Image Input and Resolution

Before you leave your home for a drive in the country you plan out the route you're going to take. For some people that means studying the maps and guide books to decide on the best route to take – whether it be the scenic winding road or the quickest highway depends on what you want to get out of your trip. Then there are the adventurous types that just jump into the car and take-off without looking at a map - willing to go wherever their instincts and gas tanks takes them.

Scanning and printing digital files are a lot like taking a road trip. Some people use precise formulas to scan in exactly the correct amount of image information to make the optimal prints while others just slap the photo on the scanner, hit scan and hope for the best. Making a scan that captures the right amount of image information with good tonal and color values is like planning out your route for the journey. Knowing the rules of the road will let you make the best scan and capture just the right amount of information you need to make a great print and this chapter is where the journey begins.

Most digital restoration work starts by getting the image information into the computer and ends by making a print. The start of the process is where the print or film original is scanned in with film or flatbed scanner. Additionally many museums and historical image collections are using high-end digital scanning cameras such as the Better Light 6000 and 8000 to scan and catalogue their collections.

The most important issue to understand is that the quality of the scan will make or break your retouching work. The computer lingo for this concept is – garbage in garbage out. The care, planning, and quality of the scan that you begin with will impact the entire retouching and printing process.

Taking a few minutes to make a good scan that captures the appropriate amount of color, tone, and image resolution for your printer is the first step in the retouching process. Those few minutes will make your retouching session easier and save you hours trying to salvage or recreate information that wasn't captured in the first place.

It All Starts at the End

Before you begin it is essential to know what is your final goal is. How are you going to print the image – a desktop inkjet printer, a large format photographic printer, a film recorder or will the image end up on an offset press being printed for a magazine or book(or all of the above)? Working backward from the end of the process (the print) to the beginning of the process (the scan) is called *reverse engineering* and it is the only way to know how to make the best scan so you can make the best print when you finish.

Believe me – trying to retouch or work with a poor scan is an exercise in frustration. A bad scan will not let you make a print with crisp detail and tonal information in the shadows and highlights.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

To calculate the scanning resolution you need to answer these questions:

1. What kind of output device will you be using? Inkjet, continuous tone, or offset? Each type of output has specific input resolution requirements that are individually addressed in this chapter.
2. Each type of output device has an optimal output resolution.
3. How big is your original? You can use inches, centimeters, picas, or points – it doesn't matter. This is the easiest issue to determine – look at the original and measure it.
4. How big is the final print going to be? Are you printing a 5 by 7-inch snapshot or a 30 by 40-inch display print. The larger the print, the larger the scanned file will be and the slower the entire scanning and retouching process. Larger is not always better. Scanning the correct amount of information is always better than scanning in too much or too little.

The large variety of printers, papers, inks, and technology you have to print with today offer a wonderful palette of possibilities. In the following section, I'll discuss the most common types of digital output – inkjet, continuos tone, and offset – and show you how to calculate the correct resolution for each one.

Inkjet Prints

Up until a few years ago no self-respecting artist or retoucher would consider using an inkjet printer to make quality prints. In fact, the inkjet printers were usually relegated to the backroom for the bookkeeping departments to print out pie charts and presentations with. In the last 3-4 years, inkjets printers have embodied the ugly duckling to prince fairy tale of the desktop industry.

Inkjet printers spray small droplet of different colored ink onto the paper. The droplets are so small that you'd have to take a magnifying glass or loupe to the print to see the dots that look like film grain. Desktop inkjet printers made by Epson, Hewlett-Packard, and Canon are priced well under $500 and more importantly they produce astonishing results on a wide variety of papers. These desktop printers can print 8 by 10-inch to 20 by 24-inch prints on photographic glossy or matte and fine-art watercolor papers. For print retouch or restoration work make sure that the inkjet printer is a six-color printer. In addition to the standard C, M, Y, K inks – the six-color printers add a light cyan and light magenta ink, which helps when printing photo-quality images. Some printers use other colors besides light magenta and cyan - either way the additional colors extends the color gamut and more importantly it produces the appearance of a more contone print as additional inks allow for additional smaller dots.

On the high-end, artists, photographers, and portrait retouchers are using the professional fine-art printers made by Scitex IRIS™, ColorSpan, and Epson to make large format prints on archival watercolor paper and fine-art linen and canvas. The Scitex IRIS 3047 printers started their ugly duckling existence as proofers for offset printing. These large, industrial looking printers are now sought after by artists and photographers to produce exhibition quality serigraphs and fine art prints with. Graham Nash, Jack Duganne, Jon Cone, and the collective Unique Editions are among the pioneers of making digital fine-art prints with IRIS printers. Artists have taken to these prints with a passion since you can print on practically any substrate that you can wrap around the printer drum with a maximum size of 34 inches by 46 inches. The disadvantage to these printers is that they are expensive in excess of $80,000 and require constant maintenance. In case you are tempted to make an IRIS print, plan on working

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

with a service bureau or fine art printer to get the best results. On a positive note, the E PSON Stylus Pro 9500 wide-format color ink jet printer (a photo-quality 44" printer) costs between $10,000-$15,000 and can handle a wide variety of fine-art papers and many service bureaus are installing them.

> *Please note; Iris printers require a CMYK file so a color mode conversion is required which may complicate things. An Epson is perfectly happy with RGB data and they also have a larger color gamut.*

Archival Issues

The type of paper you make a print on can impact the look and feel of an image in both a positive or negative manner. For the most up-to-date information on how long a print will last please visit Henry Wilhelm's website at http://www.wilhelm-research.com for a well-respected, non-partisan, and thorough resource on the numerous types of papers and inks being used today to make all types of digital and photographic prints.

Inkjet Print Resolution

The desktop inkjet printers print at 720-1440 dpi (dots per inch) which is a tremendous amount of information. Thankfully you only need to scan in 1/5th to 1/3rd of that image information per inch to achieve excellent results. There is a slight speed gain when sending an Epson a file that is evenly divided by it's output resolution. When I work with inkjet printers I try to play it safe and scan in the file with the by Epson recommended 1/3rd rule. When push comes to shove and if my image doesn't contain any hard, diagonal edges such as the picture of a windjammer sailing ship would - I scan in 1/4th of the printer's resolution (1440 ÷ 4=360 ppi) and still achieve very good results.

> *Recently, Epson has lowered its resolution requirements to be between 200-240 ppi – I haven't had a chance to test this yet (Katrin - 5/10/01).*

For retouching work you'll want to print at the higher print resolution of 1440 dpi, meaning the scan needs to capture between 284 (1440 ÷ 5=284) to 480 (1440 ÷ 3=480) ppi (pixels per inch). As explained in the *Resolution and Flatbed Scanners* section later in this chapter it is recommended you work at the true optical resolution of the flatbed scanners which will most likely be 300, 400, 600, or 1000 ppi. When working with film scanners the optical resolutions will be much higher and you will be scanning at between 2000 to 6000 pixels per inch.

The fine-art IRIS printers print at 300 dpi and with a clear conscious you can work at half that resolution, scale the file up and sharpen it in Photoshop and still achieve excellent results. Talk with the person running the Iris or Epson 7500 or 9500 printer for exact specifications on file size, sharpening, file formats, color modes, and types of paper before starting your project. The more questions you ask the better a file you can bring to the service bureau and the better print they will be able to make for you.

Size Does Matter

Knowing how many pixels the inkjet printer needs to make a good print is the first step in making a good scan, the second step is to factor in the size of the print you want to make in relationship to the size of the original.

The size relationship between the original image and the final print is the multiplication factor and it determines how high a pixel count to scan the original in with. For example if

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

you're scanning a 4 by 5-inch print to make a 4 by 5-inch print then you're not enlarging the original and the multiplication factor is 1. In this case determining the scanning resolution is straightforward – set your scanner to capture the appropriate amount of pixels on the long end of the image with the following formula.

Original Length x Multiplication Factor x Printer PPI = Image Info

5 inches x 1 x 360 ppi = 1800 pixels (on the long end of the image)

Don't forget to take the optical resolution of your scanner into account. In this example I would substitute 400 ppi for the 360 ppi value.

5 inches x 1 x 400 ppi (optical) = 2000 pixels (on the long end of the image)

If you need to make an 8 by 10-inch print from an 4 by 5 inch original your multiplication factor is 2 (10 ÷ 5=2) and you'll need to scan in twice as many pixels. To figure out your multiplication factor divide the length of your final print by the length of the original. Don't worry about the short end of the image – that dimension will fall into place.

Original Length x Multiplication Factor x Printer PPI = Image Info

5 inches x 2 x 360 ppi = 3600 pixels

5 inches x 2 x 400 ppi = 4000 pixels

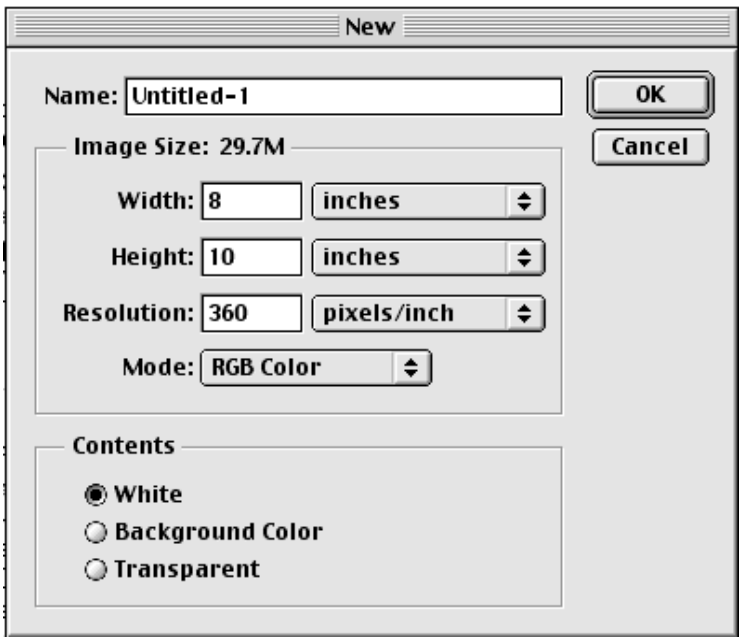
One more example: For an Epson ink jet at 1440 dpi output, let's agree that we will need 240dpi data for our print. Now ask yourself what size you want the print to be. Let's say we want an 8x10 print. Multiply the long dimension of your desired print by the output resolution and then do the same with the short dimension. That gives you the number of pixels you need in your final scan. Therefore, in this example we would need 10x240 (2400 pixels) by 8x240 (1920). Getting those pixels from your scanner will vary depending on the controls the scanning software can provide. But you know the exact pixel dimensions needed at this point.

Of course there are times when you just don't know what the final print size will be – in those cases opt for the conservative approach and scan in at the highest optical resolution possible. When in doubt, it is better to have too much information than too little. Sizing the file down in Photoshop is always better than sizing the file up.

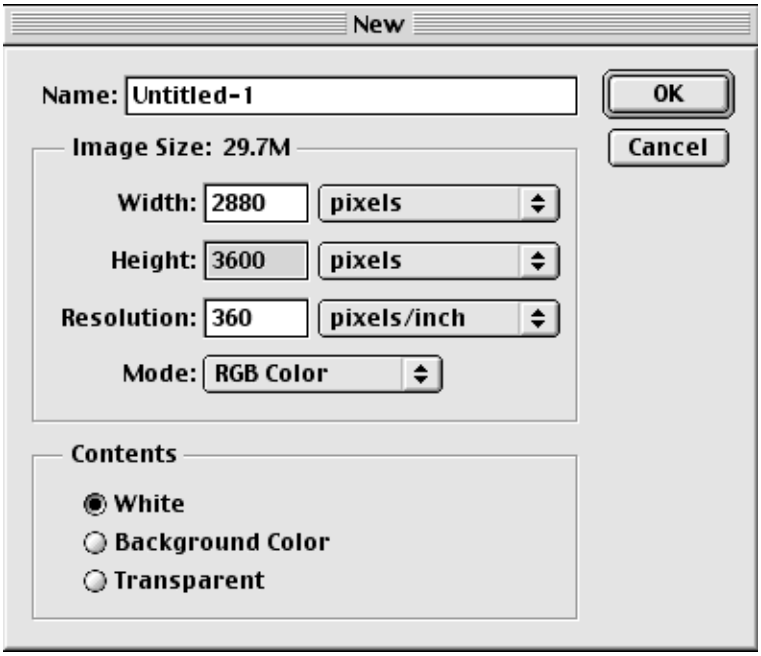
The Photoshop Calculator

If all of this talk about pixels, scanning, and resolution is making your head spin – take heart. You can use Photoshop to figure out exactly how big to make a scan. Go File > New and type in the dimensions of the desired print and the pixel resolution of either the printer or the optical resolution of the scanner. Photoshop will calculate exactly how many pixels you need to scan for optimal results. The figure #1 shows the Photoshop New File interface for an 8 x 10 inch print with 360 pixels per inch. Before clicking cancel, change the Image Size inches to pixels, write down the pixel values, and then click cancel. The values of 2880 by 3600 as seen in figure 5.2 are exactly what needs to be scanned in. To be on the safe side, I prefer to scan in a few more pixels than needed to give me some room to fine-tune the crop of the image. In this case I would scan in 3000 by 3700 pixels and crop the image to the exact dimensions of 2880 by 3600 before going to print.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.



Use the File New interface to calculate scanning resolution.



Changing inches to pixels shows how many pixels to scan in for a specific print.

Test the Digital Waters

In any creative, photographic, or digital process a great number of variables exist including the condition of the original, the age of the scanner, and the type of output you are using. Running a test before you commit to a procedure or process is the best way to discover and solve problems. A viable test is one in which you use the same equipment at the same settings that you are going to use for the project.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Use the test to try different resolutions or scanner settings. For example; scan the same image at three different resolutions; then without changing the image in Photoshop make three identical comparison prints with the paper the final image will be printed on, and then carefully inspect the prints. If you can't see a difference between the higher and lower resolution prints there is no reason to work at the higher resolution, which will only create larger files and slow down the retouching process.

As Andrew Rodney recommends; In case you are including type in an image your scanning and output resolution needs to go up. For just photographic images, most printers will do just fine with about 200 dpi of data. But as soon as you add type, the type suffers at that output resolution. You really need a minimum of 300dpi output to get clean type. So unless the user doesn't really care about the quality of the type, they could use a lot less data and get just as good a print UNELSS type is a concern. Then they obviously need more data for the photo to support the type output resolution needs.

One hint: The most important part of making a test is to develop a clear file and printing naming system. Don't just call the test scan 'scan1.pct' call the comparison series agfa300ppi.pct, agfa400ppi.pct, and agfa600ppi.pct. Use Photoshop File Info to annotate any additional information and label the digital file so that the information gets printed with the image. Test prints don't need to look pretty but they do need to be accurate for you to take advantage of them.

Making a test might seem like a waste of time and materials – but finding the best workflow before you begin a project lets you avoid many of the pitfalls that could lie in store for you.

You Want it How Big?

There are limitations as to how much you can enlarge a small original since any scanner only has so much optical resolution to work with. If a client gives you a 2 by 3-inch print and requests a 20 by 30 inch poster from it you may have to council them in the fact that making a such an enlargement may not look as good as they desire. Many times the client would much rather have a good 16 by 20 inch print instead of a 30 by 40 inch print that is soft and lacking in detail. Showing the client that you have their best interests in mind will facilitate a good relationship. Other solutions that bend the resolution rules include; include making a copy negative of the print, or scanning the original with a high-resolution digital scanning camera, or using specialized interpolation software after scanning to scale up the image. Each of these options are discussed at the end of this chapter.

Continuos Tone Output

Continuous tone devices (also referred to as contone devices) lay down pixel information so closely together that the prints look like traditional photo enlargements – without any dot pattern or screen rulings what-so-ever. Continuous tone printers come in variety of technologies including; the desktop thermal dye-sublimation XLS 8670 printers by Eastman Kodak and the thermal development and dye transfer Fuji Pictrography 3000 and 4000. The desktop models are priced between $8,000 - $17,000 with a per print cost of approximately $2.50 per sheet of paper. Thermal technology is inherently limited in the size and type of paper it can print and the success of inkjet is taking over the thermal print market. This is a shame, since thermal printers work very quickly, quietly, and produce stunning full-color photographic prints in about 70- 90 seconds.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Please note: With the release of the Epson 1280, 2000, and 3550 Epson has entered the world of continuos tone prints. In this discussion I am referring to contoneas based on the technology of the printer – not how the print looks.

Professional large format photographic printers that write a digital file directly onto traditional photo materials are becoming more and more prevalent. The most popular models include the Kodak Professional Durst Lambda 130 and the Cymbolic Sciences LightJet 5000 - all of which write onto traditional photographic glossy, matte, and display materials. Due to their high cost, large size, and maintenance requirements these high-end contone devices are installed at professional photo labs and are used to make either large display prints for artists, museums, advertising, and trade show displays or to produce high volume prints.

After the desktop thermal printers and the laser direct printers, the third type of contone output is writing a file onto photographic film with a film recorder. Writing the file onto a piece of photographic negative or positive piece of film i.e. making a color negative allows you to make standard photo prints or writing a color slide lets you project your images in a slide show.

All contone devices have one thing in common – although they write at a seemingly low ppi resolution of between 200 – 400 the effect of the closely exposed pixels - that literally touch one another - fools the viewer and it seems as if you're looking at a much higher resolution print. Calculating the resolution required for a contone device is refreshingly forward. For the best results you want to scan in one pixel for every pixel you are going to print. For example, if you were going to make an 8 1/2 by 11-inch thermal print on a Kodak XLS 8670 printer, which prints at 300 ppi use the following equation.

Print dimensions x Printer Resolution = Scan requirements
8.5 x 300= 2550 pixels

You may notice that I calculated the print resolution on the shorter end of the print rather than on the long end. This is due to the fact that the thermal head is built along the short end of the print – making the printers smaller and less expensive to manufacture.

In a nutshell – for every pixel that you want to output on a thermal or direct digital printer you should scan one pixel in.

Thermal and direct digital printers are very forgiving and you can often 'get away' with lower resolution scans and still achieve good results. You know what I'm going to say now…test the technology by making a scan and having the print done before you dedicate yourself to a project. I've printed 48-inch by 48-inch display prints on the Kodak Durst Lambda with only 85 ppi files that measured 4080 by 4080 pixels and totaled only 48 MB. The Durst Lambda can output either 200 or 400 ppi files and I was working with only about 1/3 of the required resolution. But due to the content of the images, which were soft portraits without fine type I was able to get great results from the 48Mb files. If I had been working according to ideal specifications I would have worked on either 264Mb for the 200 ppi prints or 1054 MB files to print at 400 ppi. I got around these huge file sizes by talking with the lab that was going to output the files and by making a test print before continuing with the project.

Speaking of Film Recorders

Desktop film recorders by Lasergraphics, Agfa, and Polaroid write onto 35-mm film and high-end devices by Solitaire Graphics, Cymbolic Sciences, and Durst•Dice can write onto large format 4 by 5 and 8 by 10-inch film. As mentioned, film recorders are contone devices, yet they differ from the contone printers in the regard to the terminology that is used to define their

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

resolution. In the US film recorder resolution is referred to in K – with 1 K equaling 1024 pixels across the long end of the film as listed in Table 1. The highest resolution film recorders write 16 K or 16,384 pixels along the long end of the film as listed in Table 2. You can use film recorder output make presentation slides, to archive your digital images, and to make new film originals to take into the darkroom and make traditional photographic prints form. If you need to make a lot (25 or more) photographic prints, having a digital negative made to make standard color prints from can often be an economical alternative to using the digital printers described above.

Table 1: Resolution in K for 35-mm film output

K	Horixzontal # of pixels	Vertical # of pixels	Suggested Uses
1 K	1024 pixels		Not recommended
2 K	2048	1366	Graphics
3K*	3072	2048	
4 K	4096	2732	Projection & Enlargements
6K*	6144	4096	
8 K	8192	5464	Enlargements

* Rarely used or supported

Table 2: Resolution in K for 4 x 5 and 8 by 10-inch film output

K	Horixzontal # of pixels	Vertical # of pixels	Suggested Uses
2 K	2048	1566	Not recommended
4 K	4096	3072	Small Enlargements
8 K*	8192	6144	Enlargements
16 K*	16,384	12,288	Enlargements

* Primarily used for 8 by 10-inch film

In Europe many people refer to film recorder and scanner resolution as Res (an abbreviation for resolution and pronounced *rez*) which means pixels per millimeter. The higher the value the more resolution the scan and film write have as listed in Table 3.

Table 3: Resolution in Res

Res	pixels per millimeter	≈ pixels per inch
10	10	254
20	20	508
40	40	1016
60	60	1,524
80	80	2,032
100	100	2,540

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Film recorders are the prima donnas of the output industry and they demand that you pay close attention to what you send them. The first rule is to always size the file exactly as needed – if you are making a 4 K write then size the file to be exactly 4096 (1024 x 4) pixels wide. Don't even think of sending it 4092 – those four missing pixels will cause the device to choke or worse yet add terrible interpolation artifacts.

In case your file is almost the right size but you are missing a few pixels on either end – set Photoshop's background color to black and increase the canvas size to make the perfect file size for the output – as seen below with the architectural shot of Los Angeles. Always rotate the file to take advantage of the long end of the film and work smart. If you're retouching more than one 2 1/4-inch film originals and need to make film output – think about ganging a number of the images up onto one 4 by 5-inch or 8 by 10-inch piece of film – this will save you time and money.

In these digital times you may be wondering – why would anyone write a digital file back onto film? Won't it fade or degrade the image? Many photo stock agencies are still using digitally reproduced film output to send images to clients. So is film dead? Not yet and archiving files onto film isn't as archaic as it looks at first glance – in the future anyone with a light source will be able to access the information from the piece of film - something that can't be said for an out of date digital technology.

Offset Printing

Images destined for offset printing including magazine and books are separated into four-color plates by halftoning the file. The pixels of the files are converted into spots on lithographic film, which are later used to form the spots of ink on the paper. This book and every magazine you read is an offset print.

Answer the following four questions to determine the scanning resolution for offset printing.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

1. *What line screen will be used to print the halftone?* If you're not sure what line-screen your printer uses – ask them. The most common line screens and their uses are;

   85 ls Newspaper

   120 ls Newsprint magazines

   133ls Glossy weekly magazines

   150 ls Glossy monthly magazines and books with color images

   175 ls Display Books

   200 ls Fine-art museum books

2. *What quality factor do you want for your images?* The quality factor takes into account the difference between how a pixel describes tone and how a halftone dot describes a tone in the image. You can ask your printer or use 1.25 (lowest) – to 1.5 (safe) – to 2.0 (recommended). There is no reason to go above a quality factor of 2.0 but you should experiment and test with lower values. Interestingly enough, you can use lower quality factor values for the higher resolution jobs. So always use 2.0 for newsprint and lower values for magazines and books. As the linescreen gets finer, the need for a higher Q factor isn't necessary – for example above a 185lip, a 1.5 QF is plenty.

3. *What is size multiplication factor?* Are you printing the original at exactly the same size or are you enlarging or reducing it? To calculate the multiplication factor divide the length of the final image with the length of the original. For example, if you start with a 3 by 4-inch original and need to make an 8 x 10-inch print the multiplication factor is 2.5 (10÷4=2.5).

   Or: Find out want output size you want and use the output resolution (just determined above with Q factor) and do the math. So, if we have a 150lpi with 2x Q factor, our output resolution needs to be 300dpi. Now it's 8x300 (2400) and 10x300 (3000) pixels necessary.

4. *What is your actual scanning resolution?* Your scanning resolution is the answer to the all of the above questions as described in the formula below.

LS x QF x MF = Scanning Resolution (x print length)=Final scan resolution

For example, the original 4 by 5-inch image is going to appear in a glossy magazine printed at 150 line screen as an 8 by 10-inch print. Since the image is very important and you want it to look its best – use a quality factor of 2.

150 x 2.0 = 300 x 2= 600 pixels per inch scanning resolution

The final file will be 2400 by 3000 pixels and be 20.6 Mb in file size. When in doubt use the Photoshop File New calculator trick or Image Size dialogue box or the Resize Wizard to calculate the file size and scanning resolution out.

On a more creative note: artists such as Dan Burkholder, Huntington Witherill, and John Charles Woods are writing finely-tuned photographic digital files onto offset film to make enlarged negatives for photographic contact printing. This process gives the artist access to large and inexpensive negatives with which they are making exhibition quality platinum and palladium prints. For additional information please see, "Making Digital Negatives for Contact Printing, 2nd edition by Dan Burkholder.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Resolution Summery

Scanning in at a slightly higher resolution is always better than scanning in too little information. A higher resolution file will give you more image information to work with and make the retouching process easier to see and do. Once you're done retouching, sizing the file down tends to smooth out retouching artifacts.

Resolution Summery Table:

Inkjet: Scan 1/5th-1/3rd resolution in for one dot out.

Continuos Tone: Scan in one pixel for every pixel on the output.

Offset: 1.25-2.0 pixels in for every half-tone dot out.

Web graphics: Scan in at twice the file size the image needs to be, do the retouching and then size the file down to the web resolution.

Working with a Service Bureau

After you have calculated the ideal resolution for the type of printer and print size needed - its time to make the scan or have the scan made by a service bureau. In case you're going to have someone else do the scan you need to specify as closely as possible exactly what you need from the scan. Service providers will have you to fill out a job order – this allows you to tell them exactly what you want and believe me taking a few minutes to fill out the form carefully will result in a scan you're happy with.

A typical work order will ask you the following;

1. Type of original? 35-mm, large format, slide, color negative, print, etc.
2. Size of scan required? This may be addressed in pixel dimensions or in Mb. Please don't expect the service bureau to calculate your desired resolution requirements. You tell them – they scan it.
3. Final color mode required? RGB, CMYK, grayscale, line-art?
4. Final file format desired? TIFF, EPS, Photoshop, PICT, or JPEG. To play it safe- request a Photoshop or TIFF file without compression.
5. Removable media file is to be written onto? CD, ZIP, JAZ, SyQuest? Call the service bureau before you leave the house and ask them, "what kind of removables do you support?" In most cases they'll support a variety, take an appropriate disk with you, and leave it for them to write the file onto.
6. Due date? Or when do you want to pick the scan and original up?

Remember to label everything that you bring to the service bureau – your disks, disk sleeve, envelops, and originals. I go so far as to put an address label with my phone number on everything I leave at the lab. A busy service bureau or photo lab receives hundreds of disks and files every week and the easier you can make it for the scanner operator to reach you in case there is a question the better. On that note – when I have files output at a service bureau or photo lab I go so far as to name the file by file-name/eismann/my phone number.tif That way if there is any question at any stage in the process the service bureau can reach me quickly and easily.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Flatbed Scanners

The workhorses of scanners are the flatbeds and are primarily used to scan in reflective print originals. They look like little squashed photo copy machines with a lid you lift up to place the original face down on the glass (or platen) to make the scan. Of course, not all flatbed scanners are equal and don't expect the $150 model to match the results of the professional Linotype-Hell Nexscan F4100 or Scitex EverSmart Pro II scanners. The most important considerations to look at when buying a scanner are; optical resolution, dynamic range, size of scan surface, bit-depth, software, ability to add a transparency unit to scan film originals with, and of course price. For in-depth information please read Real World Scanning and Halftones, 2nd edition by David Blatner, Glenn Fleishman, and Steve Roth.

Desktop flatbed scanners are designed to scan in reflective print originals and they are a necessary piece of equipment for a retoucher to have. Some flatbed scanners come with an optional transparency unit or a second dedicated film bed, which can work well with large format film. If you need to scan in a lot of film - its time to purchase a dedicated film scanner (which can be a flatbed).

Low-end sub $1000 flatbed scanners have an optical resolution of 300 - 400 – 600 pixels per inch, midrange $1000-$2500 flatbeds sport a 1000 – 2000 ppi optical resolution, and high-end flatbeds can push the 3000+ pixel resolution. In order to achieve the best results, scan at either the true optical resolution of your scanner or at an integral multiple of that resolution. If your scanner scans in at 400 ppi use that setting rather than telling the scanner to scan in at 480 ppi since it would only be making up i.e. interpolating the data up. Working with the integral multiple of the scanner's optical resolution allows the scanner to work efficiently and not waste time interpolating pixel information either up or down. For example, a 600-ppi scanner can be used to achieve good results at 400, 300 and 150 ppi settings. Due to the leeway that inkjet printers allow, you won't see the difference in a print that came from a 400-ppi or a 480-ppi scan. So save yourself some processing time and hard drive space and scan in at the lower and in this case more accurate resolution.

To determine the optical or true resolution of your flatbed scanner check the technical specifications. Most likely you will see two numbers such as 600 by 1200. The lower number is the maximum optical resolution and the higher number is the number of steps that the scanner stepper motor takes to move the CCD (Charged Coupled Device) linear array down the bed of the scanner. Although the quality of the stepper motor is important it does not determine actual image information. Beware of any numbers that are outlandishly high such as 9600 by 9600 or descriptions that use the words interpolated, enhanced, magic, or genie. That means the scanner software is making up pixels – something which you should avoid whenever possible.

Capturing and Preserving Tonal Detail

If you are on the market for a flatbed scanner you know that the prices range from next to nothing when you buy a new computer to tens of thousands for the professional Scitex Eversmart scanners. The primary issue that separates the low-end from the professional scanners is the ability to capture subtle differences in similar tones and resolution capacity. Where the low-end scanners see the same values, high-end scanners have the ability to differentiate fine details and tones. In the world of digital imaging – difference is information and anywhere you have tonal differences you will be able to emphasize the differences to make a better image.

The attribute that effects the ability of a scanner to capture tonal information is its dynamic range, which is the ability to capture a range between tones - from deep shadows to highlights. Dynamic Range is described on logarithmic scale with 0 being clear film and 4.0

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

pure black. If you see a scanner rated at .3-3.0 it means it has a dynamic range of 2.7. Originals be they print or film also have an inherent dynamic range as seen in Table 4. Each type of output also has a dynamic range, with newsprint being on the low end of the totem pole and the wide dynamic range of high-end film recorders on the top, as seen in Table 5. When looking at a scanners capabilities make sure to buy one that is capable of capturing the same dynamic range of the originals you will be using as seen in Table 6.

Table 4 : Dynamic Range of Input Originals

Original	Dynamic Range
Photographic Print	1.4-2.0
Color Negative Film	2.2-2.4
Standard Color Slides	2.7-3.0
Professional Color Slides	3.2-4.0

Table 5: Dynamic Range of Scanners

Type of Scanner	Dynamic Range
Low-end or older flatbed	1.8-2.5
Mid-range flatbed	2.5-3.2
High-end flatbed	3.4-3.8
Desktop film scanner	2.8-3.5
Professional desktop film scanner	3.4-4.1
Professional Drum	3.6-4.0
Kodak PhotoCD Master for 35-mm	2.8
Kodak PhotoCD Professional	3.2

Table 6 : Dynamic Range of Output

Type of Output	Dynamic Range
Newsprint	1.0
Coated stock	1.6-2.2
Photographic Print	1.6-2.2

This information is often difficult to discern from technical specs. If you have a chance to test a scanner before purchase make a scan of an image with a wide dynamic range from black to white or use a Kodak 21-step wedge. Carefully inspect the shadows to see if you can see tonal differences, then look at the highlights of the image – are they blown out to white or is there detail in them? Once again making a good scan with tonal differences and details will make the entire retouching process much easier and your results that much better.

The downside to having a lower dynamic range in this case is that you have to decide if you want to capture the darkest shadow detail, which results in blown out highlights (bad) or control the highlights and lose that shadow detail. This illustrates what dynamic range provides to the user. Without that range, one end or the other suffers.

There is NO universally accepted way to measure dynamic range so the figures provided by manufacturers are guidelines at best! Dynamic range is usually measured past a certain point of

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

noise in the shadows or blackest black in an original. Since every manufacture is free to decide what level of noise is acceptable prior to starting the measure of dynamic range, it's not uncommon to find quite large differences in supplied dynamic range specifications from manufacturer to manufacturer.

Bit-depth Issues

Bit-depth is how many true shades of gray the scanner captures and differentiates, as seen in Table 7. The bit-depth of scanners ranges from 8-bit to 16-bit – with most scanners today working with 10 or 12-bits per gray channel. Some manufacturers refer to 24, 30, or 48-bit scanners. They are just trying to impress you and all they've done is told you the bit depth of the color RGB file. 8-bit grayscale is a 24-bit RGB file and 10-bit grayscale is a 30-bit color file, etc.

Table 7:	**Scanner Bit-depth**	**Levels of Gray Captured**
	8-bit	256
	10-bit	1024
	12-bit	4096
	16-bit	65,536

To make scanning that much more exciting bit-depth is not easily comparable from scanner to scanner because manufacturers use different CCDs and A-to-D (analogue to digital) conversions. An inexpensive CCD scanner may claim to capture a 10-bit file but in reality the last 2-bits are garbage and are most likely being overwhelmed by signal noise. In other words, the marketing departments are saying you're getting a deep-bit file when in reality you're getting 8-bits of information and 2-bits of useless data. But that's better than an 8 bit per color scanner that only provides 6 bits of real data. At least with that 10-bit scanner, you are likely getting 8 bits of real data, which is the minimum we need.

A scanner with a dynamic range of 3.0 and 16 bits will not "see" shadows in a chrome that has a range of 3.1. So all you are doing is getting a lot of bits of black on the lower end which you still can't divide up with more bits because the scanner just sees black there. Bit depth without sufficient dynamic range isn't useful once you get your 8 good bits of true data. This will make itself especially evident in the shadows and highlights of your image. On a low bit-depth scanner the shadow areas will block up and the highlights will blow-out and no matter how much you tweak the scanner controls the shadows are still 0,0,0 and the highlights 256, 256, 256. While the same image scanned on a high-end scanner will show tonal differences and detail in the shadows and detail in the highlights (if it has the dynamic range to capture the data to divide up into more steps-bits). Images with a full tonal range are much more pleasing to look at.

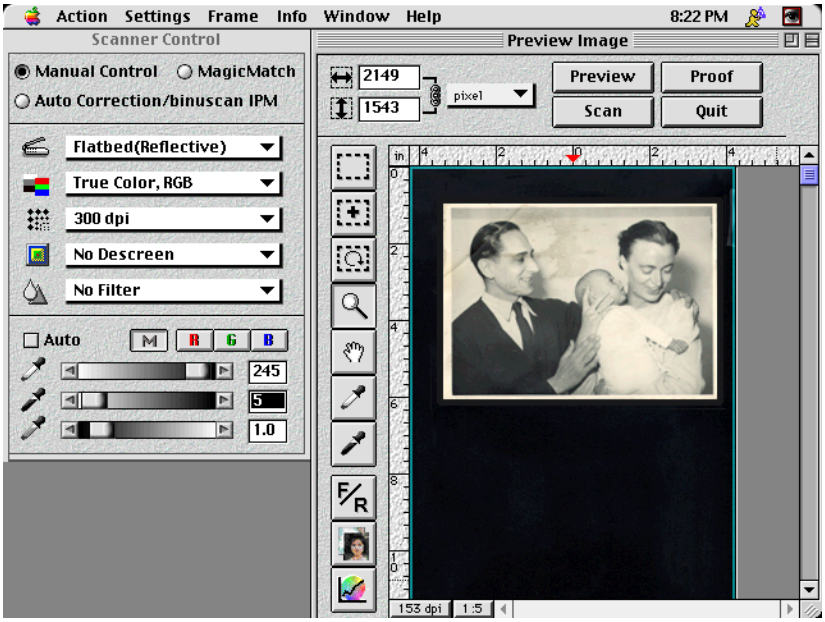
If your scanner gives you the option to scan at higher bit-depths then by all means take advantage of that feature. The downside is that your file size will double and at some point, you need to convert to an 8 bit per color file to use Photoshop layers and to make a print. Let the scanner capture as much information as possible by selecting the high bit depth option. The next decision will be when to decide to go from a high-bit file to a standard 8-bit file. Some scanner software will dump down from high bit-depth scans to the standard 8-bit and others will let you save the high-bit files. I prefer to scan in a high bit file, bring the high bit file into Photoshop to do global tonal and color correction, and then use Photoshop to reduce down to the standard 8-bit file.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Flatbed Prescan Preparations

Before you start scanning make sure to warm up the scanner lamp for 10-20 minutes before using it. The lamp needs the time to come up to temperature and come into a consistent state. In that time there is plenty that you can do to get ready to make a good scan;

1. Plan out your resolution needs as previously described.
2. Clean the scanner glass. Do not use paper towels and standard glass cleaner – as the paper towels can scratch the glass and permanently ruin the scanner. Use one-time wipes made for electronic equipment or buy glass cleaner at a professional photo supply store. Photo Solutions (www.photosol.com) offers cloths made specifically for cleaning scanners, monitors, CCDs, and other electronic devices or surfaces. Use the PEC-Pad to clean the glass of your scanner. When you're not using the scanner – close the scanner lid and cover the scanner with a lint-free cloth to keep dust away from it.
3. Clean the original. Careful – you don't want to damage the print with vigorous rubbing – but if the print is dusty or dirty gently blow or brush the dust off with a soft brush or compressed air (not the ozone depleting kind!).
4. Place the original face down on the glass (usually but sometimes it depends on the scanner) (also called the platen). Make sure that the original is straight – since it is always easier and faster to straighten the image by hand – rather than using Photoshop to rotate a file a few degrees, which will also add softness to the image.
5. Take advantage of the scanners CCD – orient the long end of the print with the CCD – i.e. try to scan wide to use the optical resolution of the scanner rather than the stepper motor. Place the long axis of the print to take advantage of the CCD – this also speeds up scanning as the stepper motor has a shorter distance to travel to make the scan.



6. Carefully close the scanner lid. If you are scanning a sensitive antique print take care not to apply too much pressure that might damage or crack the print. If you are scanning a contemporary print close the lid so that the print is held down firmly and evenly.

Once the scanner is warmed up, launch the scanner software – this is where you have control over the three most important factors that go into a good scan - resolution, tone (also referred to

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

as contrast), and color balance. A good scan captures the right amount of information with good tonal separation and good color. If you keep your eye on these three characteristics, your scanning sessions will be successful.

To Clean or Not to Clean?

If the print is an one of a kind print or has a non-hardened emulsion such as antique and old black and white prints, I cannot recommend using any type of cleaning solution on it as the liquid may cause additional damage. If the print is a contemporary color or black and white and you have access to the original negative – by all means work from the original film. When in doubt, always make a high-resolution scan prior to cleaning prints that are stained with ink, crayon, markers, soot, mold, etc. and then use Photo Solutions PEC-12 to carefully wipe away the stains.

Always test the cleaning method on an unimportant area such as the print edge or corner before using any cleaning solutions. Do not rub too hard as this may damage the original. The cleaning of ambrotypes, daguerreotypes, tintypes, and glass plates should always be left to a professional conservator.

Basic Flatbed Scanning

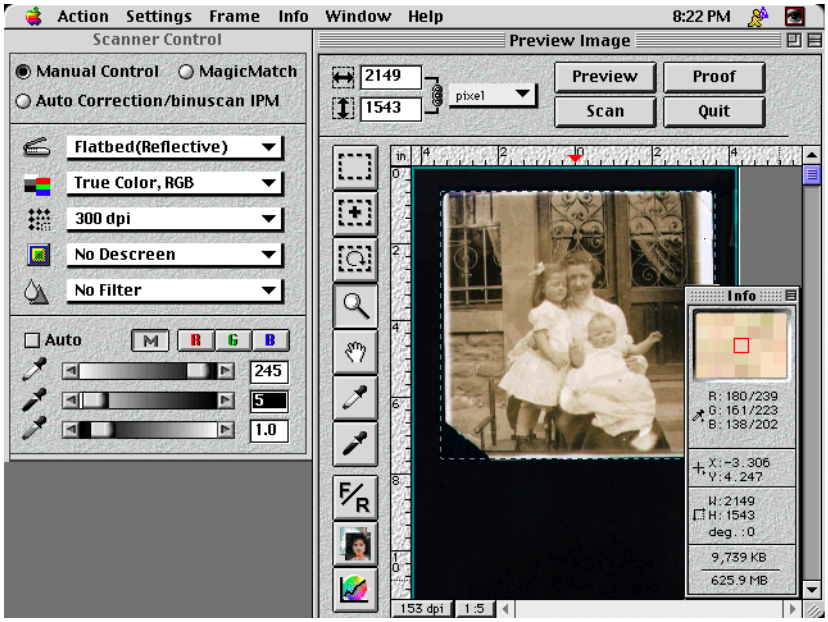
Of course I can't cover every piece of scanning software – but there are basic principles you should pay attention to get the best scan. The steps of making a scan are; preview, setting resolution, adjusting tonal range, color correction, scanning and saving the file.

1. Scan a preview and crop the image. There isn't any reason to scan the empty flatbed of the scanner. Be very careful when setting the crop, especially with scanners that automatically analyze the original to set highlight and shadow. If the crop is outside of the actual original, this auto setting can be confused. Also, if the scanner has a good auto analyze feature, often cropping smaller than the original can help. After the auto analyze, the user can extend the crop to capture the data they wish.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

2. Set the type of scan. Some scanners describe the type of original; photo, black and white photo, line art, etc. while others use the terms RGB, grayscale, or CMKY. All scanners scan in RGB (the equivalent of color photo) so that is the best choice to use. In case you need grayscale (black and white) form a color original scan in RGB and in a Chapter 8 I'll show you how to convert an RGB file into a beautiful black and white image.

3. Set the resolution of the scan, keeping in mind to use the optical or an exact increment of it to make the scan. Some scanners will describe the image resolution in ppi (pixels per inch), dpi (dots per inch), K (kilobytes), or Mb (megabytes). As many experts before me have said – the lack of standards in digital imaging only serves to confuse the user. All I can recommend is to use ppi since you've calculated the needed resolution in pixels and a pixel is a pixel is a pixel.

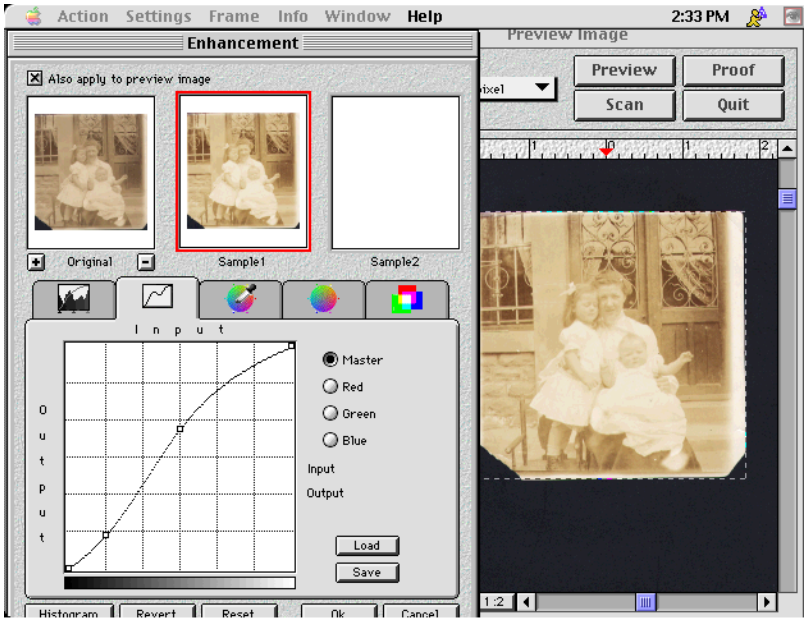


4. Use the scanner controls to set the tonal range. Most scanner software comes with a variety of tonal controls. Whenever possible use the Curves control, when working on image tone i.e.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

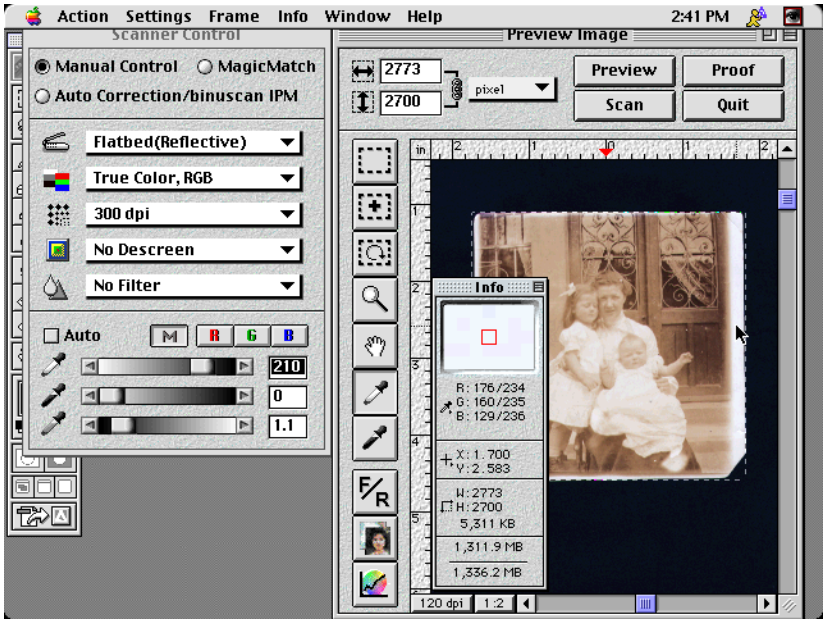
making an image lighter or darker. Naturally having a calibrated display means you can trust what you are doing based on what you see!

5. Use Curves or color correction controls to fine-tune the color.



6. After taking care of colorcasts you may need to tweak the final tonal values again.

7. Check highlights for colorcasts as seen in the following image.



8. Make the scan and save the file into your scan folder.

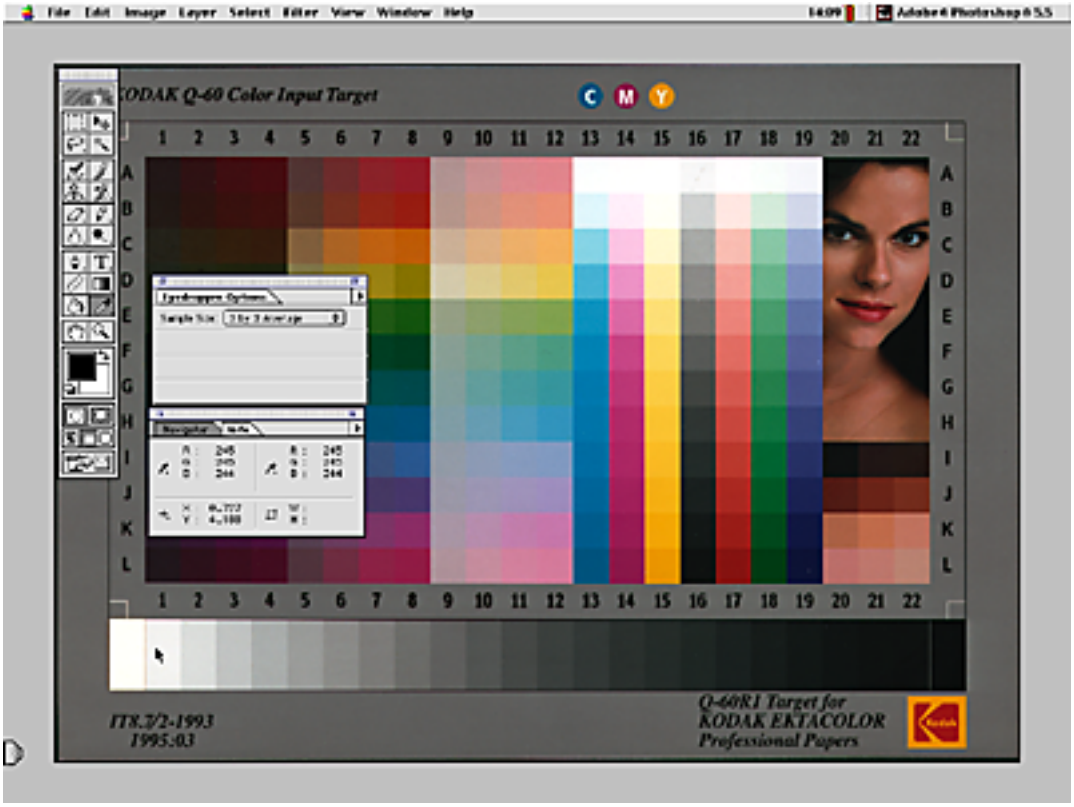
A sure sign of a professional is an organized workflow. For each project create a master folder, in which you create three sub-folders named; *Scans, WIP, Finals*. Put the original scans into the scan folder, the work in progress files in the WIP folder, and only final, ready for printing files into the Finals folder.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Additional Scanning Control

If you achieve pleasing results with the scanner's software default settings consider yourself fortunate. On the other hand, the best thing about doing the scans yourself is that you can look at the file and tweak the scanner controls to get the best scan possible. Making a good scan means repeating, testing, studying, and trying again. I rarely get the scan I need on the first try. Use the scanner software's curves, white/black point, and color correction tools to make a better scan. Don't wait until you're in Photoshop to fix bad tone or color. It takes the same amount of time to scan in 30 MB of bad data – data that has a color cast or is tonally incorrect. It takes the exact same amount of time to scan in 30 MB of a color corrected, tonally pleasing scan. Spending a few minutes tweaking your scanner interface to produce a good scan is time you've saved yourself form doing that same correction in Photoshop.

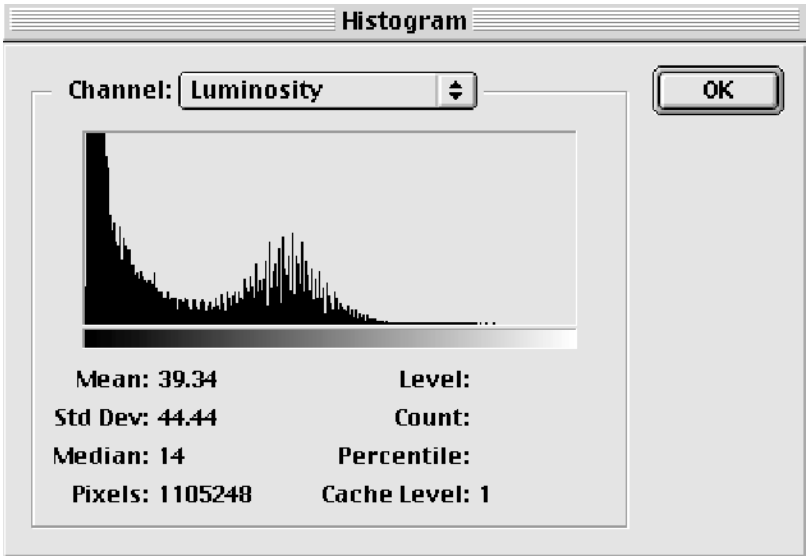
To check on and improve the tonal range your scanner is capturing scan a representative image – one with good blacks and whites with a wide tonal range and skin tones. I use the Kodak IT-8 test target or Kodak Q-60 as seen here.



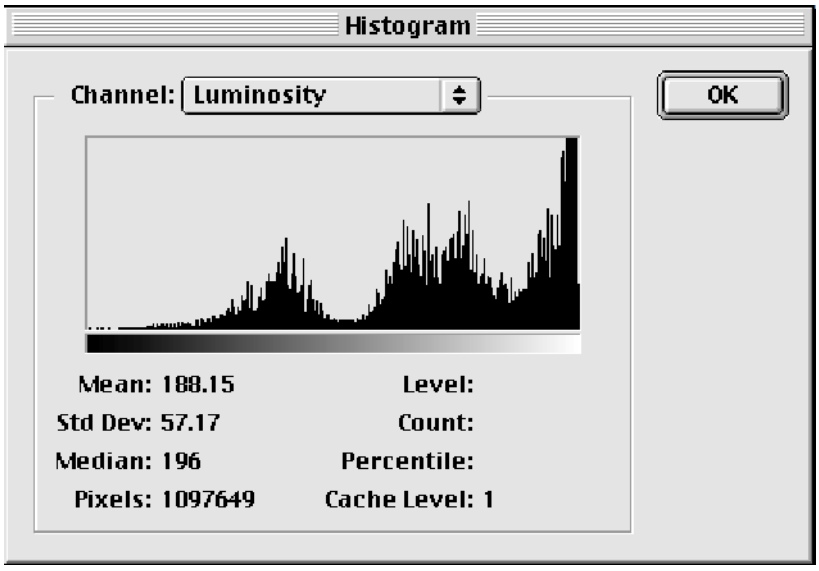
1. Scan the image with the scanner default settings and bring the image into Photoshop.
2. Check the highlights with the Info Palette – are the highlights reading 245, 245, and 245 for an RGB file and 5% for a grayscale file? By keeping the highlights at 245, 245, 245 you are making sure that the highlights don't get clipped and blown-out to pure white.
3. Look at the shadows - are they 5, 5, 5 RGB or 95% black in a grayscale file? Keeping the shadows in the 5, 5, 5 range will keep the shadows from blocking up and printing as pure blobs of black.
4. Look at the image histogram - are values being clipped either to the left or right? In the image seen here the histogram is too biased to the left. A histogram that is

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

severely clipped to the left reveals that dark tonal information is being lost or not captured.



5. Clipping on the right side of the histogram points problems in the highlights as seen below. Also look for white lines or holes in the Histogram indicating that you didn't get 8 good bits of data. Some scanners do apply corrections on the 8 bits after the initial scan so you'll now see those ugly white lines indicating data loss.



6. If you answer yes to any readings in step 2,3, and 4 go back to your scanner software and modify the brightness and/or contrast settings. If the highlights are getting clipped reduce the brightness and if both the highlights and shadows are being clipped reduce the contrast.
7. If the scan is too flat and lacking in contrast boost the scanners contrast setting.
8. Make the same scan and look at the file again. If the image is better use the new brightness and contrast settlings for all of your scans.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Note: It is very easy to add contrast to a digital file and it is impossible to add tonal information that was lost in the scanning process – so when in doubt scan in a little flatter and add contrast as needed in Photoshop.

Your target highlight and shadow values also depend upon your output device. Are you getting the feeling that everything is interrelated? Use the values in Table 8 as a guide to target the highlights and shadow values for generic output devices.

Table 8

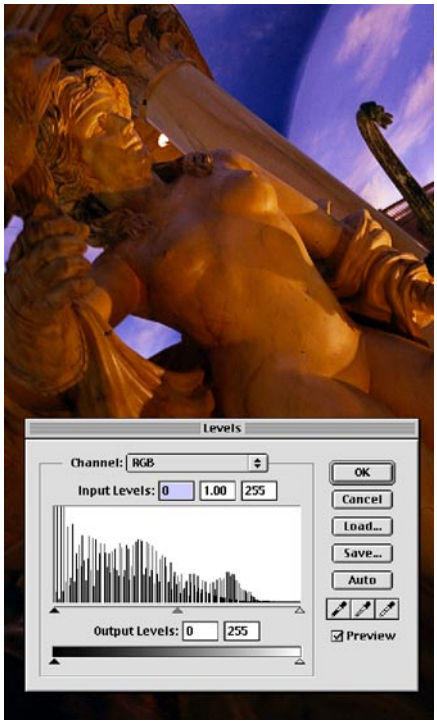
Type of Output	Highlights	Shadows
Inkjet		
Desktop	245-248	5
High-end	248	5
Contone		
Thermal	245	5
Direct Digital	250	5
Film Recorder	250	3
Offset		
Newsprint	30	22
Uncoated	25	230
Coated	12	243

The Histogram

Access the image histogram via the Image menu or by adding a Levels Image Adjustment Layer. The histogram is a bar chart that plots the image values from 0-255. The most important two aspects to keep your eye on are possible clipping above. Secondly, you want to watch out for gross white spikes also called the picket fence effect as seen in figure here with the golden statue image, in which the image originated as a shoddy scan that was taken into Photoshop and had extreme tonal and color corrections applied. The white spikes signify no pixel information and when the file is printed it may posterize.

Tip: For more accurate histograms always view the image's histogram when the image is at 100% image view.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.



This spiked histogram spells trouble. Wherever you see white spikes there is no pixel information.

A solid histogram such as this reveals a scan that has smooth transitions and good tonal information.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Auto Correction and Color Correction

Most scanner software comes with an auto-exposure button that sets the darkest pixel to black and the lightest to white. As most controls with the word 'auto' or magic' in them I remain suspect as to what it is doing and if they are helping or hurting. For example, the scanner may see a piece of dust as the darkest point in the image and set it to black, which could throw off the rest of the scan drastically. Rather than using the auto-exposure button use the black and white eyedroppers in your scanner software to define the area that you want to be white or black. I often use the white paper edge of the print as a white point – since the paper no matter how discolored or stained it is was once white. Better scanners actually allow one to control the clipping of the "Auto" so that you can get those targets mentioned above.

Color Correction in the Scanner

The jury is split as to how much color correction you should do with the scanner software. Half the jury says to get a good tonal scan into Photoshop and then use Photoshop to do the color correction. The other half of the jury says to do as much correction at the scanning stage in order to capture the best information you can. The decision depends on the quality of your scanner software, the size and accuracy of the scanner preview, and whether the scanner software is applying the changes to the high bit depth files versus changing the dumped down 8-bit file.

If your scanner preview is so small or if the image looks different in the scanner software than when you bring it into Photoshop – my advice is to make a good tonal scan and do the color correction in Photoshop. If your scanner software gives you an accurate preview that looks the same once it is in Photoshop then spending some time in the scanner software will save you time later on in Photoshop. I usually make the global tonal and color corrections with the scanner software and then fine-tune the color in Photoshop.

> *Note: Getting a match from scanner to Photoshop requires an ICC savvy scanner since we don't edit in Monitor RGB in Photoshop 5 or 6 which is what most scanners are showing. This insures that the two will not match. For additional information on color management please visit www.digitaldog.net*

Finally, many scanner software interfaces give you the option to sharpen the file – don't. Sharpening is something you want to do after color correction, retouching, and resizing. Additionally Photoshop's Unsharp Mask filter gives you much more control than most scanners sharpening controls.

Third-party Scanning Software

You can often improve a scanner's performance or productivity by investing in a third-party scanning software such as LaserSoft's SilverFast or ScanTastic by Second Glance Software. If you think your scanner is capable of better quality or if you are unhappy with your scanning software then using a third party software application can work wonders. Finally, register your scanner so that the manufacturer can contact you regarding software or firmware (internal scanner software) updates and upgrades. I also make it a habit to check-in to the scanners manufacturers website every few weeks to see if there are software updates, seminars, special offers, or announcements that I can take advantage of to keep my scanner in top shape.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Working with Sensitive Originals

The last thing you want to do when scanning a valuable or sensitive original is to damage it in the process. The factors that can damage the original are mishandling, pressure, long exposure to UV (ultra violet) light, and accidents. Remember no matter how dirty, moldy, torn or damaged the original may be – it still has sentimental value to the family or owner of it.

- No matter how dry your skin is - it contains oils – when handling sensitive film or print originals wear thin white cotton gloves that are commonly available at photo supply stores.
- Like your mother said, "Wash your hands often – especially after eating…and before handling sensitive originals."
- Always handle print originals by the corners and film originals by the edges.
- Let large prints hang down by their natural weight.
- Do not show a large print to someone by holding it in the air. Always lay the print down when looking at it or showing it to someone else. Paper is a sensitive material and once you've crimped it or created those ugly half-moon pressure dings the damage is permanent.
- When scanning thick originals with a flatbed scanner avoid closing the lid down on the original. Some scanners - such as the Umax PowerLook series -allow you to lift the lid off of its hinges to support the scanner lid with for example four 35-mm film cans. You can also remove the lid completely and carefully drape a dark cloth over the object to be scanned.
- When scanning antique books never open the book flat and apply pressure to it. Photograph the pages on a copystand with a large format film or digital camera. Visit www.octava.com to see breath-taking examples of historical books that have been digitized with high-resolution Better Light digital scanning cameras.
- Long exposure to ultra violet can damage the colors in an image. Too avoid this keep the original packaged in archival paper or box. An excellent source for acid-free storage boxes, folders, and interleaving paper is the reseller Light Impressions in Rochester, NY http://www.lightimpressionsdirect.com/

Finally the most irritating kind of damage if the kind you can avoid – accidents, dropping, and misplacement. Treat your client's originals as if they were your own valued family heirlooms. I prefer to scan the originals and return them to the owner as soon as possible. Keep beverages away from your scanning area and originals away from the edges of tables to avoid the possibility of falling. A print that lands on a corner could be permanently

Copyright Issues

The ability to scan practically anything you can see doesn't mean that you should. Please be aware that the artist, photographer, magazine, book publishing company, etc. most likely holds copyright over whatever you see in books, magazines, stock photo catalogues, etc. and you do not have the legal right to copy it. Without getting into a lot of legal mumbo-jumbo I treat someone else's images as I would want my own to be treated. In other words, would you like someone to copy your work and take credit for it? Of course not – so just because you can doesn't mean you should scan everything that comes within reach. Enough said.

For additional information visit http://lcweb.loc.gov/copyright/ or request the Copyright Information Kit for the Visual Artist form the Copyright Office, Library of Congress, Washington DC 20559.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Selecting the Best Original

After the quality of the scanner and your skill in making a scan - the most important element to making a good scan is the quality of the original. Starting with a well exposed, sharp, and clean original can save you hours of retouching. To choose the best originals keep an eye on the print's or film's density, focus, and physical condition. As seen below, I had the opportunity between working with a large, faded print or a smaller print with better color. In many cases starting with a large original is often better – but in this case the smaller original has better color, tone, and doesn't show any fading as the larger print that was in the frame reveals.

Although this original print is larger it is faded and discolored and is not a good choice as a start for an intensive retouching session.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

In this example the smaller print a better original to start with.

To judge a film's density pay attention to the subject matter, tonal character, and exposure, since the subject matter of the photograph will determine the best exposure. For example the best exposure for a moody candle-lit dinner picture will be different than a picture of a wedding photo where the bride is wearing a white dress. Subject matter and exposure determine the tonal character of the image – from high-key to low-key – a good exposure maintains image information where it is needed. See chapter 2 for additional information on histograms and image tonality.

To judge the focus of the film you'll need a light table and an optical loupe, which is nothing more than a strong magnifying glass that you place directly on top of the film to view the film. Choose originals where the main subject is sharp or in focus. If the image is slightly out of focus you may be able to sharpen it a bit but if the image is very soft don't waste your time scanning it in the hope that Photoshop will be able to work magic on it.

Loupe film originals to check for sharpness and damage.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Finally, look at the physical condition of the original - clean is always better. Sadly most dirt, lint, dust, grime, fingerprints, etc. are introduced due to careless handling and storage. Try to remove loose dirt form the film original before scanning since cleaning up a dirty scan before scanning will save you hours of tedious cloning and digital dust-busting.

The primary differences between color slides (also called color reversal) and color negatives are; color slides are positives which look exactly like the real world and they have the greater dynamic range of 3.2-4.0. Additionally, color slides are sensitive to exposure mistakes - if the photographer misses the exposure the entire image may be unusable. Color negatives have wider exposure latitude – meaning the photographer can 'miss' the perfect exposure and still get a very usable image. Color negatives look like orange strips with negative images, they have a dynamic range of 2.7 and due to their wider exposure latitude are most often used by consumers (and photo-journalists who have to work quickly in difficult or uncontrollable lighting situations).

Film Scanners

Just as their name says – film scanners are designed to scan in transmissive film originals – including color slides, color negatives, and black and white negatives. Before you buy a film scanner look at how often and what size of film you'll be scanning. If you only need to scan a film original every once in a while it may be easier to have the scan done at a commercial photo-digital lab or service bureau. The size of the film you plan to regularly scan will also impact your choice of film scanners, since some scanners can only handle 35-mm while others can accept a variety of film sizes.

When shopping for a film scanner you'll immediately notice that the quoted resolutions are much higher than their flatbed counterparts. The desktop film scanners start at approximately 2,000 ppi optical resolution, the Imacon Precision II offers 5760 ppi, and the Linotype-Hell Tango drum scanner captures a staggering 11,000 ppi. These higher resolutions are required since a film original is usually much smaller then the print you'd scan with a flatbed scanner.

The primary types of film scanners include; adding a transparency unit to a flatbed scanner, desktop CCD, desktop professional, and drum scanners.

- [Transparency Units: If you primarily scan print originals yet are required to occasionally scan film then working with a flatbed scanner that accepts a transparency unit may be a viable option. In my experience transparency units do an adequate job on medium (2 1/4-inch) to large format film (4 by 5-inch) but I try to avoid them when scanning 35-mm slides or negatives. The small surface size of 35-mm film is a challenge for any film scanner and many flatbed scanners just do not have adequate resolution to digitize 35-mm originals.
- Desktop CCD scanners: Interestingly enough the major photographic companies all have good 35-mm film scanners on the market including the Nikon Super Coolscan 2000, Olympus ES-10, Minolta Dimâge Scan Speed, Polaroid SprintScan 4000, and Kodak RFS 2035+. The features to look for when deciding which scanner to buy include; optical resolution, dynamic range, scan speed, software interface, scanner bit-depth, connectivity, and that the scanner works with mounted slides and unmounted, uncut negative strips. Some newer film scanners also accept APS film cartridges.
- Desktop Professional: Higher up on the scanner foodchain are the desktop professional scanners such as: the exquisite Imacon Precision II, AgfaScan T5000 Plus, Nikon LS-4500AF, and Polaroid SprintScan 45i. These scanners offer professional performance at a professional price.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

- Drum Scanners are the Rolls Royce of film scanners. Based on PMT (Photo Multiplier Tube) technology these scanners made by Dianippon Screen, Linotype-Hell, and Isomet can set you back well-over $20,000-50,000 and are usually reserved for professional prepress or commercial photographic labs.

The convenience of having a flatbed scanner and a desktop CCD scanner in a retouching studio makes them in integral piece of equipment. Make sure to know the potential and limitations of your scanner to recognize when having a high-resolution scan made by a service bureau that is outfitted with a desktop professional or drum scanner will yield better results.

Film Prescan Preparations

Just like working with the flatbed scanners warming-up a film scanner is a good idea. In the mean time you can use some of the following techniques to prepare the film for scanning;

- Use cotton gloves when handling film originals and always handle the film by the edges.
- Use a soft brush or compressed air to remove debris.
- Be very careful – film has two sides – the shiny side called the base and the duller most important side called the emulsion. If the base is dirty or has fingerprints on it use Kodak Film Cleaner to carefully clean off the dirt. Don't rub too much – fingerprints contain oil and may have permanently altered the color of the original in a fingerprint pattern.
- If the dust is embedded in the film's emulsion (and if you have permission from the film's owner) you may consider soaking the film in 72˚ water for ten minutes. Then adding a tiny drop of Kodak Photo Flo a water softening agent that will cause the water to sheet off of the film's surface. Hang the film by a corner, in a dust-free environment and let it air dry naturally – do not get out the hair dryer.
- If the base of the film is scratched some people recommend filling in the fine scratches with the grease from the side of your nose. I have never achieved anything less than a smeary mess with this technique and cannot recommend it.
- If the film is bent or warped – sandwich it between two protective covers and place an evenly dispersed weight on it for 48-72 hours. This may save you the headache of fixing focus problems caused by curved film.

Making the Scan

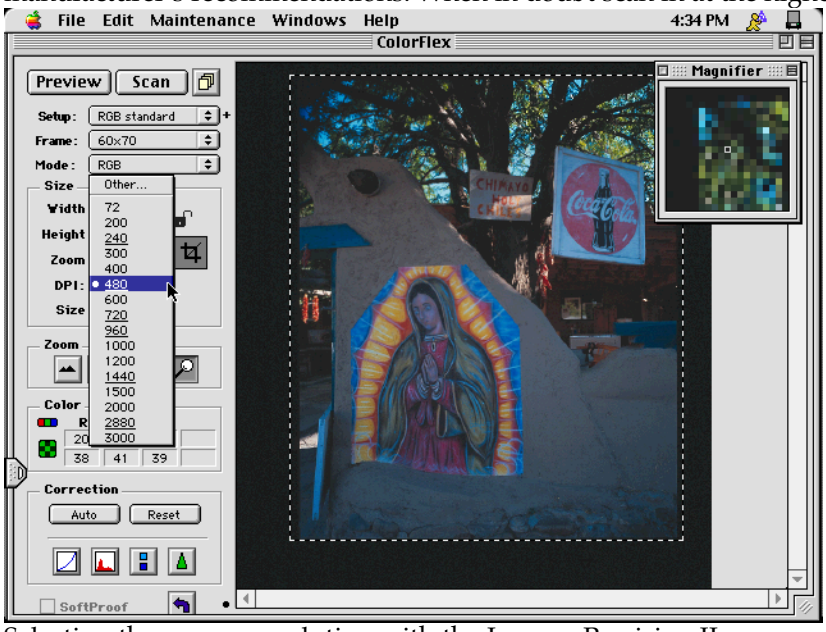
The fundamentals of working with a film scanner or a flatbed scanner are similar – mount the original, preview, set resolution, adjust tone and contrast, finesse the color, and then make the final scan. The primary difference between scanning a print on a flatbed scanner and using a film scanner is that you have to select the type of film in the scanner software.. The scanner software will apply different CLUTs (color look-up tables) and algorithms (mathematical calculations) to the file depending if you're scanning a color slide, color negative, or black and white negative. When scanning a color negative the scanner will automatically invert the image values, compensate for the strong orange mask that all color negs have, and deliver a photographic file with realistic tones and colors.

Basic Film Scanning Process

1. Place the film, be it slides or filmstrips in the appropriate film carrier that came with your scanner. Make sure that the film is as straight as possible and that the dull emulsion side is facing the light source of the scanner.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

2. Launch the scanner software and select the film type that you are scanning.
3. Scan a preview and crop the image as needed.
4. Set the resolution of the scan, keeping in mind to use the optical or an exact increment of it to make the scan. Some scanners show you suggested resolutions that reflect the optical or optimal resolution for that scanner, as seen in the Imacon's interface, in which the optical and therefore suggested resolutions are underlined. Use the manufacturer's recommendations. When in doubt scan in at the higher resolution.



Selecting the proper resolution with the Imacon Precision II scanner software.

5. Use the scanner controls to set the tonal range.Take care of gross colorcasts, after which you may need to tweak the tonal values again.
6. Make the scan and save the file into your scan folder.

Additional Scanning Control

For additional control use the guidelines as described above in the flatbed scanning section. Making sure that the highlights aren't blown out with values over 248, 248, 248 and the shadows don't fall below 5, 5, and 5. I prefer to remove gross colorcasts in the scanning process and use Photoshop to fine-tune the color correction.
When working with color negatives it may be difficult to imagine what the original scene really looked like. In those cases take a few moments to look at the image and use your visual memory to identify colors, subjects, or tones that are recognizable. In most images you'll find a reference to use to make color judgements with. For example; sidewalks are usually gray - giving you a good point to use for a neutral gray point. People's skintones also offer a reference and many times you can find something in a picture that should be white, such as a person's shirt or cloud in the sky.

To Sharpen or not to Sharpen

Most scanner interfaces offer a sharpening component, which I suggest you do not use. Sharpening is best done after color correction, retouching, and resizing in other words fairly late in the image enhancement process. Sharpening the scan in the scanner software may actually introduce problems by accentuating image noise or unwanted details such as dust and scratches.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Additionally, Photoshop's unsharp mask filter offers you much better preview and controls than most scanner interfaces do. Please see Chapter 8to see how to use the unsharp mask filter to make your images appear sharper.

Dust, Mold, and Scratches Disappear

One of the most popular desktop film scanners is the Nikon LS-2000 scanner – it is a straightforward scanner with a creative interface. One of its strongest features is the included hardware software technology called Digital ICE (an acronym for Image Correction and Enhancement) that comes with all Nikon film scanners. Digital ICE adds a fourth pass to the standard RGB scan that is used to calculate and subtract the non-image information (read dust, mold, and scratches) from the file. In the example below, I scanned the same slide with the Nikon scanner – once without Digital ICE and once with it turned on. The image on the left is a straight scan and reveals all of the mold and dust that forty years of being in a shoebox can add to an image. On the right, is the same scan but with Digital ICE.

Straight scan on the left and scan made with Digital ICE on the right. The Digital ICE removed nearly all of the dust and mold that had accumulated on the original film.

Scanning in RGB or Grayscale?

All the originals you scan will not be color images and not all prints you make will be in color. Images made in the 19th and well into the 20th century were all monochrome unless they were hand-colored by the artist. Although some color processes were available in the early 20th century they were very cumbersome. For commercial photographers color was made possible with the advent of Kodak Kodachrome™ film in 1936 and the art of dye transfer prints. For the many photo enthusiasts and happy family snapshooters, color was born in the early 60's with the introduction of the Kodak Instamatic camera and Kodacolor print film. Think back to your own family photos – when did color photos start popping up? For my family – we were black and white people until the mid-60's and then we became colorful when I was given an Instamatic camera that used 126 film cartridges.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

But what does the history of color photography have to do with making a scan? The easy solution would say , "if you want a black and white print from a color original set the scanner to black and white and make the scan." But the testing I've done suggests a different approach. I scan all color and antique originals in color – even if my goal is a black and white print. The advantage to scanning in color is in the results – you get three black and white images (one Red scan, one Blue scan and one Green scan) each with different tonal rendition. I can select, combine, and take advantage of these three black and white images to create the best grayscale file with a wider tonal range and greater emotional impact than a straight black and white scan could ever yield. Interestingly enough, this is especially true of antique and damaged prints that have brown or sepia tones or stains.

By using the techniques described in Chapter 8 to convert a color scan to grayscale you will achieve better black and white images that pop off the page, mimicking the classic black and white darkroom. Additionally all of the true color scans you've already made can be reworked to look like fine black and white photos. Just think of it – when you're out taking pictures you don't need to worry about what kind of film you have in the camera. Go ahead shoot in color, scan in color, and then convert to grayscale with the power and finesse that three channels offer.

Input Alternatives

Digital imaging is very often about problem solving and being a retoucher often challenges us to be especially innovative when working with delicate, small, or rare originals. All of the below-discussed recommendations require that you research the local service providers and test the process through from start to finish.

Copy Negatives

Only too often the only original that a client has is a small, wallet sized picture of a loved one from which they want a large print. Or sometimes the film original is too delicate, torn, or damaged to mount in a film scanner. Consider making or having made a high-quality, large format (4 x 5-inch) film duplicate that you can handle and scan in at will. Think of the copy negative as an 'insurance copy' of the delicate original, which you can then scan just like a standard film original.

Making a good copy negative is much more than taking a snapshot of the original. Good copy work is an artform; requiring consistent, edge to edge lighting, exact focus, the best flat-field quality optics, appropriate use of filters on often both the light source and the camera lens, and exposure and processing that doesn't add too much contrast to the image.

Digital Cameras

The high-resolution digital scanning cameras made by PhaseOne, Kontron, and Better Light can scan 36 to over hundreds of megabytes. In the case of the Better Light Super8K it scans in up to 244 Mb of uninterpolated data or 549Mb of enhanced resolution image data. Scanning cameras are being used in world-class museums to capture and archive sensitive artwork with better color and tonal quality and detail than the best large format film could ever muster.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.

Interpolation Software

When you hit the resolution wall or your scanner just can't squeak out another pixel you may have an additional chance to increase the file size. I would never recommend to interpolate a file up in Photoshop just because the scan was too small – but sometimes when my digital back is against the wall I use a third-party application by LizardTech called Genuine Fractals. This Photoshop plug-in encodes the image with a sophisticated fractal-wavelet algorithm that compresses and encodes a copy of the original file. The next step is to import that proprietary file back into Photoshop through the Genuine Fractal interface. It is here that you can scale the file up and achieve good results. I'm not suggesting that you take all of your tiny web graphics and scale them up – rather I am suggesting looking at the Genuine Fractals as an interesting option when you need to interpolate files up.

Closing Thoughts

Digital imaging is all about relationships – from the quality of the original to the ability of the scanner and skill of the scanner operator – it's all interrelated. So take the time to clean the originals, calculate optimal resolution, push the scanner software, and test, test, test. In the end the time you put into the process will payoff in the quality and beauty of your scans and retouching.

© Katrin Eismann, 2001 www.digitalretouch.org and www.photoshopdiva.com
Document may not be reproduced without prior written permission of author.