coming out, you'll find an article about what is current in scanner specs on the Unit Two WebCenter. However, let's take a look at a current

ad for a typical flatbed model and discuss the various specifications and what they mean:

Flatbed Scanner Specifications.

This illustration is representative of the types of specs that you are likely find in an ad for a flatbed scanner. The truth of the matter is that if all the scanner ads were alike, it wouldn't be so difficult to choose a good scanner because you could compare each model, feature by feature. However, it's not in the manufacturer's or dealer's best interest to provide you with all of this information, so you may have to do some research to identify the missing specifications if you want to make accurate comparisons. We recommend you compare ads from different dealers for the same models and learn as much as you can about the scanner before purchasing it.

Let's start by discussing the first two specifications: "1200x2400 dpi optical hardware resolution" and "9600x9600 enhanced (interpolated) max. resolution" both specifications relate to the very same thing: the maximum capture resolution of your scanner. Unfortunately, both are not created equal.

- 1200x2400 dpi optical hardware resolution
- 9600x9600 enhanced
- (interpolated) max. resolution
- 42- bit color depth input and output
- DR: 3.4
- 8.5"x11.7" max. scan area
- Includes 35mm slide and filmstrip TMA
- USB, SCSI (card included) and parallel interface,
- FireWire optional
- Fastest scanner in class
- One touch 5 button control panel (scan, copy, e-mail, fax)
- Scanner software, Omnipage LE, PhotoDeluxe

Note: Most scanner manufacturers use dpi (dots-per-inch) as a measurement method. In this case, you can substitute ppi (pixels-per-inch) as the measurement method. If you are confused about the difference between dpi and ppi, visit the Study Hall for a more detailed explanation.

Optical Resolution vs. Interpolated Resolution.

When you compare scanners (and digital cameras) one of the most important specifications you should consider is resolution. Just like with a digital camera, a higher resolution file will generally create a better quality image. In our example, the scanner being sold has a maximum 1200ppi optical hardware resolution. What does this mean?

It means that you can scan a 4" x 6" print at 1200ppi and produce a 4800 pixel x 7200 pixel digital image file.

4 inches x 1200ppi = 4800 pixels
6 inches x 1200ppi = 7200 pixels

Printing this file with an inkjet printer at 300 ppi would allow you to produce a photo–quality print that is 16" x 24".

4800 pixels divided by 300ppi = 16"
7200 pixels divided by 300ppi = 24"

The numbers that refer to optical resolution are a much better gauge of quality than the interpolated figures. Optical resolution indicates that the scanner has actually seen a color, processed it, and mapped that color to a pixel. No guessing by the scanner software allowed here.

The advertisement also mentions that the scanner has an enhanced resolution of 9600ppi. With the enhanced resolution you could produce an image that's 38,400 pixels x 57,600 pixels. That's enough pixel information to produce a 128" x 192" print at 300 ppi! It seems pretty impressive, however, enhanced resolution is obtained through interpolation. Interpolation involves averaging and estimating to create non-existent pixels for the sole purpose of increasing resolution. These numbers are generally useless because interpolation often results in poor reproduction. Don't be impressed with "enhanced" resolution specifications. Avoid interpolation as a way to increase resolution.

In the advertisement, the interpolated resolution specs are spelled out and you know what results you will get in both optical and interpolated resolutions. That is not always the case, so if you only find one set of numbers, you need to make sure whether they are optical (sometimes just referred to as "hardware resolution") or interpolated (sometimes simply referred to as "maximum resolution").

Bit Depth.

The scanner advertisement that we gave you says that the scanner offers “42-bit color depth input and output.” When we studied digital cameras, we did not talk about bit depth but the concept is important to understand for both cameras and scanners.

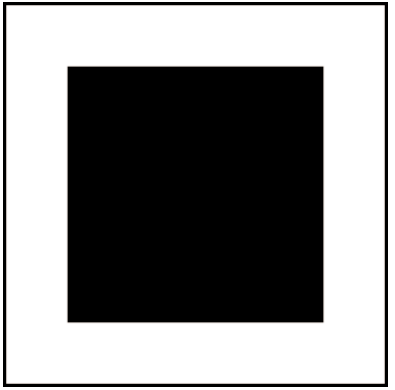
In the computer, bits are used to define the color or tone of pixels in a digital image. A bit can have two possible values 0 or 1. By increasing the amount of bits that are used to describe an image (bit depth) the range of tones a pixel is able to represent is increased as well.

The smallest bit depth image is also the easiest to understand.

A 1-bit image can be represented by 2 tones expressed mathematically as 21 or 2 x 1 = 2.

In this case the two tones are black and white.

white pixels = 1
black pixels = 0



A black square on a white piece of paper is an example of a 1-bit image, which consists of two colors, black and white.

1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	0	0	0	0	0	0	0	0	1	1
1	1	0	0	0	0	0	0	0	0	1	1
1	1	0	0	0	0	0	0	0	0	1	1
1	1	0	0	0	0	0	0	0	0	1	1
1	1	0	0	0	0	0	0	0	0	1	1
1	1	0	0	0	0	0	0	0	0	1	1
1	1	0	0	0	0	0	0	0	0	1	1
1	1	0	0	0	0	0	0	0	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1

The same image mapped to a pixel grid, or raster, shows how this 1-bit image is described digitally. White = 1 and Black = 0.

A 2-bit image can be represented by 4 tones expressed mathematically as 2^2 or 2 x 2 = 4.

In this example the four tones are black, white and two tones of gray.

white pixels = 11
black pixels = 00
light gray pixels = 01
dark gray pixels = 10

In digital photography, black and white images (also known as grayscale images) are 8-bit files.

An **8-bit image** means that each pixel can represent one of 256 different tones. The math is exactly the same: 2^8 or 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 = 256.

With a total of 256 tones (including pure white, pure black, and 254 shades of gray) you can produce photo-realistic grayscale images.

Full-color digital photographic images are typically 24-bit.

A **24-bit image** is essentially three 8-bit images combined. In Photoshop, each of the three channels of an RGB image (Red, Green and Blue) is an 8-bit image.

So a 24-bit image is comprised of a Red channel, in which any pixel can be represented by 256 tones of red, a Green channel, in which any pixel can be represented by 256 tones of green, and a Blue channel, in which any pixel can be represented by 256 tones of blue.

Three color channels x 8-bit = 24-bit or 8-bit (Red) + 8-bit (Green) + 8-bit (Blue) = 24-bit (RGB)

Because we already know that an 8-bit image can be represented by 256 tones, three 8-bit channels combined increase the tonal possibilities dramatically.

256 x 256 x 256 = 16.7 million tones or colors.

16.7 million different tones is enough to satisfy the needs of most digital imaging professionals.

Digicams generally offer "24-bit depth," which means that each pixel is defined by 24-bits of color information. With scanners, you will find models that offer 24, 30, 36 and even 40-bit depth and higher!

When a scanner captures more information than the image-processing program can use, the processing software will discard the excess pixels. Only high-end equipment can preserve the higher bit-depths color information. Since most printers can only reproduce a few thousand colors, 16.7 million colors (24-bit) is more than adequate.

So what about those scanners that are promising even higher bit-depths? Capturing additional color information can be advantageous for a number of reasons. Most notably, the potential for increased detail and tonal range is enhanced. Because you're working with more bits of color, you ultimately have more control over your image quality. Finer detail and subtle tonal changes may be captured in this way. By utilizing your scanning software optimization tools, you are almost guaranteed better scan quality. As you become more familiar with the process (both its possibilities and its limitations) you will begin to produce excellent output.

However some scanners capture a higher bit-depth but output the image at a lower bit-depth. For instance, some scanners on the market will capture a 36- or 42-bit image but will save the image as a 24-bit image. You would not be able to take advantage of the higher bit-depth outside of the scanner software once the image was saved even though some programs, do let you work at higher bit-depths. The specifications of 42-bit input and output indicate that our sample scanner has the ability to capture and save an image at 42-bits.

Buy a scanner with the highest bit-depth you can afford. Competition has spurred the scanner industry to produce more sophisticated, faster, less-expensive machines. Do your research!

Dynamic Range.

One other specification you should consider when purchasing a scanner is Dynamic Range. In our example, this spec is called DR but it is also referred to as D-Range or density range and is more likely to be found in ads for film scanners than flatbeds though it is relevant for both. Dynamic range refers to the range of tones, from brightest to darkest, that a scanner can distinguish–in other words, how well a scanner can capture highlights and shadows in your photograph. D-range is expressed as a number from 0 to 4.0. A higher D-range value indicates the ability to capture a wider range of tones. If a scanner could capture every possible tone, each and every time, it would have a D-range of 4.0.

So what D-range can you expect from a good scanner?

To put this in perspective, consider the following:

A good color print made by a custom lab usually has a D-range of about 2.3. A good color slide has a D-range of 3.0 to 3.5. In a flatbed scanner look for a D-range of around 3.0. Remember, we've indicated that a good print has a range of 2.3. A scanner with a D-range of 3.0, therefore, should be able to capture all the subtle differences between dark and light in a print.

On the other hand, a good negative or slide has a D-range of at least 3.0. So a film scanner should have a minimum D-range of at least 3.0 and preferably more. Many of the film scanners on the market today have D-ranges between 3.2 and 3.4. The more expensive models have D-ranges of 3.6, or higher, but these are usually expensive professional models. When you select a consumer film scanner, therefore, get one with a minimum D-range of at least 3.2, and higher if you can. One of the reasons that flatbeds with transparency adapters don't perform as well as dedicated film scanners is because of the flatbed's lower D-range minimums.

Just for your information, drum scanners can have very high D-ranges nearly reaching the theoretical optimum level. This is one reason scans made by professional service bureaus are so good…and cost so much!

However, all of this discussion of D-ranges is a bit misleading. If you look around the marketplace, you'll see scanners well over the theoretical maximum D-range of 4.0. Why is this the case? The reality is that manufacturers are trying to take the photographic term of D-range which was a standard meant to help photographers evaluate traditional film images, not digital and then using their own proprietary math to come up with better and better D-range numbers to give the public. Frankly,

it's mixing apples and oranges all designed to help them sell more scanners. So how do you evaluate a scanner's D-range number to determine whether it captures more ranges of tones from white to black? Your best bet is to use this number only as one of the many criteria in evaluating a scanner and not as the main reason for purchasing one model over another.

File Formats.

File formats are a very important part of the digital imaging puzzle. A file format is the method by which digital information is arranged and stored. Different file formats store image data in different ways. It is not necessary to understand how the formats crunch the numbers. It is important, however, to understand when to save a file as a particular file format. Look for a scanner that allows you to choose from multiple formats with at least one uncompressed format such as TIFF. That way you can get the best quality image when you want to make the highest-quality reproductions. For more specific information about formats go to the archived Digital Dialog articles in the Student Lounge. We'll also cover file formats in greater detail in the next Lesson.

What About Compression?

Compression is used to reduce file size for the purpose of storage, processing and transmission. Compression works by abbreviating the binary code of a digital image with complex algorithms *(algorithm: a set of rules for solving a problem in a finite number of steps, as for finding the greatest common divisor)*. There are standard and proprietary compression schemes available today. It's a good idea to use standardized compression formats to ensure that they can be used and read by many people for many years to come. Again, obsolescence is of prime concern when considering new or old technologies.

Compression algorithms can be broken into two distinct categories, "lossy" and "lossless."

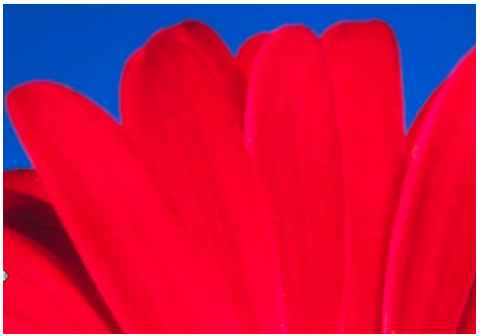
"Lossless" compression abbreviates the image code without discarding information. When the image is decompressed it contains exactly the same information as the original file. The GIF format utilizes lossless compression.

"Lossy" compression abbreviates the image code by discarding the information deemed to be of the least importance to the image. The JPEG format utilizes lossy compression.

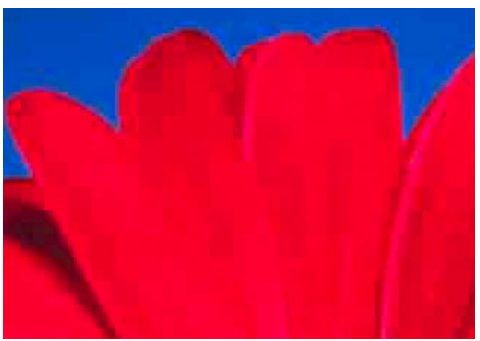
Yes, you can save space by compressing the image. But as we have noted, you lose some quality whenever you compress an image. In a digital camera, storage space comes at a premium, so compression of images allows you to shoot more images before you must download. You will lose some image-fidelity but you'll also be able to shoot and save more images on your memory card.

Since a scanner is connected to a computer, the situation is not quite the same. Computers have lots of storage space on their hard drives. Today, we talk about hard drives in terms of gigabytes. It's not uncommon to see hard drives with maximum capacities of 80 or 120 GB. While computer storage is not unlimited, it is far bigger than the storage available on a typical digital camera card. So it's not as important to make the trade off—that is, you don't have the same incentive to sacrifice quality via compression in order to store more images.

In fact, your objective in scanning is to capture the highest-resolution image necessary for the end-use you have in mind. This usually means scanning and saving an uncompressed image. Digital image files can be big. Sometimes huge.



Close-up of a TIFF file with no compression.



Close-up of the same file saved as a JPEG with high compression.

Since even a large computer will eventually run into storage limitations, we recommend that digital photography enthusiasts store their image files on removable media like CDs. You will find these types of media a very viable option for storing large amounts of digital image information.

Color In Scanning.

RGB Color Model.

When you capture a digital image with either a digicam or a scanner, Red Green and Blue (RGB) is the color model most commonly employed. Let's discuss this color model. In the light spectrum, Red, Green, and Blue are known as the primary additive colors. If you were to focus three colored light sources, one red, one green, one blue at the same intensity, at the same spot, they would produce white light. RGB is the color model that is used by computer monitors and televisions because they rely on light being projected on a screen.

CMYK Color Model

The colors Cyan, Magenta, and Yellow are the complementary, or opposite colors, to Red, Green, and Blue. Cyan, Magenta, and Yellow are also known as the subtractive primaries. These colors are most commonly associated with 4-color printing inks. Mixing these three colors together will theoretically produce black; however, because of impurities in printing inks they will actually produce a muddy brown. As a result commercial printers add one more color (black) to the mix to compensate for these impurities. CMYK (Cyan, Magenta, Yellow and Black) is the common color model for images destined for a printing press. Black is abbreviated by its last letter, "K," to differentiate it from Blue, or "B," in the RBG additive triad.

For most of us, understanding the RGB color model will be enough. That's because most consumer model printers rely on images being delivered as RGB images. However, knowing the subtractive primaries and how they relate to the additive primaries is important for another reason–color correction. For example if your image is looking a little green, you can add the complementary color magenta to correct it.

You can learn more about color complements by going to the Study Hall and clicking on the color wheel. You can learn even more about RGB and CMYK by clicking on the interactive demonstration digital primaries.

Choosing a scanner that can scan in other color spaces such as CMYK is not really necessary at this point in the Course. Even

if your scanner does offer other color space options, we suggest scanning all your images in RGB mode to start. If you need to convert it to another color mode, you can make a copy of the file and make the conversion later in Photoshop.

Scan Area Size.

We've talked a bit about scan area size before, but basically, you need to determine what size prints or documents you are likely to be scanning and buy a scanner that will accommodate them. You will pay more for a scanner that can handle oversized prints and documents. Scan area size also comes into play with film scanners. Most film scanners on the market will accommodate 35mm film. If you shoot medium or large format film, you will need to purchase a film scanner that can accept these formats. One less expensive solution for medium and large format photographers is to consider a very good quality flatbed scanner with a transparency adapter like the one shown below. That's because the larger-sized medium and large format film typically does not have to be enlarged to the degree that the smaller 35mm negatives and slides do. If you primarily use 35mm slide film your best choice would still be a dedicated film scanner.

Transparency Media Adapters (TMA).

We've talked quite a bit about transparency adapters and whether or not they are the best solution for photographers based on what type of film you primarily use. If you decide that a flatbed scanner with a transparency adapter is what you need, here are a few things you should consider.

Many of the flatbed scanners that can handle both prints and film offer either a separate device or a special drawer for scanning film. This is preferable to models that simply offer a replacement lid, which goes on top of your scanner's glass plate

©Agfa

and illuminates the slide . These replacement lids don't work very well. It's not too different from trying to use a copy machine to make a photocopy of a slide. The result would be a tiny, dark, little square on a large piece of paper. The solution, albeit not a great one, is that you would need to mask off the top of the glass plate all around the slide in order to limit the amount of light that the CCD sensor is picking up. This is time consuming and not always successful. So, your best bet is to look for a transparency adapter that has a separate area for slides and negatives where the light is better controlled.

Many flatbed/transparency scanners will also come with film holders for handling multiple–sized negatives and slides. If you decide to buy a scanner with a transparency media adapter try to find one that offers the best resolution and highest dynamic range setting you can afford.

USB And FireWire.

USB and FireWire are two popular ways to connect your scanner to your computer. USB ports are now built into virtually every new computer and connection is simple.

USB devices can be daisy-chained together (using the USB port on one device to connect another device to the computer), so you can connect both a scanner and a USB-enabled printer to the same USB port. FireWire is almost 30 times faster than a USB connection, which makes it the connection interface of choice for high-end flatbed and film scanners. You can read more about USB and FireWire connectivity in the Unit One WebCenter.

Your scanner connection decision should be based on the capabilities of your computer and your speed requirements.

USB and FireWire also have the distinct advantage of being "hot-swappable." That means that the computer doesn't have to be restarted before it recognizes the device.

Speed Of The Scanner.

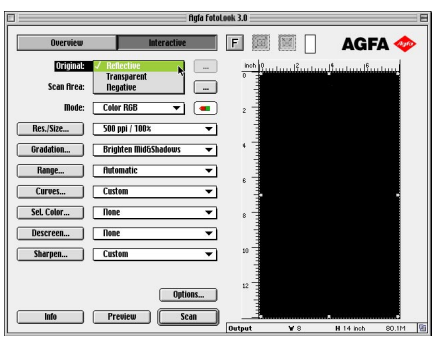
As we've stated above, how your scanner connects to your computer affects the speed of your scans. Other factors that determine scan speed are resolution, the number of passes a scanner makes to capture the image, and the type of processing that the scanner software performs. If speed is an issue—for instance if you plan to use the scanner to archive a slide collection—then you would do well to research the length of time it takes different models with similar specifications to capture a scan at the same resolution.

Automated Scanning.

Manufacturers are hard at work trying to make scanners easier and simpler to use than ever before. The latest scanners include one-touch buttons that will automatically scan an image. Some even include buttons that tell the scanner that your image is destined for the Web or for e-mail or for a printer or fax machine. The scanner then adjusts the resolution and size of the image and can automatically send that image to a printer or attach it to an e-mail message. While this means that everyone from your Aunt Sally to your elementary school child can use a scanner, it does not necessarily mean that this is the best choice for a serious photographer who wants to get an optimum quality scan. You'll find that the lower-priced scanners may not offer you the ability to override these buttons. So, when you are shopping for a scanner, do some research to see what buttons, if any, are on the scanner and whether you still have control over the scanning software.

Software.

The final specification in our sample scanner advertisement is for software. There are usually two or three types of software that will come with your scanner. The first is the scanning software that controls the actual scanning process. Most scanners will also come with some low-end digital image–editing program and perhaps some OCR software that will let you scan printed text into a word processing program.



Scanner Software: Unlike digital camera software that simply transfers your pictures from camera to computer, the software that controls the scanner is much more sophisticated. This software will vary greatly from manufacturer to manufacturer and model to model, so it is important to do some research to find out the exact capabilities of the scanning software available with a scanner you are considering buying. Typical scanning software will let you preview your scan, crop it, adjust color settings, resolution, brightness and contrast, automate the scan based on your output and save your image. More sophisticated software will also let you override any automation, set the highlights and shadows for a particular image, clean up dust and scratches, correct for possible color problems caused by the type of material you are scanning, adjust color values, and save your image in a number of file formats.

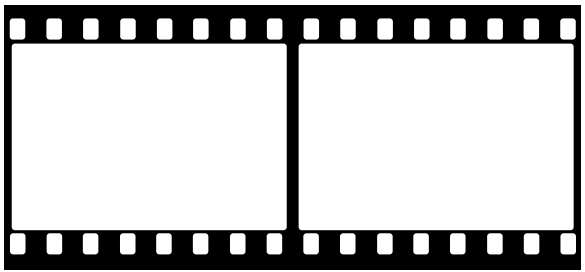
Once you've connected your scanner to your computer, you have to "tell" the computer how to communicate with your particular scanner. You do this by loading the scanning software program that came with your scanner.

Comparing scanners' software is just as important as looking at scanners' hardware. Do your research and make sure you're making a good choice for your workflow needs. Although scanning through Photoshop is a viable option we'll explore in Unit 3, choosing a scanner with good software will give you more choices later.

Digital Image–Editing Software: The second type of program that may come with your scanner is an entry-level image–editing program which will allow you to do basic manipulation, print your image, create calendars and cards, and have fun with your photos, all with a few clicks of a mouse. These basic programs vary greatly in their abilities. Later on in your Course you'll learn how to use Adobe Photoshop, a much more sophisticated digital imaging program to correct and enhance your scans.

OCR Software: As we've said, many flatbed scanners now come with a third piece of software—OCR software. While we will be concentrating on showing you how you can scan photographs, images are not the only thing you may need to scan. OCR software lets you scan text, but rather than simply creating a picture of the words, OCR software lets you bring that text into a word processing program and then treat it exactly as you would any other type of text file.

film scanner *©Minolta*



35mm film actual size

Film Scanners.

There are some significant differences in the specifications of a film scanner versus a flatbed scanner. If you decide that you need to buy a film scanner over a flatbed or flatbed with a transparency adapter, here are some things you need to consider.

Film Scanner Resolution.

What we said about optical versus interpolated resolution with flatbed scanners also holds true for film scanners. However, you will find the resolution abilities of a film scanner are only expressed as one number such as 4000 dpi instead of a flatbed's 1200 x 2400 specification. A film scanner needs to be able to provide higher resolution than a flatbed scanner because of the small size of the originals that you will be scanning. If you use a flatbed scanner to scan a 4" x 6" print and wish to produce a 4" x 6" 300 ppi ink jet print, you can scan that photo at 100%. This would produce an image exactly the same size as the original. However, if you scan a 35mm slide at 100% you will get a print that will be the size of the 35mm slide, 1⅜" x ⅞". Obviously, this is not the size that you would want to use to create a print. To scan a 35mm slide you would need to scan it at a much higher resolution to create a 4" x 6" print. Don't worry if this sounds confusing. We'll be covering exactly how to size your scans in

Negative strip carrier for Nikon film scanner.

Lesson Seven and again in Unit Three. So, before you buy a film scanner, give careful consideration to the size of the prints that you want to be able to produce and buy a unit that provides enough resolution to get the size of the print you want at the optimal resolution for your printer.

Film Scanner Dynamic Range.

D-range, eventhough it's not a truly accurate way to determine a scanner's ability to capture ranges of black and white, is even more critical in a film scanner than in a flatbed scanner. As we've stated before, dynamic range refers to the range of tones, from brightest to darkest, that a scanner can distinguish. Slide films tend to have a greater density than prints. A standard print may have a D-range of 2.3 so a 3.0 D-range on a flatbed scanner is sufficient enough to produce a good scan. A slide's D-range starts at 3.0, so a minimum D-range on a film scanner needs to be higher than that. Many of the newer film scanners have a D-range approaching 4.0 or even higher.

Sizes Of Film.

A film scanner is designed to handle transparent media such as film negatives or slides. Many film scanners are designed to handle specific sizes of film. Some are designed only for 35mm film. Some film scanners are designed to handle more than one size—for example, 35mm and APS film. Expensive scanners are available for professional-size medium format film, like that used in the Hasselblad, Mamiya and other professional studio cameras. Most likely, these will not be the types of scanners that you'll be interested in.

Our suggestion is that if you select a film scanner, be sure it can handle the size film you work with most often. If all your work is with 35mm, you may not consider it worthwhile to pay extra for a model that can also handle APS. Or if you always shoot medium format, then 35mm and APS may be of little value to you. So choose the film scanner that can handle the size film you most often use. Let a service bureau handle those

other sizes you may need only once in a blue moon. Or bring them to a store that offers Photo CD service.

In a typical film scanner you feed the negative or slide into a slot, and it is drawn inside and moved, line by line, past a fixed light source and the CCD head. You then press a button, and the film is ejected through the same slot.

With all film scanners the light shines through the negative or transparency and is read by the CCD sensors on the other side. This is an important difference between print scanners and film scanners.

Most film scanners can accept strips of film (such as cut negative strips) or individual slides in mounts. Typically, a strip of six frames of 35mm film can be slipped into the scanner, and each one is scanned individually. Some scanners accept an entire cartridge of APS film, which it "draws" through the scanner in a continuous strip.

Film Scanner Speed.

Because of the higher resolution output of film scanners, expect the speed of a film scanner to be quite slow as compared to a flatbed scanner. It is not unusual for a 4 MB file, which is a small image, to take over a minute on some film scanners. A recent review of a popular 2700 dpi (3.6 D-range) film scanner mentioned that it took over nine minutes to scan at highest quality. Part of the reason for this has to do with the number of times a film scanner's CCD chip will pass over an image. Some film scanners give you the choice of making multiple passes over the film original. One particular brand of scanner makes at least 16 passes over the film, each time eliminating more noise and other artifacts.

Film Scanner Software.

The software that controls the scanning process on a film scanner is even more critical than those that come with flatbed or flatbed with transparency adapter scanners. Film scanner software is much more sophisticated than a flatbed's software. It is important that you do as much research as possible to find out as much as you can about the software that comes with any film scanner that you are considering buying. Remember, this

is the software that actually operates the scanner, not the entry-level digital imaging program that will also come with most film scanners.

A film scanner's software needs to be able to scan both slides and negatives. Slide film tends to have specific color characteristics depending on the brand that you use, and some, but not all, slide scanners will include settings that let you tell the scanner what type of film you used. Having these pre-determined settings can be quite helpful, especially if you use multiple brands of film. Color negative film also has a different color balance. In addition, the image on a color negative is inverted and has an orange cast to it that the film scanner software has to deal with.

Some film scanner software includes Digital Ice technology, developed by a company called Advanced Science Fiction. This allows the software to eliminate dust and scratches automatically from the negative or slide. As we explained, since you normally scan a slide or negative at greater than 100% to produce a standard size print larger than the size of the original slide or negative, dust and scratches will be magnified as well. Having the software eliminate them automatically can be advantageous and save you time in the digital darkroom later. Other features normally found in slide scanner software include the ability to adjust the focus of the scanner, set the white and black points on a slide, and turn off the color management options when scanning specific films.

The Generational Loss Issue: Print Scans vs. Film Scans.

Which produces a better scan: A print that is scanned by a print scanner, or the same image, scanned as a negative or a slide by a film scanner?

Generally, you should get a better scan from the film scanner.

Here's why:

First, whenever you make a copy of an image, you degrade it somewhat. The farther you are from the original—that is, the more "generations" removed from the original—the less faithful the copy. When you scan a print, you are making a third-generation copy of an original. Let's see why. Your scan is a (third-generation) copy of a print (second generation) that was made from a negative or slide (first generation). On the other hand, when you scan a negative or slide, your scan is a (second-generation) copy of the original negative or slide (first generation). So all other things being equal, a scanned

negative or slide will be more faithful to the original than a scanned print because the scan will be second-generation rather than third-generation.

Second, the detail and tonal range (levels of brights and darks) recorded in a print is considerably less than the detail and tonal values recorded in film. For example, a print may have a range that compresses the differences between the darkest shadow to the brightest highlight. On the other hand, black-and-white and color-negative film usually have a much wider range of values. The differences between a print from a slide and the original slide are even more dramatic.

Conclusion.

Think Output From the Start.

When you make a scan, whether from a print or a frame of film, you cannot get more range than is present in the source you're scanning. When you scan a print, you are limited by the range of the print. On the other hand, when you scan a negative or slide, your original has a wider range, so your scan can contain more image information and range. Remember in our first lesson we talked about "garbage in, garbage out?" Better originals will yield better scans.

When looking for a scanner think about how you will be using your scanned images and buy accordingly. By starting at the end product and working forward, you will ensure that you will buy a scanner that can accommodate all your current and future needs.

We'll discuss output requirements and scanner use in the next two Lessons.

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