An Introduction to the Digital Reproduction of Photographs

CHAPTER 1

OBJECTIVES

After completing this chapter you will be able to:

- explain the sources and attributes of digital photographs.
- explain the methods used to reproduce digital photographs.
- explain the conventions used by professional printers/ publishers to describe halftones.
- use Photoshop's tools to measure halftone dot shape, screen angle, and screen frequency.
- explain the different types of resolution measurements.
- use a step-by-step process to choose the correct dot shape, screen angle, and screen frequency for a given printing process and substrate using a given output device.
- choose the best file format in which to save a given photograph.

Printing and publishing technicians are required to prepare photographs for reproduction so that the printed photographs appear pleasing to the viewer. This is not an easy task. When a photograph is printed, many variables, including the type of printing press, the type of paper, the ink, and even weather conditions combine to alter the appearance of the reproduction. Even if the photograph is to be reproduced by electronic means—on the Internet or CD-ROM, for instance—the viewer's computer and monitor will affect the appearance of the image. If the technician knows in advance the variables that will affect a reproduction, corrections can be built into the photograph so that the reproduction will appear pleasing to the eye. If these corrections are not made, the reproduced photograph will probably look unsightly. In the past, such corrections required the skill of highly talented photographic retouchers who knew all the variables that could affect a printed reproduction. Fortunately, contemporary computers and software make the process easier than it used to be. One software package that can be used to prepare photographs for reproduction is Adobe Photoshop® 4.0. This text will teach you about the variables that affect printed photographs and how Photoshop can be used to account for those variables.

Adobe Photoshop 4.0 is an extremely powerful software package that fulfills the needs of two separate and distinct worlds: that of the graphic designer and that of the professional printer/publisher. The graphic designer utilizes Photoshop's tools to create and manipulate images, while the professional printer/publisher generally uses Photoshop to retouch photographs and prepare them for reproduction using various processes, including conventional printing and, to an increasing extent, electronic distribution. Many textbooks cover in detail how to use Photoshop to create and manipulate images from the graphic designer's perspective. The authors of this textbook assume that you have completed such a course in the basic features of Adobe Photoshop, such as those covered in *Introduction to Photoshop 4.0* by Suzanne Sayegh Thomas, published by Delmar. If you completed the basic course but used Photoshop 3.0, open the contents window for on-line help of Photoshop 4.0, then read the help topic *What's New in 4.0*.

- **tone**
- **color**

NOTE

New terms appear in the text in *italics* and are listed in the left column. Complete definitions can be found in the glossary.

This textbook covers the more advanced topics that involve the use of Photoshop by the professional printer/publisher to prepare photographs for reproduction. The professional printer/publisher is concerned with adapting a photograph to match the requirements of a specified reproduction process, to fulfill the client's requirements, and to improve the photograph's overall appearance. In particular, this textbook will focus on correcting tones and colors. In the context of this book, *tone* refers to the darkness or lightness of areas within a black-and-white photograph. *Color* refers to the hue, saturation, and brightness of colors other than black and white. Chapters 1 and 2 deal with tone correction; Chapters 3 and beyond address color and color correction. Chapter 8 covers other techniques that are useful to professional printers and publishers, such as minor retouching, rotating, scaling, cropping, setting type, and proofing a job. Chapter 9 covers the preparation of photographs for on-line publishing using multimedia or Internet distribution.

Getting Started

NOTE

For Windows Users: Table 1.1 illustrates the PC equivalent of the Macintosh terms that are used throughout this book.

Adobe Photoshop can be used on either the Macintosh or the PC platform. Most current users of Photoshop use the Macintosh version. For the most part, both versions of Photoshop look and act exactly alike. Rather than publishing two separate books, this textbook takes a hybrid approach to the issue of platform preference. Since the majority of current Photoshop users do so on Macintosh computers, the screen shots used throughout the textbook have been captured from the Macintosh version of Photoshop 4.0. The steps can be accomplished using either Macintosh or PC, but where the PC procedures vary significantly, a symbol appears next to those steps that should be followed by PC users. Macintosh users should ignore these procedures. Minor vocabulary differences will not be differentiated (see Table 1.1). To make life complicated for PC users, Photoshop 4.0 can theoretically run on either Windows 3.1 or Windows 95. When necessary, major differences between Windows 3.1 procedures and Windows 95 procedures will also be stated, but the authors assume that most Windows users of Photoshop are running Windows 95.

Table 1.1: Macintosh terms and PC equivalents

Macintosh Term	PC Equivalent
"press" a menu	"click" a menu
pop-up menu	drop-down menu
⌘ key	Ctrl key
option key	Alt key
return key	↵Enter key

NOTE

Macintosh Note: You may wish to write a simple *AppleScript* to perform these steps and save the script file in the Automated Tasks folder in the Apple Menu Items folder.

Whichever version you use, Photoshop keeps track of the settings activated during all work sessions by storing them in its Preferences file. Photoshop's ability to "remember" is great in the real world because it increases the user's productivity, but in the academic world it poses problems. Before opening Photoshop, you should delete the Preferences file so that any settings used previously are deleted. This procedure is especially important if you are working in a laboratory setting in which the computers are used by various students for a variety of tasks. If you are working in a lab, you should erase the Preferences file at the beginning of each work session by following steps 1 through 4 in Exercise 1.1 below *before* you launch Photoshop. If you delete the Preferences file first, Photoshop generates a new one based on the default settings the next time you launch the program. If you are using your own machine, it is not necessary to delete the Preferences each day.

Here's another suggestion: If you are using your own computer, if you are allowed to save files in allocated space on the network or on the hard disk of a computer in a school laboratory, or if your computer is equipped with a removable disk drive such as a Iomega Zip™ or Syquest® drive, do not use floppy disks when completing the exercises and projects in this text. Instead, create a folder named [your name] Photoshop Folder on the disk or server. (**Windows 3.1 user's note:** Your directory names are still limited to eight characters and no spaces.) Inside this new folder, create another folder named Photoshop Files 1 (**Windows 3.1 user's note: Use PSFiles1**). Save all the files that are supposed to be saved on the Photoshop Files 1 disk in this folder. Whenever the text instructs you to prepare a new disk, create a new folder within your Photoshop Folder instead. Save your files in folders named the same as the disks specified in the text so that you can find files when they are requested.

All the student data files in the Photoshop Student Files folder have been locked or saved as read-only so that you cannot accidentally change the original files. You can, however, save a read-only file, along with any changes you make, by choosing Save As from the File menu and giving it a different name.

A final note: This chapter contains a few exercises (Exercises 1.1 through 1.6) that may cover information you already know. We included them for two reasons. First, we'd like you to get in the habit of setting your computer's interface in a certain way so that the image you see on the screen will match what is in the illustrations. Second, there are several new features of Photoshop 4.0 that we wanted to cover in case this book is your first introduction to the upgrade. If you find that you know the information, complete Exercises 1.1 through 1.3, then jump to "Sources of Digital Photographs," on page 19.

Exercise 1.1 Getting Started

In this exercise, you will delete the Adobe Photoshop 4.0 Preferences file, prepare a disk or folder, and launch Photoshop.

1. Turn on your computer. After the machine has started up, locate and open the System folder.

- Turn on your computer. Then, using Microsoft Explorer or Windows File Manager, locate the Photoshop subdirectory within the Adobe directory.

2. Open the Preferences folder, then locate the Adobe Photoshop 4.0 Prefs icon (Figure 1.1).

- Open the Prefs subdirectory, then select Photos40.PSP.

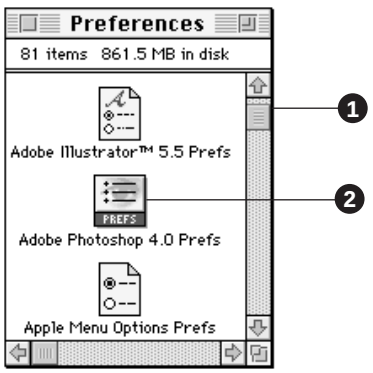


Figure 1.1 The Adobe Photoshop 4.0 Prefs Icon

1. Your Preferences Folder will probably appear different from this one.
2. The Adobe Photoshop 4.0 Prefs icon.

3. Drag the Adobe Photoshop 4.0 Prefs icon to the trash. Then, from the Special menu, choose Empty Trash. When prompted, allow the trash to be emptied.

- Press Delete. When prompted, confirm that you want to delete the file.

4. Close the Preferences and System folders.

- Go to step 5.

5. Place a blank high-density disk in the disk drive. If necessary, format the disk. Name it Photoshop Files 1. Alternatively, create a folder named Photoshop Files 1 on the hard drive, removable drive, or in your allocated space on the network.

- Place a blank high-density disk in the disk drive. If necessary, format the disk. Name it Photoshop Files 1. Alternatively, create a folder named Photoshop Files 1 on the hard drive, removable drive, or in your allocated space on the network. (Windows 3.1 users: You must follow conventional naming procedures. Use PSFiles1.) Close Microsoft Explorer or Windows File Manager.

When you launch Photoshop, the program will create a new Preferences file, based upon the program defaults, and will place it in the Preferences folder.

6. Locate the Adobe Photoshop 4.0 application icon (Figure 1.2). Depending on the configuration of your computer, you may find the icon in the Adobe Photoshop 4.0 folder, in an applications folder, in a window called the Launcher, in the Apple Menu, or in other locations. If you cannot find the Adobe Photoshop 4.0 icon, ask your instructor, lab assistant, trainer, or supervisor for help.

- Click Start, press Programs, then click Adobe from the program list or double-click the Adobe group icon (your computer may have a group called Photoshop instead of Adobe).

NOTE

The screen shown in Figure 1.3 was captured using a 17-inch monitor with an 800 × 600 monitor resolution setting. If you have a larger or smaller monitor, the elements of the Photoshop 4.0 application window may appear either closer together or farther apart. However, if your monitor does not display the same interface elements as shown in Figure 1.3, then you did not erase the Preferences file. From the File menu, choose Quit, then complete steps 1 through 4 in Exercise 1.1.

Figure 1.2
The Adobe Photoshop® 4.0 Application folder

1. The Adobe Photoshop® 4.0 Application icon.
2. Your window may appear different from this one.

7. Double-click the Adobe Photoshop 4.0 application icon (see Figure 1.2).

Launch Adobe Photoshop 4.0.

The program launches and the default application window appears as shown in Figure 1.3 with the application window maximized.

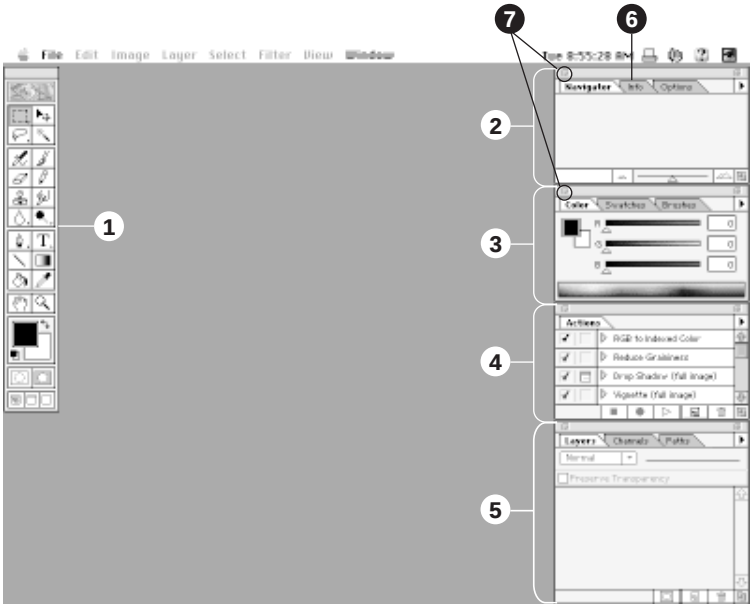


Figure 1.3
The Adobe Photoshop 4.0 default Application window

1. The Tool palette
2. The Navigator/Info/Options palette
3. The Color/Swatches/Brushes palette
4. The Actions palette
5. The Layers/Channels/Paths palette
6. The Info tab
7. Palette close boxes

Exercise 1.2

Adjusting the Application Window

NOTE

If your monitor resolution is not set for at least an 800 × 600 resolution, then the Actions palette may become part of the Layers/Channels/Paths/Actions palette. If this occurs, do *not* remove the Actions tab from the Layers/Channels/Paths/Actions palette.

The default application window is most useful for graphic designers rather than professional printers/publishers. At the beginning of each work session, you will need to change several attributes of this window to make it easier to measure and alter the tones and colors in photographs and to follow along with the figures in the text. You will make these changes in this exercise.

1. Close the Color/Swatches/Brushes palette by clicking the Close box in the upper-left corner of the palette (see Figure 1.3).

Close the Color/Swatches/Brushes palette by clicking the Close box in the upper-right corner.

2. Close the Actions palette (see Figure 1.3). Do *not* close the Layers/Channels/Paths palette or the Navigator/Info/Options palette.
3. Open the Window menu (Figure 1.4). Notice that the items in the menu are preceded by either *show* or *hide*. If an item is preceded by "Show," it is not currently displayed. If it is preceded by "Hide," the item is currently displayed.

   Notice that Color, Swatches, Brushes, and Actions are all preceded by "Show" because you closed those palettes in steps 1 and 2. Also notice that Navigator is preceded by "Hide" because it is currently displayed on the screen. The other windows contained in the Navigator/Info/Options palette are preceded by "Show" because they are not currently displayed. You may display a window by either choosing its name from the Window menu or by clicking its tab on a displayed palette.

Figure 1.4
The Window menu

4. Close the Window menu.
5. Click the Info tab on the Navigator/Info/Options palette (Figure 1.5).

   The Info palette is displayed on the screen.

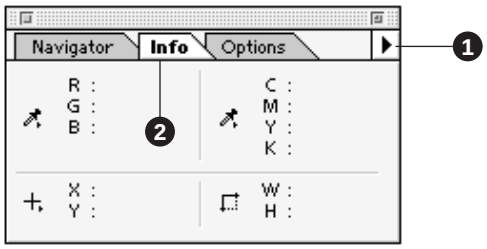


Figure 1.5
The Info palette

1. Info palette menu triangle
2. The Info tab

6. Press the Info palette menu triangle (see Figure 1.5) near the top right corner of the Info palette, then choose Palette Options. The Info Options dialog box appears.
7. In the First Color Readout area of the dialog box, press the Mode pop-up menu, then choose Grayscale (Figure 1.6).

In the First Color Readout section of dialog box, click the Mode drop down arrow, then choose Grayscale. In the Mouse Coordinates section, click the Ruler Units drop down arrow, then choose Inches (Figure 1.6).

Figure 1.6
The First Color Readout displaying the Grayscale mode

8. Click OK. The altered Info palette now appears (Figure 1.7).

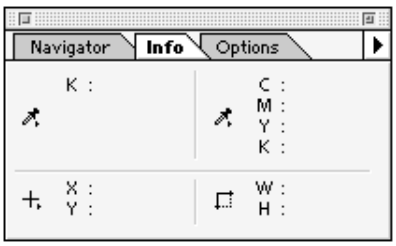


Figure 1.7
The altered Info palette

From now on, while using this textbook, always start each work session with the application window adjusted as instructed in this exercise and shown in Figure 1.8.

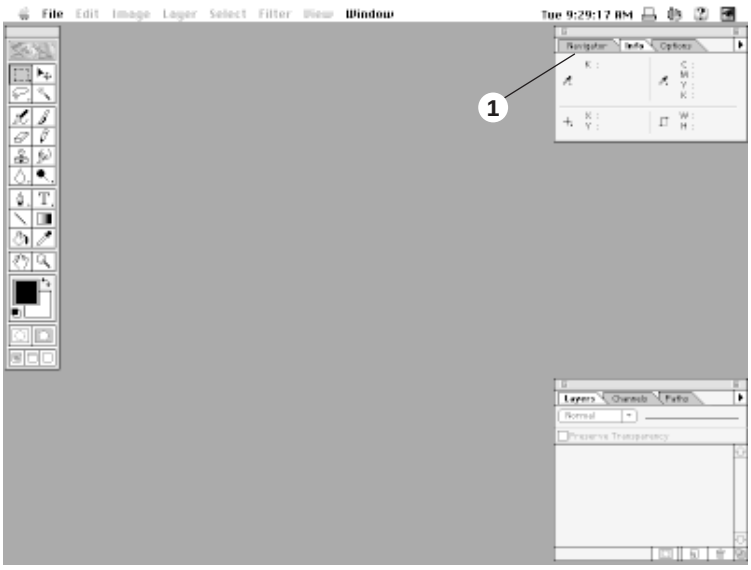


Figure 1.8
The altered application window

1. The Navigator tab

Exercise 1.3 Opening a Document

In this exercise, you will open a previously prepared Photoshop file that you will use during the remaining exercises in this chapter. This file, along with all other files to be used in the exercises from this textbook, are stored in a folder named Photoshop Student Folder. This folder is located on the CD that accompanies the textbook. Alternatively, your facility may have the files stored on the hard disk or on the network. Ask your instructor, trainer, supervisor, or lab assistant for information regarding the location of the student data files.

Photoshop provides you with information regarding the image that will be important to you as you manipulate the image. The size of the file is displayed in the lower left of the window, and you can also display information about the pixel dimensions and resolution of the image. You can also get an idea of how large an image is by displaying the horizontal and vertical rulers after you open the file.

NOTE

Depending on your computer system's configuration, all the colors may disappear from your screen. Don't worry! The file you just opened is a grayscale image of a black-and-white photograph. On some systems, especially those that display only 256 colors, Photoshop turns off the colors on the monitor when a grayscale image is displayed.

1. From the File menu, choose Open. The Open dialog box appears.
2. Navigate to the Photoshop Student Folder containing the student data files located on the CD, the hard disk, or on the network.

   (**Note**: If you cannot find the Photoshop Student Folder, ask your instructor, trainer, lab assistant, or supervisor for help.)
3. Select C1exercise.tiff, then click Open. A message appears stating "C1exercise.tiff is locked, so you will not be able to save any changes." Click OK (Figure 1.9).

Select c1exer.tif, then click Open (Figure 1.9). The Read-Only attribute has been applied to this file so you cannot save this file using the same name.

The photograph opens in its own document window within the application window. The document window is not maximized.

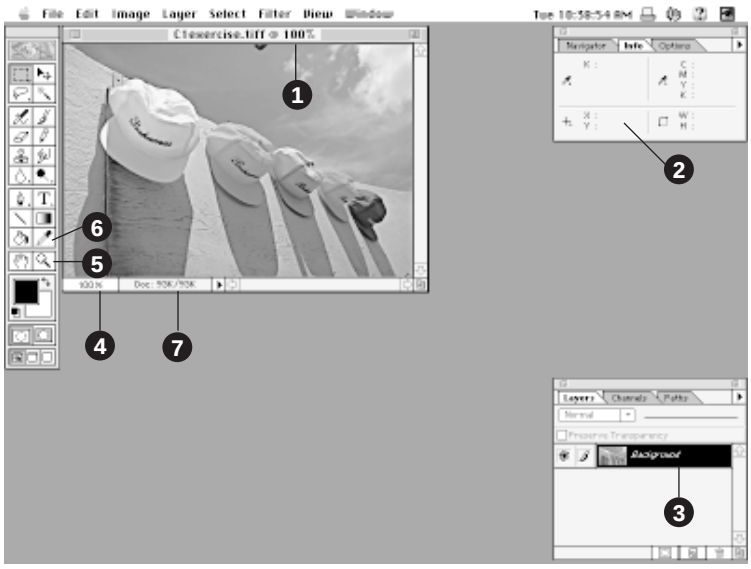


Figure 1.9
The C1exercise.tiff document window opened within the Photoshop application window

1. Magnification in title bar
2. The XY coordinates field
3. Layers in this document
4. Zoom percentage box
5. Zoom tool
6. Eyedropper tool
7. File Size box

4. From the View menu, choose Show Rulers to display horizontal and vertical rulers.

   You should get into the habit of always displaying the rulers whenever you are using Photoshop so that you can quickly note the size of the image on which you are working.

If the image does not open at 100% magnification, then the resolution setting of your monitor may be less than 800 × 600. To continue with the exercises in this chapter, you need to increase the magnification to 100%.

If the magnification percentage of your image is *not* at 100%, then you need *to complete the following steps*. Otherwise, skip to the next section, Understanding Pixel Dimensions, Image Resolution, and Monitor Resolution.

5. Select the Zoom tool, then click the image until the magnification increases to 100%. Scroll bars appear around the image, indicating that not all of the image is visible in the document window.
6. Drag the Size box at the lower right corner of the document window down and to the right until the scroll bars disappear indicating that all of the image is visible.

Move the mouse pointer over the lower right corner of the image until the pointer changes to a double-headed arrow, then drag down and to the right just until the scroll bars disappear indicating that all of the image is visible.

Understanding Pixel Dimensions, Image Resolution, and Monitor Resolution

pixel

Before beginning to manipulate an image, you should learn about the photographic information stored in the image's file. You need to know the file size, the dimensions of the image, and the image's resolution. You can use the features of Photoshop to find out this information.

Pixel Dimensions

The file size of the image is displayed in the File Size box in the lower left of the image window (see Figure 1.9). The width and height dimensions of an image can be described in pixels or inches. Photographic data is stored in a file and displayed on the screen in picture elements or *pixels*, which are tiny spots of color.

Image Resolution

- image resolution
- ppi

Image resolution is the number of pixels in each unit of measurement. Image resolution is usually measured in pixels per inch or *ppi*. To calculate image resolution, you use the following formula:

$$\text{Image resolution} = \frac{\text{number of pixels in width or length}}{\text{width or length in inches}}$$

For example, if an image contains 750 pixels in its width and it is 3 inches wide, its resolution is 250 ppi:

$$\text{Image resolution} = \frac{\text{750 pixels in width}}{\text{3 inches wide}}$$

$$= \text{250 pixels per inch (ppi)}$$

If you already know the image resolution and either the width or length of the image in inches, then you can calculate the width or length in pixels using the following formula:

$$\text{Width or length in pixels} = \text{image resolution} \times \text{length or width in inches}$$

For example, if an image was scanned at 266 ppi and it is 4 inches wide, it is 1,064 pixels wide:

$$\text{Width in pixels} = 266 \times 4$$

$$= 1{,}064$$

You can display the dimensions and resolution of an image, as well as the number of channels saved for the image, by pressing and holding down option, then clicking and holding down the mouse button on the File Size box.

Monitor Resolution

- monitor resolution

Do not confuse image resolution with *monitor resolution*. Monitor resolution is also measured in pixels per inch with typical monitor resolutions ranging from 40 to 90 ppi. The monitor resolution, as well as the monitor setting (640×480, 800×600, and 1020×768) and the monitor size (13", 15", 17", 21") determine the size of the image that is displayed on the screen (Figure 1.10). Figure 1.10 illustrates the effect of monitor size and resolution on an image that is 640×480 pixels.

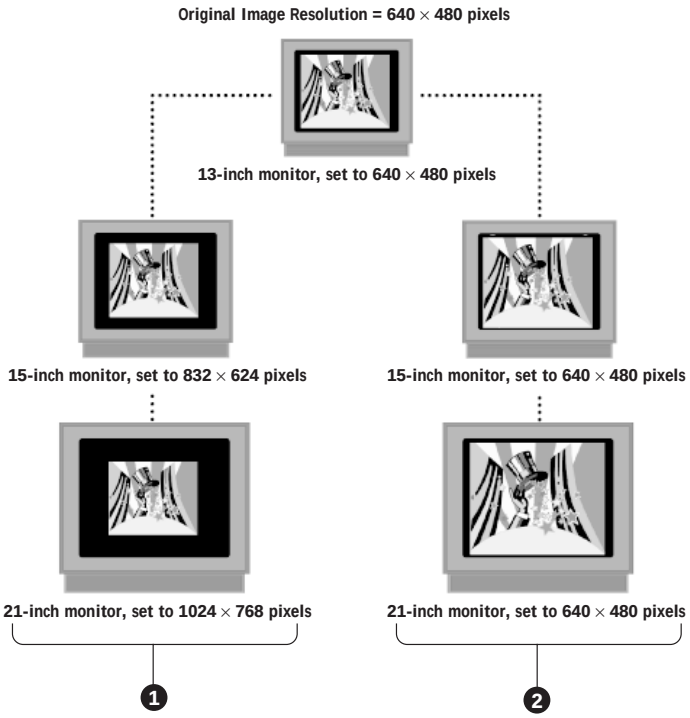


Figure 1.10
Image resolution versus monitor resolution

1. On-screen images appear the same size as the 13-inch monitor at these resolutions.
2. On-screen image appears larger than the 13-inch monitor when these larger monitors are set to the same resolution as the 13-inch monitor.

Exercise 1.4 Examining Pixel Dimensions and Image Resolution

In this exercise, you will use Photoshop's tools to examine pixel dimensions, image resolution, and print size of an open document.

1. Press and hold down option, move the pointer over the File Size box, then press and hold down the mouse button (Figure 1.11). Information about the image dimensions, channel, and image resolution is displayed.

Remember, the Ctrl key is equivalent to the ⌘ key and the Alt key is equivalent to the option key.

Figure 1.11
The expanded File Size box

2. Notice that the divisions on the rulers are not actual size—the distance between 0 and 1 is greater than one inch. The rulers indicate the dimensions of the image as it will print, not the actual size of the image displayed on the screen. Thus, this image will print 3.837" wide even though it appears to be about 5 1/2" wide on the screen.
3. From the View menu, choose Print Size.

   The image displayed on the screen decreases in size to match the actual size it will print. Note that the divisions on the rulers are now displayed at actual size, but the magnification has been reduced.
4. From the View menu, choose Actual Pixels.

   When Actual Pixels is chosen, every pixel in the file is displayed on the screen.

Magnifying a Photograph

NOTE

You can engage the Zoom tool temporarily no matter which tool is selected by pressing ⌘ + spacebar to zoom in or by pressing option + spacebar to zoom out, then clicking the part of the image you want to magnify or reduce.

You will often need to magnify or reduce an image when manipulating it. The magnification percentage of an image is shown in the title bar next to the file name after the @ symbol and in the Zoom Percentage box. To "zoom in" increases the magnification of the image; to "zoom out" reduces the magnification of the image. The maximum magnification is 1,600% of the original image view.

If the magnification reads "@ 100%," then all the pixels in the file are displayed on the screen. This is known as same-size magnification. Note that an image displayed at 100% will probably not print the same size as it appears on the screen due to resolution factors that will be discussed later.

NOTE

The monitor resolution for all screen captures for this textbook was set at 800 × 600. If your monitor is set for a different resolution, then your screen will not appear exactly as the figures in the textbook. Ask your instructor, trainer, supervisor, or lab assistant to show you how to adjust the monitor resolution.

To make an image larger than 100%, Photoshop temporarily makes and displays copies of pixels that exist in the file. The result is a pixelized or stair-stepped image. For example, if the magnification reads 200%, the image would be magnified twice as large as its actual size—two pixels are displayed for each pixel in the file. If the magnification reads 50%, the image would be displayed at one-half its actual size—one pixel would be displayed for every two in the file. In other words, you are not changing the actual dimensions of a photograph when you change its magnification on-screen; magnification is a tool that makes it easier for you to work on a photograph.

You can change the magnification of a photograph by using the Zoom tool, the View menu, the Zoom Percentage box, keyboard shortcuts, or the Navigator palette. You can quickly return to 100% view by double-clicking the Zoom tool or by choosing Actual Pixels from either the View menu or the Options palette of the Zoom tool.

To zoom in on a particular area of the image, select the Zoom tool in the Tool palette then drag a marquee around the area you wish to enlarge. The area within the marquee will be enlarged to fill the document window.

Exercise 1.5

Changing Magnification

In this exercise, you will use the Zoom tool, the View menu commands, shortcut keys, and the Options palette for the Zoom tool to change the magnification of the photograph.

1. If necessary, click the Zoom tool (or type Z) to select the Zoom tool, then move the mouse pointer over the B in Bahamas in the first hat. The mouse pointer changes to the Zoom In pointer.
2. Click the mouse button three times. The image increases to 400% and the area under the pointer is moved toward the center of the window.

   Note the pixelization in the enlarged image.
3. Double-click the Zoom tool. The image returns to 100% magnification.
4. From the View menu, choose Zoom Out. The image reduces to 66.7%.

5. From the View menu, choose Actual Pixels. The image returns to 100% magnification. Macintosh users: click the Zoom box in the title bar to enlarge the document window to match the size of the photograph.
6. Drag across 100 in the View Percentage Box, type "300", then press return.
7. With the Zoom tool still selected, click the Options tab of the Navigator/Info/Options palette. The Options palette for the Zoom tool appears.
8. Click Actual Pixels. The image returns to 100% magnification.
9. Click the Info tab on the Navigator/Info/Options palette, then select the Zoom tool, if necessary. Move the Zoom In pointer over the image to the area near the top left corner of the left hat. On the Info palette, the XY coordinates field should read approximately X: 0.30 and Y: 0.30 (see Figure 1.9 for the location of the XY coordinates field).
10. Press the mouse button, then drag down and to the right until the XY coordinates read approximately X: 1.50 and Y: 1.50. A marquee enclosing the image within the area appears. Release the mouse button. The image inside the marquee is enlarged to fill the document window.
11. From the View menu, choose Actual Pixels to display the image at 100%.

    Note that the Zoom Percentage box now reads 100%. All the pixels in the file are once again displayed.

Exercise 1.6 Using the Navigator Palette

The Navigator palette is a new feature of Photoshop 4.0. You can use it to change the magnification of the image and to choose just that portion of the image you wish to view. Figure 1.12 displays the Navigator window with its elements labeled. The Zoom Percentage box in the lower left corner of the Navigator window reads the same as the size displayed in the Zoom Percentage box of the document window. Also notice the frame that surrounds the image in the Navigator window. The red frame indicates the Proxy Preview Area or the area that is displayed in the

document window. You can change the magnification of the image by clicking the Zoom In or Zoom Out buttons, dragging the Zoom slider at the bottom of the window, or by entering the magnification percentage in the Zoom Percentage box, then pressing Return.

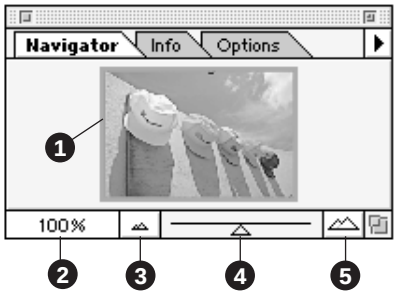


Figure 1.12
The Navigator window

1. Red frame around image
2. Zoom percentage box
3. Zoom out button
4. Navigator slider
5. Zoom in button

1. Click the Navigator tab on the Navigator/Info/Options palette to display the Navigator window. Alternatively, you can choose Show Navigator from the Window menu. The Navigator window appears on the top of the Navigator/Info/Options palette (see Figure 1.12).
2. Move the pointer over the Navigator slider (see Figure 1.12), press the mouse button, then drag the slider to the right until the Zoom Percentage box reads about 150% (you probably will not be able to stop at exactly 150%). Then, release the mouse button.

   Notice that the image has been enlarged and that the red frame now indicates that only part of the image is being displayed in the document window.
3. Move the pointer anywhere over the area enclosed by the red frame. Press the mouse button and drag the red frame to the lower right corner of the Proxy Preview area.

   Notice that the area enclosed by the red frame is displayed in the document window.
4. Click the Zoom Out button (see Figure 1.12) until the Zoom Percentage box reads 100%.
5. Drag across the 100 in the Zoom Percentage box of the Navigator palette, type 67, then press Return. The image changes to 67%.

To keep the Zoom Percentage box highlighted, hold down shift as you press Return.

6. Drag across the 67 in the Zoom Percentage box, type "125", press and hold down shift, then press Return. The image size changes and the Zoom Percentage box remains highlighted.
7. Type "100", then press Return. The image returns to 100% magnification, and the Zoom Percentage box is no longer highlighted.
8. Click the Info tab.

Sources of Digital Photographs

halftoning

Once a photograph is digitized (converted into a binary language composed of only ones and zeros), Photoshop does not care where the original photograph came from. The professional printer/publisher, however, must be concerned about the source of the image because the digitization process imposes limits on the final printed size and quality of the reproduction.

Most printed photographs have been converted into tiny dots through a process called *halftoning*. Halftoning is the process in which an image composed of many shades is broken down into tiny dots of varying size (Figure 1.13). For instance, to reproduce a black-and-white photograph, you would vary the size of the black dot so that more or less of the white paper will show through. Bigger black halftone dots that allow less of the white paper to show through are used to create a darker gray, and smaller black halftone dots that allow more of the white paper to show through are used to create a lighter gray. Thus, black-and-white photographs printed using halftone dots do not require many shades of gray ink to be printed to reproduce the tones in the original—only black ink on white paper is needed (see Figure 1.13). Color photographs printed using halftone dots require only four colors of ink—cyan, magenta, yellow, and black—on white paper (see Chapter 3).

NOTE

If black-and-white or color photographs are printed on colored paper, the printed reproduction will not resemble the original. In particular, printing color photographs on colored paper results in a shift of the color balance in the image toward the color of the paper. For example, if a color photograph is printed on green paper, all the colors in the image will be skewed toward green.

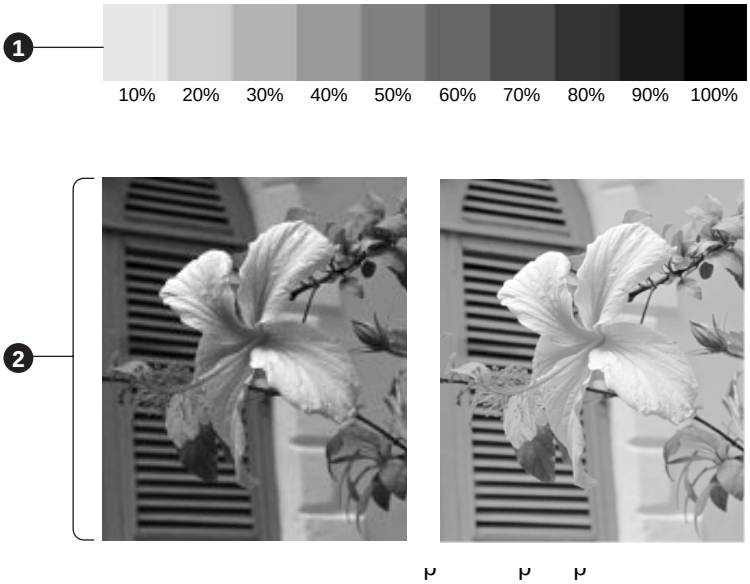


Figure 1.13
Halftone dots

1. Relative size of halftone dots. Dots are oversized so they can be seen.
2. Black-and-white photograph reproduced using halftone dots. Left example has oversized dots so they can be seen. Right example has normal-sized dots that are almost invisible.

Stock Photo CDs

- stock photos
- compact disk (CD-ROM)

Perhaps the easiest way to obtain high-quality images is to purchase compact disks (CD-ROMs) that contain digitized versions of professionally captured photographs. Commercially available photographs—called *stock photos*—can often fulfill a publication's requirements without the need to hire a professional photographer. Stock photo CD-ROMs are readily available from computer mail-order stores and offer a vast library of photographs for a low per-image cost. The photographs are stored digitally on the CD-ROM in files that can be opened by Photoshop. You are generally granted a license to print the photographs in your publications. However, you are usually not granted permission to alter the photographs or to give the electronic files to others.

Scanning Continuous-Tone Images

- continuous tone

Even though stock photographs on CD-ROM are useful, publications often require a particular image that is not commercially available for sale. In this case, a photographer is hired to capture the necessary images. Most photographs are created by a photographer capturing a scene using a camera. Light is reflected from the scene and recorded in the camera on a light-sensitive material called film. The film may be able to record colors, or it may capture only black-and-white images. In either case, the film is removed from the camera and developed using chemicals.

The image formed on the film is almost always a *continuous tone* image—that is, it is composed of an infinite number of shades of color or gray that appear to the naked eye to be seamlessly smooth.

If you like to think using computer terminology, a continuous tone photograph is an analog reproduction that consists of an uninterrupted range of shades of color or gray. Conversely, every photograph that appears on a computer or television monitor has been digitized or broken into separate pixels. Continuous tone films can either be used as is, in the case of transparencies (slides), or photographically printed onto paper, in the case of photographic prints. Some continuous tone images are currently being digitized and stored on CD-ROMs like the stock photos mentioned earlier.

Photographers will most likely provide you with continuous tone images—either photographic prints or transparencies—that must be transformed into a digital image using a scanner before printing. A scanner is somewhat like a copy machine, except that a scanner copies an original into a computer file instead of onto paper. Scanned photographs are saved as digital files on disk and can be opened using Photoshop. Only continuous tone photographs should be scanned. In most cases, scans of previously printed halftones do not produce acceptable results because the original is already a halftone (see Figure 1.21).

To make a scan, an original photograph or transparency is loaded into the scanner and the scanner takes a series of tiny "pictures" of the original. These tiny pictures, called image pixels to distinguish them from screen pixels, record the color or shade of each individual spot. If the original is a black-and-white photograph, each point is recorded using a scale from 0 to 255 (0 is equivalent to black and 255 is equivalent to white). If the original is a color photograph, each point is recorded three times—once each for red, green, and blue—using a scale from 0 to 255 (0 is equivalent to black and 255 is equivalent to the pure color in question: red, green, or blue).

Scanner resolution is rated by the number of pixels per linear inch (ppi). For example, some scanners have 1,200 ppi. More expensive scanners can usually scan at a higher resolution than less expensive ones.

Types of Scanners

Scanners that can only digitize black-and-white images are known as grayscale scanners. Grayscale scanners are often called 8-bit scanners

because they are capable of sensing 2^8, or 256, shades of gray. Color scanners can usually sense 256 shades each of red, green, and blue. Thus they are known as 24-bit scanners because they can sense 2^{24} ($2^8 \times 2^8 \times 2^8$), or 16.7 million colors. Color scanners can scan black-and-white photographs. However, grayscale scanners cannot make color scans of color originals.

Categories of Scanners

- drum scanner
- desktop scanner
- midrange scanner
- photomultiplier tube
- CCD (Charged Coupled Device)

Many different models and brands of scanners are available in a wide price range. There are three categories of scanners: *drum* or *high-end* scanners, *desktop* scanners, and *midrange* scanners. Drum scanners produce the best images, scan color or black-and-white originals at high resolution, capture images with high quality and expensive *photomultiplier tubes*, usually use transparencies as originals, and cost in excess of $100,000. Desktop scanners provide the lowest quality, scan at relatively low resolution, capture images using low quality and inexpensive light sensitive *CCDs* (Charged Coupled Devices), usually use photographic prints as originals, and cost as little as $500. Some desktop scanners can scan only black-and-white originals, while others can scan both color and black-and-white. Midrange scanners use the high-end photomultiplier tube technology but have fewer "bells and whistles" and cost less than high-end scanners. The quality afforded by various machines is usually a function of the price of the scanner. More expensive scanners can usually scan at a higher resolution than less expensive ones. Desktop scanners should be able to scan at least 600 × 1,200 ppi. For quality work, avoid inexpensive desktop scanners that can provide less than 600 × 1,200 ppi scans.

Cropping and Scaling Photographs

- cropping

Before scanning a photograph, you must know the portion of the photograph to be used and its final size. First, you must know which part of the photograph is important to the publication being created. Extraneous images that may confuse the reader should be eliminated. For example, you may have a picture of a woman and her dog. If the publication contains a story about the woman—but not the dog—only the part of the photo that contains the woman's image should be used. The dog's image is extraneous. The process of choosing which portion of a photo to use is called *cropping*. Small crop marks on the edges of a

photo show how the photo should be cropped (Figure 1.14). Cropping decisions, which are usually determined by the graphic designer, should always be made before scanning because scanned photographs consume a tremendous amount of disk space. An uncropped photograph will result in a large file that will take longer to process in Photoshop than a well-cropped image. Therefore, scanning uncropped photographs wastes time and valuable disk space.

Figure 1.14
A photograph with crop marks indicated

1. Crop marks

After a photograph has been cropped, you must know what its final size will be, based on the amount of space available in the document. It is best to reproduce a photograph either the same size as or smaller than the original. If you enlarge a photograph, its imperfections become more pronounced. When you change the size of a photograph during scanning, both the height and the width change proportionally. You must know which dimension of the photograph—width or height—is more important to the document's design, then measure the distance between the relevant crop marks on the photograph. A proportional wheel or simple mathematical formula is used to calculate the reproduction percent, or scaling, required to scan your photograph at the desired size. The formula is:

$$\text{reproduction \%} = \frac{\text{reproduction size}}{\text{original size}} \times 100$$

For example, if the original is 5 inches wide and the reproduction is to be 3 inches wide, the reproduction percent is 60%:

$$\text{reproduction \%} = \frac{3}{5} \times 100$$
$$= .6 \times 100$$
$$= 60\%$$

Basic Desktop Scanner Settings

Software programs that operate desktop scanners vary greatly. Some have only a few minor adjustments that you can make; others are more complex. However, there are certain basic settings that must be made for any scanner. These include type of reproduction, image resolution, reproduction percent (also called scaling), cropping, and contrast control. Even though these functions appear in virtually every scanner program, they may be called by different names.

Type of Reproduction

line art

Most scanners can scan both line art and black-and-white continuous tone photographs. Some can also scan color continuous tone photos. *Line art* is a term referring to drawings—such as a page from a coloring book or a black-and-white cartoon—that are reproduced with only one solid color of ink. Black-and-white continuous tone photographs are printed with varying sizes of halftone dots. If you were to scan a black-and-white continuous tone photograph using the line art setting on a scanner, the photograph would be reproduced without halftone dots and would consist of large areas of solid black or solid white. Such a reproduction would look similar to the result that occurs when you make a copy of a photograph using a copy machine. If you want a black-and-white photograph reproduced using varying shades of gray, you should use your scanner's grayscale setting. If you have a color scanner and a color original, you can choose either the color or the grayscale setting. If you are preparing a single-color document, scan the color photograph using the color setting, then transform it into a grayscale image later using Photoshop.

Image Resolution

After you set the type of reproduction, you must set the image resolution in ppi. A line art image should be scanned at the same resolution as the laser printer on which it will be output (300 ppi for a 300 dpi printer, 600 ppi for a 600 dpi printer, and so on). Line art images to be

NOTE

A more comprehensive discussion of image resolution for grayscale and color images is given later in the section "LPI (Screen Frequency) and Image Resolution" on page 44.

reproduced using an imagesetter should generally be scanned at approximately 1,000 ppi.

Color and grayscale images should generally be scanned at approximately 150 to 300 ppi. It is *extremely* important that the resolution of color and grayscale images be properly set. Figure 1.15 illustrates the effect of low-resolution and high-resolution scans. Notice the stair-step pixelization that appears in the image on the left.

Low Resolution Scan **High Resolution Scan**

Figure 1.15
Low versus high resolution scans

Contrast Control

Most scanner software programs provide an automatic contrast control function. This setting instructs the scanner and software to reproduce the original as accurately as possible. Unless there is a specific reason, it is best to use the automatic contrast control because you can alter a photograph's contrast later with Photoshop.

File Format

A final consideration when scanning photographs is to determine the type of file you wish your scanner to produce. Typically, it is best to choose TIFF (Tagged Image File Format) when you first scan an image because it is one of the most common and versatile formats. If necessary, you can save the image using a different file format after you manipulate it in Photoshop. See the section about file formats later in this chapter for additional information.

When scanning photographs, you must always choose between high image resolution (resulting in large files) and small file size (due to low image resolution). Increasing image resolution increases file size, which increases the disk space required to hold the file and the time required to manipulate and print the photograph. Decreasing image resolution

decreases file size but also decreases the clarity and detail of the printed halftone.

If the image resolution of a scanned photograph is too low, the final printed size of the photograph will be small. Many photographs, including most of those downloaded from the Internet, have low image resolutions. In fact, many photographs available on the Internet will be less than one inch wide when printed! If you attempt to print such photographs at larger sizes, the result will be a blurry, pixelized image.

Other Digitizing Methods

In addition to scanning, an image can be digitized through three other contemporary technologies:

Kodak Photo CD™

- The photographer can take the film to a processing service that produces *Kodak Photo CDs*™. The film is sent to a special laboratory, processed normally, and photographic prints are made. In addition, a special scanning device digitizes the images and encodes them onto a Photo CD. These Photo CDs can be read by Photoshop using a CD-ROM drive.
- The photographer can use a digital camera instead of a conventional camera. The camera automatically digitizes the image and records it to memory or directly to a computer's hard disk. The images captured by these cameras are *not* continuous tone images because they are composed of individual pixels rather than varying shades and colors. Digitally stored photographs can be transferred to your hard disk, ready to be opened by Photoshop. Digital cameras range in price from about $200 for a low-resolution handheld model, to tens of thousands of dollars for a high-resolution studio model. Handheld digital cameras sold for consumer use currently produce images with up to about 750 × 500 pixels. An image of this size is acceptable for viewing on a computer screen, but would only yield a printed image measuring about 3" × 2". High-resolution digital studio cameras currently produce images with high enough resolution to print images in excess of 8" × 10". These cameras are being widely used for catalog work. Even though digital cameras are, at present, too expensive or too limited, it is widely predicted that technological improvements to these cameras will render film-based photography obsolete.

- You can capture frames from a videotape if you have a special video-capture board in your computer. Unfortunately, the image resolution of video images is so low that such images can only be reproduced at very small sizes.

Reproducing Digital Photographs

In addition to understanding the significance of the source of the digitized image, the professional printer/publisher must have an understanding of the different methods that can be utilized to reproduce the digitized image on paper or other material.

Reproduction Methods

When beginning to prepare an image for reproduction, it is important to begin at the end. That is, you must consider the method that will be used to reproduce the final image. Today, an image can be reproduced in many ways. For example, you can print copies of an image on your own black-and-white or color laser printer and make additional copies on a black-and-white or color copy machine. If you need many copies, or if you would like your copies to look better than those made on a copy machine, you can send your digital files to a professional printing company for reproduction. The printing firm will use your file to print copies using various printing processes, such as offset lithography, gravure, screen printing, or flexography.

Several procedures, typically referred to as "prepress" processes, are usually necessary to prepare your file for printing. These processes generally include preflighting, preproofing, imagesetting, film assembly, contract proofing, and platemaking (all of these processes will be explained as you work your way through this book).

It is important to note that corrections can be made to the job during the entire prepress process—however, such changes do come at a price! In general, the farther a job has progressed in the prepress process, the more expensive a change will be. However, the bottom line is that if your file contains errors, changes *can* be made before printing commences.

New Printing Technologies

New printing technologies are decreasing the number of steps between the creation of a file and its reproduction. For example, the

Heidelberg GTO-DI and Quickmaster offset lithographic presses prepare the printing plates directly from a digital file *while the press is running.* The technology employed by these machines eliminates most traditional prepress activities. Therefore, *there are few opportunities to correct errors.* Simply stated, the file must be correct the first time! Consequently, the person who creates a file to be reproduced using one of these machines must possess a high degree of skill and knowledge to patiently build into the file *all* the attributes it needs to print well.

On-Demand Printing

on-demand printing

Contemporary technologies also allow you to merge the convenience of the copy machine with nearly the quality of conventional printing processes. New machines, with names such as Xerox Docutech, Xerox Docucolor, Indigo E-Print, Xeikon, and Agfa Chromapress, can print beautiful images *on-demand*—that is, as many or as few copies as you want whenever you want them. The Docutech prints only black and white, but the Docucolor, Indigo, Xeikon, and Chromapress print in full color.

Features of Contemporary Printing Machines

There are two important distinctions that should be made about contemporary printing machines: 1) Is the machine toner- or ink-based?; and 2) Does the machine deal with variable or constant data? Traditional printing presses, the Heidelberg GTO-DI and Quickmaster presses, and the Indigo E-Print use ink. The resulting images look and behave like traditionally printed products. The Xerox Docutech and Docucolor, Xeikon, and Agfa Chromapress machines print using toner. Toner-based images look and behave like copy-machine copies.

To illustrate the difference between variable and constant data output, consider an order for a thousand copies of a color flier. Traditional printing presses and the Heidelberg GTO and Quickmaster presses print from a plate that contains an image that remains constant throughout the press run. These presses would print a thousand copies of the exact same flier. The Xerox Docutech, Docucolor, Indigo E-Print, Xeikon, and Agfa Chromapress machines can all produce documents that contain variable data—every sheet that is printed *can* have different content. An example of the use of variable data would be to print a *different* color photograph and recipient's name on *each* flier. In essence, the press would print one copy each of a thousand different fliers.

Common reproduction processes, their characteristics, and common products are described in Table 1.2.

Table 1.2 Common printing processes

Process	Characteristics	Products
Offset lithography/ Waterless lithography	Provides excellent quality and high resolution for photographs and text. Most offset lithography is currently done using the conventional lithographic process that requires the use of water as well as ink. Waterless lithography, a relatively new and growing type of lithography, uses no water. It can print better-looking images than conventional lithography.	Most printed products: newsletters, annual reports, books, many magazines, brochures, etc.
Flexography	Every image has a slight halo around its perimeter. Reproduction quality of photographs is not as high as offset lithography.	Most packaging, from cereal boxes to candy wrappers and frozen food wrappers, is printed using flexography.
Gravure	Every image, including text, is created using small dots. The process can produce very good quality photographic reproductions, especially if quality paper is used.	Extremely long-run editions (millions of copies). Direct mail catalogs, such as those distributed by Sears and J. C. Penney, are often printed using gravure. *National Geographic* is printed with the gravure process.
Screen printing	Capable of applying the thickest layer of ink of any printing process. Can print on odd-shaped objects and materials that are difficult to print using other processes, such as glass bottles and T-shirts.	Short runs, difficult to print materials (such as textiles), T-shirts, billboards, convenience-store signs, point of purchase displays, and printed circuit boards.
On-demand printing	Any printing process that allows you to make only as many copies as you need whenever you need them. Examples include personal laser printers, copy machines, and new machines such as the Xeikon, Docutech, Indigo, and Chromapress.	Short runs of many types of documents, including business forms, personalized letters, and memos.

Halftoning

One of the most important characteristics of practically any commonly used printing process is the simple fact that a press can print only one color at a time—it can print a color of ink or leave the paper blank. If you consider the fact that your computer monitor can probably display up to 16.7 million colors, then you can imagine how long it would take for a printing press to print those millions of colors one at a time. Fortunately, professional printers can do magic! Using a process called halftoning, the eye can be fooled into thinking that a single color of ink has hundreds of different shades. Halftoning is the process in which an image composed of many shades or colors is broken down into tiny dots of varying size. Small dots are used to represent light areas, while dark areas are composed of large dots (refer to Figure 1.13)

In the past, service providers traditionally performed halftoning photographically through the use of a halftone screen. Today, however, most halftones are made electronically. The file of an image, created by scanning an original photograph or from a Photo CD, is then opened using an image-editing program such as Adobe Photoshop or a page layout program such as QuarkXPress. Using information provided by the laser printer's or imagesetter's printer description file, the image-alteration or page layout software transforms the digital image into a halftone.

halftone cell

Traditionally, halftones made photographically with a halftone screen contained a virtually unlimited number of different sizes of halftone dots. Today, however, digital halftones output on laser printers and imagesetters cannot provide an unlimited number of halftone dot sizes. Laser printers and imagesetters can leave the paper or film blank or can create various sizes of halftone dots using adjoining *same sized* printer dots. To create various sizes of halftone dots, the printer or imagesetter must use groups of printer dots—known as *halftone cells*. Each halftone cell is composed of individual printer dots. Halftone cells with few black printer dots appear white to medium gray. Halftone cells with more black printer dots appear dark gray or black. In Figure 1.16, the halftone cells contain 64 printer dots, making them capable of representing sixty-four different shades of gray.

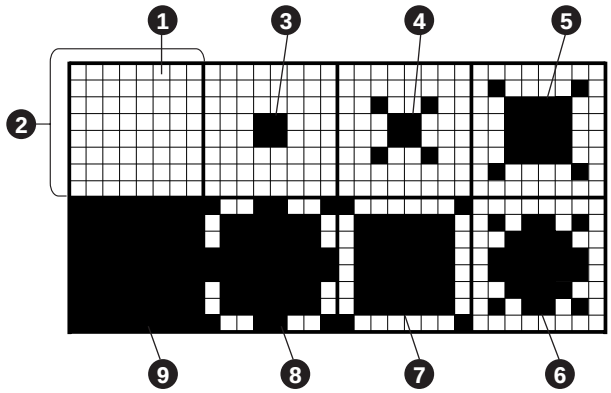


Figure 1.16
Eight different halftone dot cells

1. One printer dot
2. One halftone cell This cell has no black dots and prints white.
3. Light gray
4. Light medium gray
5. Medium gray
6. Medium gray
7. Medium dark gray
8. Dark gray
9. No white dots = black

Halftone Conventions

During the decades that traditional halftone screens were used, techniques were learned and conventions were adopted for working with photographs. In particular, these conventions, or attributes, include the dot percent size, screen frequency or screen ruling, the screen angle, and the dot shape. These halftone conventions are summarized in Table 1.3 and explained in the following.

Table 1.3 A summary of halftone conventions

Convention	Meaning
Dot percent size	The percentage of the paper covered by dots of a given size. A 50 percent dot covers 50 percent of the paper and leaves the other 50 percent blank.
Screen frequency (screen ruling)	Number of dots per linear inch (lpi). Number of rows of halftone dots in a linear inch. The higher the lpi, the smaller the dots and the better the halftone will look. High lpi halftones require more careful adjustment of the printing press than low lpi halftones–leading to potentially higher printing costs. High lpi halftone files are large and take longer to process and output compared to low lpi halftone files.
Screen angle	The angle at which the rows of dots are aligned. Rows of dots used to print black-and-white photographs are usually aligned at 45° because that is the angle that the dots are least noticeable. Each color of a multicolor reproduction must be printed at a different angle to prevent the formation of an undesirable pattern called moiré (see Figure 1.21). Traditionally, printers used the following screen angles: 15° , 45° , 75° , and 90° (see Figure 1.20). Modern output devices like imagesetters and scanners use screen angles similar to these.
Dot shape	Individual dots may be round, diamond-shaped, square, or elliptical (football-shaped). Alternatively, halftones can be made using straight or wavy lines, patterns, or circles instead of dots.

Photoshop has several tools and dialog boxes that you can use to examine and manipulate the attributes of a digital halftone. You can use the Eyedropper tool and the Halftone Dot Percentage field (K field) in the Info palette to check the halftone dot size that Photoshop will use to reproduce a particular point. You can set the halftone screen frequency, angle, and shape in the Halftone Screen dialog box. The Halftone Screen dialog box (see Figure 1.19) allows you to let your laser printer or imagesetter determine how best to handle the halftoning process; or you may input your own values for lpi, screen angle, and dot shape. Using the Halftone Screen dialog box to set digital halftone attributes assumes that you are going to print documents directly from Photoshop. However, it is more common for photographs to be printed from within page layout programs, such as Adobe PageMaker® or QuarkXPress®, which also allow you to specify the screens that will be used to print halftones. If you print directly from Photoshop, you can leave the default setting, Use Printer's Default Screen, selected to allow the output device's printer description file to select the halftone conventions for you. Deselect this option to make your own choices. Selecting the Use Accurate Screens option instructs the imagesetter used to output the final printed image to activate Accurate Screening technology. However, many imagesetters do *not* have Accurate Screening technology, so it is best to leave this option deselected unless your service provider tells you to activate it.

Stochastic or Frequency Modulated Screening

- **stochastic screening**
- **frequency-modulated screening**

Another type of screening, known as s*tochastic* or *frequency modulated* screening, does not use rows of varying sizes of halftone dots to give the illusion of tone. Instead, it uses clusters of same-sized microdots—light areas are composed of a few widely separated microdots while dark areas are composed of many tightly clustered microdots. In essence, dark areas are composed of more microdots than light areas. Stochastic screening does not use rows of halftone dots, so the halftone conventions taught in this chapter do not apply. Stochastic screening can only be performed by computer—not by photographic means—and is not supported by Photoshop 4.0.

Dot Percent Size

The first convention used to describe a halftone dot is the percentage of the paper that it covers. Dot percentages range from 0 percent (the paper is left blank) to 100 percent (the paper is completely covered by ink). Thus, a 10 percent halftone dot covers 10 percent of the paper within a given halftone cell while a 90 percent halftone dot covers 90 percent of the paper within a given halftone cell (see Figure 1.13).

You can sample the halftone dot size in Photoshop by using the Eyedropper tool. Move the Eyedropper tool over the point you want to sample, then read the value in the Halftone Dot Percentage field in the Info palette. The value represents the percentage of ink coverage for the specific pixel sampled.

Halftone dot percent sizes measured in Photoshop will not measure the exact same size when printed. Specific attributes of printing presses, inks, and substrates usually combine to cause dots to appear larger than they should. These attributes are discussed at length in Chapters 2, 4, and 5. Also remember that your monitor will not actually display the halftone dots. They only appear when a document is printed.

Exercise 1.7 **Examining the Halftone Dot Percent Sizes in an Image**

In this exercise, you will use the Info palette and the Eyedropper tool to examine the halftone dot percentage sizes Photoshop uses to reproduce various areas of a photograph.

1. Click the Eyedropper tool in the Tool palette or type I to select the Eyedropper tool.
2. Move the Eyedropper pointer over the image. While moving the mouse, look at the Halftone Dot Percentage (K) field at the top left of the Info palette. Notice the number in the field changing as you move the mouse.
3. Move the tip of the Eyedropper pointer into the bright white area at the left side of the bill of the left hat as shown in Figure 1.17.

Figure 1.17
Measuring the halftone dot values of the left hat's bill

1. **The Eyedropper pointer in position**
2. **The halftone dot value for the point indicated by the tip of the Eyedropper pointer**

Notice that the Halftone Dot Percentage field in the Info palette reads 5%. This means that this area will be printed with halftone dots that cover 5% of the area. These dots are slightly smaller than those shown in the 10% example in Figure 1.13.

4. Move the Eyedropper pointer to the bill of the second hat from the left. Move the pointer around within the bill and notice the values displayed in the Halftone Dot Percentage field vary from approximately 53 to 69.

   These readings indicate that various parts of the second hat's bill will be reproduced using halftone dots ranging from 53% to 69%.

5. Temporarily select the Zoom Out tool by pressing ⌘ + spacebar then dragging a marquee around the word "Bahamas" in the left hat to zoom in on those pixels. When you release the Command key, the Spacebar, and the mouse button, the Eyedropper tool is still selected.

6. Place the tip of the Eyedropper pointer on one of the enlarged black pixels that form the word "Bahamas." Notice that the Halftone Dot Percentage field in the Info palette reads approximately 94.

The black pixels that comprise the word "Bahamas" will print with dots that cover approximately 94% of the paper for that halftone cell.

7. Press and hold both the option and spacebar keys. Notice that the pointer changes to a reducing Zoom pointer. Click the mouse button several times to return to 100%.

Screen Frequency

- **screen frequency**
- **screen ruling**
- **lines per inch (lpi)**

The second convention used to describe a halftone dot is its *screen frequency (screen ruling)* or *lines per inch (lpi)*. Screen frequency refers to the number of rows of halftone dots in one linear inch or one linear centimeter. For example, in Figure 1.13, the halftone on the left is reproduced using a 35 lpi screen, while the photograph on the right uses a 133 lpi screen. Notice that the dots in the 35 lpi screen can be seen easily while those in the 133 lpi screen are almost invisible.

Another way of illustrating frequency would be to consider the compactness of halftone dots within a square inch. Higher lpi screens have many more halftone dots in a square inch than lower lpi screens. For example, a 133 lpi screen has 17,689 halftone dots per square inch (133×133) while a 35 lpi screen has only 1,225 halftone dots per square inch (35×35). A screen suitable for converting photographs to be printed in a newspaper will have fewer lines per inch (less compact) and larger halftone dot cells, while a screen for a high-quality brochure will have much smaller halftone dot cells and many more of them per square inch. The choice of a particular lpi is largely determined by the paper the image will be printed on and the process that will used to print it (for more information about choosing lpi, see the section entitled "Other Variables Affecting Choice of LPI," later in this chapter). Some commonly used screen rulings include 65, 85, 100, 120, 133, 150, 175, 200, and 300 lpi.

You specify the halftone screen frequency (lpi) in the Halftone Screen dialog box. If you choose, you can specify the halftone screen in lines per centimeter (lpc).

Exercise 1.8

Changing the Halftone Dot LPI

NOTE

Macintosh users: If your computer is running Apple Laserwriter 8.4, you must press the pop-up menu labeled "Page Attributes" and choose Adobe Photoshop 4.0 to see the Photoshop-specific Page Setup choices.

In this exercise, you will open the Halftone Screen dialog box to change the screen frequency option.

1. From the File menu, choose Page Setup. The Page Setup dialog box appears (Figure 1.18). Your dialog box may appear different from the one shown in Figure 1.18.

Figure 1.18
The Page Setup dialog box

2. Click the Screen button found near the bottom of the dialog box. The Halftone Screen dialog box appears (Figure 1.19). Notice that, by default, the Use Printer's Default Screen option is selected and that the Halftone Screen area of the dialog box is grayed-out.

Figure 1.19
The Halftone Screen dialog box

3. Deselect the Use Printer's Default Screen option.

   The default screen information for whatever printer was previously selected is now displayed in the fields of the Halftone Screen area of the dialog box.

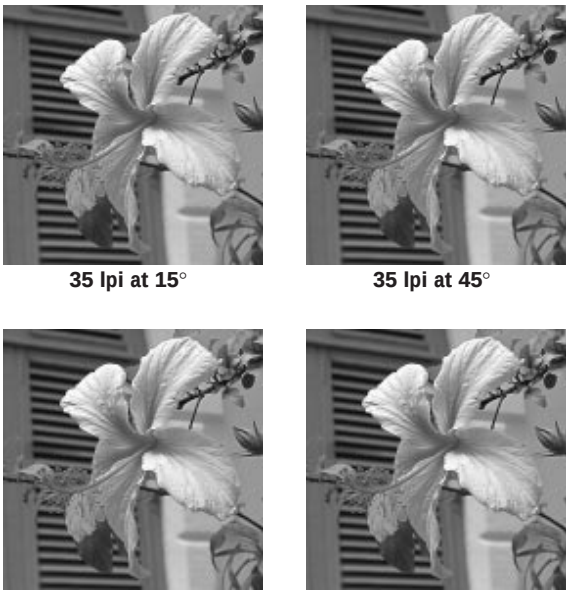
4. In the Frequency field, type "133". Note the pop-up menu to the right of the Frequency field. Pressing this pop-up menu allows you to choose lines per inch (lpi) or lines per centimeter (lpc).

In the Frequency field, type "133". If necessary, click the down arrow next to the Frequency field, then choose lpi (lines per inch) rather than lpc (lines per centimeter). When you delete the Preferences file at the beginning of each work session, this setting may return to lines per centimeter.

Screen Angle

The third convention used to describe each halftone dot is its screen angle. The screen angle can be set within a range of –180° to 180°. The rows of dots may be aligned at several different angles for different purposes. Typically, a halftone that is printed in only one color, most commonly black, has its rows of dots aligned at a 45-degree angle. Dots aligned at a 45-degree angle are the least likely to be noticed by the eye. However, dots can be aligned at other angles. A halftone reproduced using the four common screen angles—35 lpi at 15°, 35 lpi at 45°, 35 lpi at 75°, and 35 lpi at 90°—is shown in Figure 1.20. You also specify the halftone screen angle in the Halftone Screen dialog box.

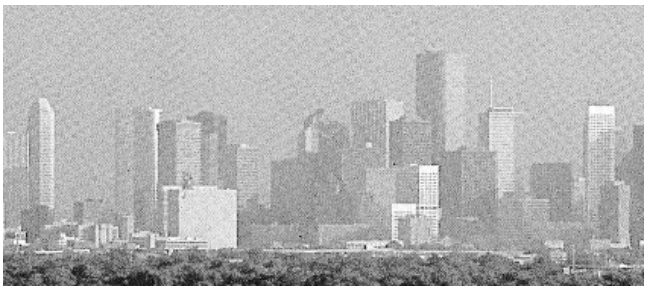
Figure 1.20
Screen angles



moiré

If a photograph will be reproduced by superimposing several colored halftones, each color's screen angle must be different—approximately 30° apart. For example, if a photograph is to be reproduced using two colors—black and orange—the black halftone could use a 45-degree screen angle while the orange halftone could use either 15° or 75°. If the halftone screens in a multicolor image are not aligned 30° apart, an undesirable pattern called *moiré* appears in the printed image. An example of moiré appears in Figure 1.21.

Figure 1.21
An example of moiré



Dot Shape

The final convention used to describe each halftone dot is its shape. Photoshop provides a choice of six shapes of dots: round, diamond, ellipse, line, square, and cross in the Halftone Screen dialog box. The choice of a dot shape depends on the subject of the photograph. You can also create your own custom dot shape.

Round dots are the most simple and work well in light-colored images. However, the round shape causes problems with darker areas of photographs, so its use should be limited. Diamond and ellipse dots chain together and produce a smooth transition from one tone to another. For this reason, they are often used to reproduce photographs of people. Both the diamond and ellipse dots are approximately the same shape except the ellipse has rounded corners. Square dots increase the impression of sharpness and, for this reason, are often used to reproduce photographs of mechanical things such as cars and home appliances. Line and cross screens are used for special effects—whenever you want the pattern of the screen itself to be a part of the design or look of the product. Figure 1.22 illustrates the same photograph reproduced at 35 lpi using Photoshop's six standard dot shapes.

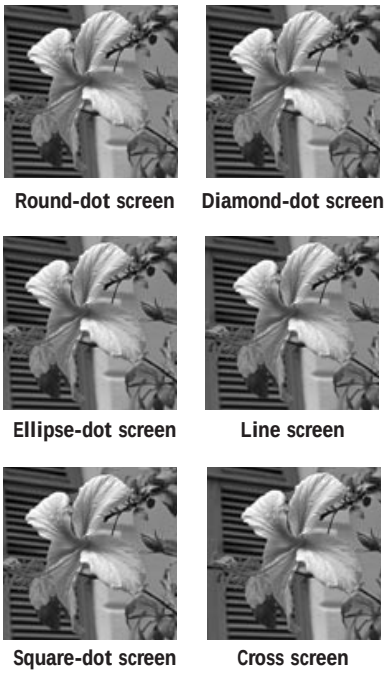


Figure 1.22
Halftone dot shapes at 35 lines per inch

Exercise 1.9 Changing the Screen Angle and Dot Shape

In this exercise, you will use the Halftone Screen dialog box to change the screen angle and shape of the halftone dots that will be used to print your image.

1. In the Angle field of the Halftone Screen dialog box, type "75".
2. Press the Shape pop-up menu, then choose Ellipse.

   You have now specified elliptical halftone dots that are 75° and 133 lpi (Figure 1.23).

Figure 1.23
The completed Halftone Screen dialog box

Exercise 1.10 **Saving Halftone Screen Settings**

You may need to use these same settings at another time in a different file. Instead of entering the data again, you can save these settings and reload them when you need them. This technique is especially useful if you regularly use the same settings—if you save them, you do not need to remember exactly what the settings are. To load these screen settings at another time, simply navigate to the Halftone Screen dialog box, click Load, find the file name of the saved settings you wish to use, then click Open. The stored settings will be loaded into the dialog box.

1. Click Save. The Save halftone screen in dialog box appears. Navigate to your Photoshop Files 1 disk or folder so that its icon appears at the top of the dialog box (Figure 1.24).

Click Save. The Save dialog box appears. Navigate to your Photoshop Files 1 disk or folder.

Figure 1.24
The Save halftone screen in: dialog box

NOTE

We realize that the information in the rest of this chapter is, well, boring. There is also quite a bit of math, which some of us just hate! However, whenever we speak at seminars or conferences, many questions people ask are rooted in a lack of understanding of the concepts that this chapter covers. Please make a valiant attempt to learn these concepts. Don't skip *anything*, and be sure to do the exercises. We guarantee that it will be time well spent!

2. Type Chapter 1 Screens in the Save halftone screen in field, then click Save. You are returned to the Halftone Screen dialog box.

Type c1screen in the File name field, then click Save. The extension AHS is automatically added to the halftone screen setting file name.

3. Click OK to return to the Page Setup dialog box, then click OK again to return to the image.

Determining the Printer LPI Setting

The manipulations you can perform effectively with Photoshop will depend on the attributes of the files with which you are presented and the attributes of the reproduction process to be used. The attributes of the original file you work with will determine the *maximum amount of*

data you have to manipulate in Photoshop, and the attributes of the reproduction process used to output the final image will determine the *minimum amount of data needed* to produce a quality image. Hopefully, the amount of data you have after manipulating the image will be greater than the minimum amount of data needed to produce a quality image.

Printer Resolution

- dpi

The resolution of a printer is rated according to the number of dots per linear inch or *dpi* that a laser printer or an imagesetter can produce. Image resolution (ppi) is usually proportional to, but seldom the same as, printer resolution. Most laser printers in common use have output resolutions of 300 to 600 dpi, and high-end imagesetters can print 1,200 dpi, 2,400 dpi, or higher. To set the lpi of the printer you must know the resolution of the printer and the number of levels of grays to be used in the image.

Gray Levels

- PostScript
- gray levels

As previously mentioned, a printer produces halftone dots using cells, each containing a group of printer dots. A halftone cell containing two rows and two columns of printer dots can produce 2^2 or four different sizes of halftone dots and four different shades of gray. Similarly, if a cell contains eight rows and eight columns of printer dots, 8^2 or sixty-four sizes of halftone dots can be created, making it capable of representing sixty-four different shades of gray. *PostScript*, the language used by most laser printers and imagesetters used by graphic professionals, is capable of reproducing 256 sizes of halftone dots. Consequently, most service providers use 256 halftone dot sizes. This choice corresponds to 16 rows and 16 columns of printer dots ($16^2 = 256$). In addition to the number of sizes of halftone dots that can be produced, a laser printer or imagesetter can also leave the paper blank. Thus, a 2×2 cell can produce five *gray levels* (four sizes of dots plus blank paper), while a 16×16 cell can produce 257 gray levels (256 sizes of dots plus blank paper).

If you increase the number of gray levels, the maximum lpi a printer can produce will decrease because more of the imagesetter's dots are being used to make each halftone dot. If, on the other hand, you decrease the number of gray levels, the maximum lpi a printer can produce will increase because fewer of the printer's dots are needed to make each halftone dot. With a given printer, you can increase lpi or levels of gray, but not both.

Higher resolution printers can produce higher lpi halftones. The relation between printer dots and halftone dot cells is illustrated in Figure 1.25.

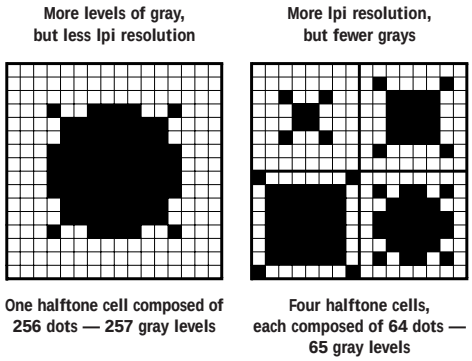


Figure 1.25
Levels of gray versus LPI resolution

How many gray levels should you choose? If your photograph contains a lot of detail and you want to reproduce it on high-quality paper, you may need all 257 gray levels. However, for a lower-quality reproduction, such as a photograph for a newspaper, 65 gray levels is probably enough.

Determining a Printer's Maximum LPI

To determine the maximum lpi a printer can produce, divide the resolution of the printer or imagesetter by the square root of the number of gray levels you want minus one.

$$\text{maximum lpi a printer can produce} = \frac{\text{resolution of output device}}{\sqrt{\text{number of gray levels desired} - 1}}$$

For example, if you have a 600 dpi printer and want 65 gray levels, you must divide 600 by 8 (the square root of 64). The result is 75 lpi. Thus a 600 dpi printer can produce 65 gray levels when printing a 75 lpi halftone.

$$\text{maximum lpi a printer can produce} = \frac{600}{\sqrt{65 - 1}}$$

$$= \frac{600}{\sqrt{64}}$$

$$= \frac{600}{8}$$

$$= 75$$

The lpi's possible for several prevalent printer resolutions and commonly used gray levels are given in Table 1.4.

Table 1.4 Maximum lpi for various printers and gray levels.

Desired number of gray levels	300 dpi printer	600 dpi printer	1,200 dpi printer	2,400 dpi imagesetter	3,200 dpi imagesetter
5	150 lpi	300 lpi	600 lpi	1,200 lpi	1,600 lpi
17	75 lpi	150 lpi	300 lpi	600 lpi	800 lpi
65	37.5 lpi	75 lpi	150 lpi	300 lpi	400 lpi
257	18.75 lpi	37.5 lpi	75 lpi	150 lpi	200 lpi

Banding

banding

Avoid choosing an lpi that is higher than a printer or imagesetter can produce with 257 gray levels. Choosing a higher lpi than a printer can produce results in reducing the number of possible halftone dot sizes and causes banding to occur. *Banding* is a defect in a halftone in which parallel breaks, like stair steps, appear in an image (Figure 1.26).

Figure 1.26 Banding in a gradient

gradient

Banding is most visible in areas of photographs that gradually change from one shade to another similar shade. It is caused by having too few gray levels to produce the fine distinctions between similar colors. Fewer than 257 gray levels can be chosen if the photograph to be reproduced does not contain fine detail, is very contrasty, or will be printed on low-quality paper—like newsprint. Banding is also prevalent in gradients that are created in Photoshop. A *gradient* is a gradual transition between two or more shades or colors. Figure 1.26 is a gradient that was created in Photoshop.

LPI (Screen Frequency) and Image Resolution

The image resolution of a photograph impacts the maximum lpi (screen frequency) that can be used to print the photograph as well as the quality of the printed image. Low image resolution photographs should only be printed with low lpi screens. If a high screen frequency is used on a low image resolution photograph, image quality will suffer (see Figure 1.15).

The image resolution of a photograph must be adjusted to match the lpi of the screen chosen for the halftone reproduction. In a perfect world, scanners would only need to scan one pixel per halftone dot. However, scanners are imperfect, so Photoshop needs more than one pixel to make a high-quality halftone dot.

Experts disagree on the optimum number of pixels per dot, but most agree that the absolute minimum is 1.5 and the maximum is 2.0. Thus, if you are using a 100 lpi screen, the scanned photograph should contain a minimum of 150 ppi and a maximum of 200 ppi. When Photoshop transforms a photograph into a halftone, it takes the 1.5 to 2 pixels that are available for each dot and averages the color or tone of the pixels to determine the optimum halftone dot size.

To determine how wide a printed photograph can be, divide the number of pixels across the image by either 1.5 times the lpi (Photoshop calls this "good quality") or 2 times the lpi (Photoshop calls this "best quality").

$$\text{printed width of an image} = \frac{\text{number of pixels across the image}}{\text{1.5 or 2} \times \text{lpi}}$$

For example, if a given digital photograph is 1,330 pixels wide and you wish to use a 133 lpi screen with best quality, divide 1,330 by 266 (twice the lpi). This photograph can be reproduced a maximum of 5 inches wide.

$$\text{printed width of an image} = \frac{1{,}330}{2 \times 133}$$

$$= \frac{1{,}330}{266}$$

$$= 5$$

If, however, the specified lpi is 150, the photograph can only be 4.4 inches wide (1,330 divided by 300).

Manipulating Image Print Size and Image Resolution

The Image Size dialog box allows you to inspect and adjust the print size and resolution of an image (see Figure 1.28). If you select the Auto button, Photoshop will help you select an appropriate resolution based on three quality levels: Draft quality produces an image that is acceptable only when viewed on the screen—such images cannot be printed acceptably. Good quality produces 1.5 pixels per halftone dot; best quality produces 2.0 pixels per halftone dot.

You can also manually change the resolution relative to the print size of the image or independently of the print size of the image using the Print Size area of the Image Size dialog box. If you change the resolution relative to the image's print size, an increase in resolution will result in a decrease in image print size. Similarly, an increase in image print size will result in a decrease in resolution. Thus, image print size and image resolution are inversely related—an increase in one results in a decrease in the other.

Resampling

- **resample**
- **upsample**
- **downsample**

If you change resolution independently of print size, Photoshop must *resample* the image. When an image is resampled, Photoshop adds or removes pixels. If you increase the print size of an image without decreasing its resolution, more pixels must be added. More pixels must also be added if you increase resolution without decreasing image print size. This process is called *upsampling*. If you decrease the print size of an image without changing its resolution, Photoshop discards pixels. This process is called *downsampling*. Upsampling causes the file to become larger while downsampling results in smaller files.

Usually an image will not be badly harmed if you downsample. If, on the other hand, you upsample, Photoshop must guess what color the additional pixels should be. Unfortunately, Photoshop may not guess well when it resamples (Figure 1.27)! Resampling to a larger size generally causes images to looked stair-stepped or pixelized—pixelized photographs are usually not acceptable.

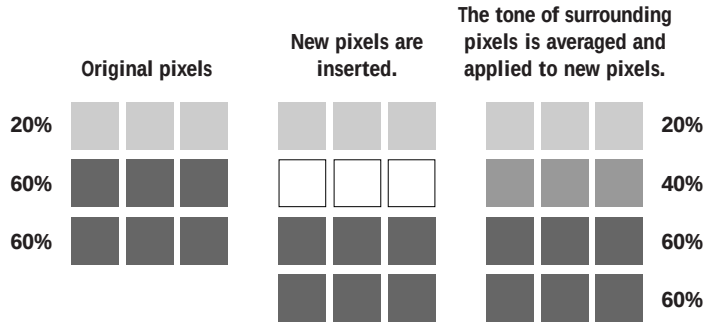


Figure 1.27
Upsampling—inserting new pixels to enlarge an image

Acceptable and Unacceptable Practices for Resizing and Changing Resolution

It is an acceptable practice to decrease a photograph's print size or to decrease its resolution (downsampling). You may also increase resolution *if* you decrease the print size of the image. Conversely, you may increase the print size of an image *if* you decrease its resolution.

You can change the resolution or print size of an image independently if you choose the Resample Image option in the Image Size dialog box. However, you *should not* increase an image's resolution without decreasing its print size. Similarly you *should not* increase an image's print size without decreasing its image resolution.

If you absolutely must increase the print size or resolution of a photograph, Photoshop 4.0 provides three methods of resampling that can be chosen from the Resample Image pop-up menu in the Image Size dialog box when the Resample Image option has been chosen. These methods include Nearest Neighbor, Bilinear, and Bicubic. Nearest Neighbor is the fastest and least precise resampling method. Bicubic is the slowest, but it provides the smoothest and most precise results. Bilinear is a medium-quality interpolation method. Remember that any method of resampling to a larger print size (upsampling) is a last resort and should only be used when absolutely necessary.

You may also change the proportions of an image in the Image Size dialog box. Unless there is a compelling reason, you *should not* change the proportions of a photograph because it changes the intended meaning of the image. For this reason, it is best to always check the Constrain Proportions option in the Image Size dialog box.

Exercise 1.11 Inspecting and Adjusting an Image's Resolution

In this exercise, you will inspect the image resolution previously applied to C1exercise.tiff. Then, you will make modifications to the settings.

1. From the Image menu, choose Image Size. The Image Size dialog box appears (Figure 1.28).

   Notice the following information that appears in the dialog box:

   - The file is 93K in size (shown next to Pixel Dimensions at the top of the dialog box).
   - The file is 376 pixels wide and 251 pixels high.
   - The file is 3.836 inches wide and 2.561 inches high.
   - The resolution is 98 ppi.

Figure 1.28
The Image Size dialog box

2. At the bottom of the dialog box, click the Resample Image checkbox, if necessary, to select this option (the checkbox should contain an X). Also select the Constrain Proportions option by clicking its checkbox, if necessary.
3. Click Auto. The Auto Resolution dialog box appears (Figure 1.29).

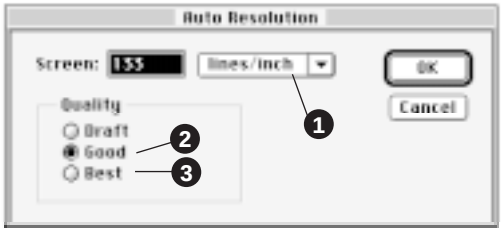


Figure 1.29
The Auto Resolution dialog box

1. Windows users: make sure lines/inch is chosen
2. Results in 1.5 pixels per halftone dot
3. Results in 2.0 pixels per halftone dot

4. In the Screen field, type “133”.

In the Screen field, type “133”, then click the drop down arrow to select lines/inch, if necessary.

This is a common halftone lpi used when printing uncoated paper by offset lithography.

5. In the Quality section, click Best, then click OK.

Notice the changes to the dialog box:

- The resolution is now 266 ppi (twice the lpi).
- The file size has increased to approximately 680K.

6. Click the Resample Image checkbox at the bottom of the dialog box to deselect this option (there should *not* be an X inside the box).

Notice the changes to the dialog box:

- The Pixel Dimensions returned to 93K.
- The Print Size decreased to 1.414" × 0.944". In order to increase the resolution without increasing the file size, Photoshop had to decrease the size of the image.

7. Click Auto again.

8. In the Screen field, type “65”, then click OK.

Be sure the Resample Image option is *not* selected, then notice that the Print Size has increased to 2.892" × 1.931". Because you decreased the lpi, Photoshop was able to increase the image size.

9. Click OK. You are returned to the C1exercise.tiff image.

In steps 4 through 8 you should notice three major points: 1) If you have a photograph that has a low image resolution, reproducing it using halftone dots requires the image to be drastically reduced in size—something that is usually unacceptable. You need to prevent this by always capturing sufficient data when a photograph is scanned; 2) Photographs take up considerable disk space when reproduced at high quality using high lpi screens; 3) You can increase image size by decreasing screen lpi.

Image Resolution and File Size

The total amount of pixel information in an image (image resolution) determines its file size. A one-inch square, high resolution (i.e., 300 ppi)

image has more pixels, and therefore a larger file size, than a one-inch square, low resolution (i.e., 72 ppi) image. File size determines the disk space needed to store a file and the speed with which it can be edited or printed. You must answer the question, "Will the image resolution (ppi) be enough to produce the lpi required for the halftone reproduction you need to produce?" In other words, can the file produce the lpi the printing process requires within reasonable performance parameters?

To calculate the size of a scanned picture file, you must know the lpi of the halftone screen you wish to use on the final document and the area of the photograph at the size it will be printed. Most scanning software programs provide you with an indication of the size of the resulting file before the photograph is scanned. Use the following formula to find the optimum size of a grayscale photograph's file in bytes:

$$\text{file size} = \frac{\text{2 pixels per}}{\text{halftone dot}} \times (\text{line screen})^2 \times \left(\frac{\text{area of}}{\text{photograph}}\right) \times \left(\frac{\text{number of}}{\text{colors}}\right)$$

In this formula, the area of the photograph is found by multiplying the length by the width of the picture box into which the photograph will be placed in the page layout program. The line screen is determined by your choice of halftone screen frequency (lpi)—use Table 1.5 on page 54 as a guide for choosing the appropriate lpi. The number 2 is the number of pixels per halftone dot (see the previous section, "LPI [Screen Frequency] and Image Resolution"). If disk space is a concern, you can use a factor of 1.5 rather than 2. Unfortunately, the quality of the finished reproduction will not be as good compared to a file that was increased in size by a factor of 2.

To convert bytes to kilobytes, divide the number of bytes by 1,024. To convert kilobytes to megabytes, divide the number of kilobytes by 1,024. To convert bytes directly to megabytes, divide the number of bytes by 1,048,576.

Files for photographs to be printed in color will need to be three times as large as single color files because Photoshop requires three separate channels—red, green, and blue (RGB)—to create a color image. Each channel requires the same amount of data as a single color photograph.

Color photographs are *printed* with four halftones—cyan, magenta, yellow, and black (CMYK). Photoshop converts the three-channel RGB image into a four-channel CMYK image. A CMYK image will be four

times as large as a grayscale image and 1.33 times larger than an RGB image.

File sizes increase geometrically when the area of the printed halftone is increased. Using the above formula, you can calculate that an 8" × 10" color photograph reproduced with a 133 lpi screen in CMYK would require a minimum file size of 11,320,960 bytes.

$$\begin{aligned}\text{file size} &= 2 \times (133)^2 \times (8 \times 10) \times 4 \text{ colors} \\ &= 2 \times 17{,}689 \times 80 \times 4 \\ &= 11{,}320{,}960\end{aligned}$$

To convert bytes to kilobytes, divide the number of bytes by 1,024. Thus, 11,320,960 bytes is equivalent to 11,056K. To convert kilobytes to megabytes, divide the number of kilobytes by 1,024. Thus, 11,056K is equivalent to 10.8MB. To convert bytes directly to megabytes, divide the number of bytes by 1,048,576.

$$\text{kilobytes} = \frac{\text{bytes}}{1{,}024}$$

$$11{,}056\text{K} = \frac{11{,}320{,}960}{1{,}024}$$

$$\text{megabytes} = \frac{\text{kilobytes}}{1{,}024}$$

$$10.8\text{MB} = \frac{11{,}056\text{K}}{1{,}024}$$

Exercise 1.12 **Determining File Size**

In this exercise, you will calculate the optimum file size for scanning a given black-and-white photograph.

1. Calculate the optimum file size in bytes. For example, say that you want to scan a black-and-white photograph that will be printed 2" × 3" using a 133-line screen. Calculate the file size as follows:

$$\begin{aligned}\text{file size} &= 2 \times (133)^2 \times (2 \times 3) \times (1) \\ &= 2 \times (17{,}689) \times (6) \times (1) \\ &= 212{,}268 \text{ bytes}\end{aligned}$$

2. Convert the file size in bytes to kilobytes. Divide the number of bytes by 1,024.

$$\text{file size} = 212{,}268 \text{ bytes} \div 1{,}024 = 207 \text{ kilobytes}$$

207K represents the optimum file size for a single-color scan. For example, a 2" × 3" black-and-white halftone printed using a 133-lpi screen would need a file size of at least 207K.

3. If the photograph is to be scanned in RGB color, multiply the answer you calculated in Step 2 by 3 (there are three colors in an RGB file). For example, a 2" × 3" color photograph would require a minimum file size of 621K.

The Relationship Between File Size and LPI

If you do not have a scanner, you will need to rely on someone else to digitize photographs for you. You can obtain digitized photographs from commercially available CDs, capture frames from a videotape, download photographs from a computer network, or contract with a service provider to scan your photographs. Unfortunately, you do not have control over the amount of data that has been placed into those files. You will need to determine if a file contains enough data to reproduce a halftone with the lpi resolution you desire. Before you begin to calculate the lpi a file can produce, you must convert the file size to bytes. To convert kilobytes to bytes, multiply the number of kilobytes by 1,024. Thus, 915K is equivalent to 936,960 bytes. To convert megabytes to bytes, multiply the number of megabytes by 1,048,576. Thus, 10.8MB is equivalent to 11,324,621 bytes. The formula for calculating the maximum lpi that a given file can produce for a single color halftone is:

$$\text{maximum lpi a file can produce} = \sqrt{\frac{\text{file size in bytes}}{2 \times (\text{area of photograph})}}$$

To find the maximum lpi of a color reproduction, you need to use the following formula:

$$\text{maximum lpi a file can produce} = \sqrt{\frac{\text{file size in bytes}}{2 \times (\text{area of photograph}) \times (\text{\# of colors})}}$$

Exercise 1.13 **Determining the Maximum LPI a File Can Produce**

This exercise will demonstrate how you can determine the maximum lpi that the data in a given file can produce.

1. Assume that you have a file size of 1.5MB and that you want to reproduce it as a 5" × 7" black-and-white halftone. What is the maximum lpi? Use the following procedure:

$$\text{maximum lpi a file can produce} = \sqrt{\frac{\text{file size}}{2 \times (\text{area of photograph})}}$$

$$= \sqrt{\frac{1.5 \times 1{,}048{,}576}{2 \times (5 \times 7)}}$$

$$= \sqrt{\frac{1{,}572{,}864}{70}}$$

$$= \sqrt{22{,}469.486}$$

$$= 149.89$$

This file has sufficient data for you to reproduce a halftone with a 133-lpi screen, but it does not have enough data to produce a 150-lpi halftone.

2. Assume that you have an RGB file size of 2.9MB and that you want to reproduce it as a 4" × 5" color halftone. What is the maximum lpi? Use the following procedure:

$$\text{maximum lpi a file can produce} = \sqrt{\frac{\text{file size}}{2 \times (\text{area of photograph}) \times (\text{\# of colors})}}$$

$$= \sqrt{\frac{2.9 \times 1{,}048{,}576}{2 \times (4 \times 5) \times 3}}$$

$$= \sqrt{\frac{3{,}040{,}870.4}{120}}$$

$$= \sqrt{25{,}340.587}$$

$$= 159.187$$

This file has sufficient data for you to reproduce a halftone with a 150-lpi screen, but it does not have enough data to produce a 175-lpi halftone.

Other Variables Affecting Choice of LPI

substrate

Three additional variables that affect the value of the halftone screen frequency include the printing process, the type of substrate to be used when reproducing the photograph, and the distance between the viewer and the photograph. The *substrate* is the material on which the image will be printed. Substrates can include paper, plastic, wood, metal, glass, and fabrics.

Printing Process

Before beginning to prepare any photograph for reproduction, you must know the printing process that will be used to reproduce it. Refer to Table 1.2, Common Printing Processes on page 29, to review the different printing processes and their uses.

The halftone screen frequency (lpi) that should be used for a particular photograph is dependent on the printing process that will be used to print the reproduction and the type of substrate on which the image will be printed. Each printing process puts ink on paper using different methods. The way the ink is applied to the paper influences how large the dots can be. For example, offset lithography uses a soft and smooth rubber surface—called a blanket—to press the ink onto the paper. The blanket is capable of transferring very small dots, so high lpi screens can be used. On the other hand, screen printing uses a stencil mounted to a fabric screen to print images. Ink is forced through the stencil onto the substrate using a squeegee. Halftone dots in a stencil must be large enough for the ink to pass through them. Consequently, screen printing cannot print as small dots as offset lithography can print. Other printing processes are capable of reproducing various lpi dots. Refer to Table 1.5 on page 54 for more specific halftone lpi's that various processes can accommodate.

In many cases, the same photograph will be reproduced using several different printing processes. For example, a fast-food restaurant may have a photograph of a sandwich to be reproduced in a national magazine printed by gravure, on placemats printed by offset lithography, and on point-of-purchase displays printed by screen printing. The halftone must be prepared with a different lpi screen for each of these products.

Substrates

Halftones can be printed on a variety of surfaces. For example, the fast-food sandwich photograph described above probably will be reproduced on smooth, shiny coated paper in the national magazine, on rough absorbent uncoated paper for the placemats, and on plastic for the point-of-purchase displays. The absorbency and roughness of the paper affects the lpi screen that should be used. Generally speaking, rougher papers must use lower lpi screens than smoother papers because printing presses have a difficult time pressing tiny dots into the crevices of rough papers. In addition, ink has a tendency to blot when printed on absorbent

(uncoated) paper. In particular, 50 percent and larger dots may become enlarged by this blotting action—so much that they create a darker-looking image than they should. To keep dots in dark areas of photographs printed on absorbent paper from touching, lower lpi halftone dots are generally used. Conversely, coated papers absorb very little and cause little blotting to occur. Therefore, higher lpi screens can be used on coated papers. Most materials other than paper (plastic, metal, glass, and so on) tend not to be absorbent, so higher lpi screens can usually be used.

When you consider both the process and substrate variables, offset lithography is capable of reproducing much higher lpi screens on uncoated paper than screen printing can produce on coated paper. Furthermore, screen printing can print higher lpi screens on smooth materials than it can on textiles. Table 1.5 provides guidelines to be used with various printing processes. However, you should always check with the firm or department that will do the printing to find out the best lpi to use for a given job.

Table 1.5 Screen rulings for process and substrate combinations

Process/Substrate	lpi
Screen Printing on Textiles	50
Xerographic copy machines	50 to 75
Xerox Docutech	35 to 75
Agfa Chromapress/Xeikon	35 to 75
Indigo	50 to 133
Screen printing—smooth surfaces	85 to 110
Flexography—uncoated paper	up to 133
Flexography—coated or label paper	133 to 150
Flexography—pharmaceutical printing on coated paper	up to 175
Conventional offset lithography—uncoated paper	120 to 133
Conventional offset lithography—coated glossy paper	150 to 250
Waterless offset lithography—coated glossy paper	200 to 800
Gravure—all substrates	150 to 200

The Distance Between the Viewer and the Photograph

Printed photographs viewed from a distance—on a billboard or point-of-purchase display—can use very low lpi screens because the dots are too far away from the viewer to be seen. On the other hand, printed photographs viewed in a book at arm's length must have higher lpi's to decrease the chance that the dots will be perceived.

Planning and Setting the Correct LPI

In the Halftone Screen dialog box, you are allowed to choose the halftone screen frequency (lpi) you wish to use for reproducing a particular photograph. Which screen frequency should you choose? This is not an easy question to answer because of all the many variables previously discussed in this chapter.

The following list summarizes the items you must consider when you plan and set lpi.

1. Start at the end. What printing process and substrate will be used to print this photograph? Use Table 1.5 to determine the appropriate lpi for this process and substrate combination. Better yet, ask the firm or department that will actually print the product.
2. Determine the planned dimensions of the printed photograph.
3. Consider the distance between the viewer and the printed photograph.
4. Determine the required number of gray levels.
5. Determine the resolution of the output device.
6. Calculate the maximum lpi the printer/gray level combination can produce.
7. Choose the most appropriate lpi for the image based upon the answers to questions 1 through 6.
8. Once you have determined the appropriate lpi, you must use the Image Size dialog box to find out if the image resolution is high enough to support a reproduction at the desired size and lpi.

Exercise 1.14 **Planning and Setting the Correct LPI**

In this exercise, you will plan the lpi for C1exercise.tiff to be output on a laser printer and reproduced on a particular substrate/printing process combination. Here are the variables to consider:

- The photograph will be imaged on a 1,200 dpi laser printer.
- The printing process to be used is screen printing.
- The substrate is a T-shirt.
- 257 gray levels are required.
- The image needs to be about 3" × 5" in size.

1. Start at the end. What printing process will be used to print this photograph? *Screen printing.* Consider the substrate. *Textiles.* Use Table 1.5 to determine an appropriate lpi for this process and substrate combination. *50 lpi.*
2. Consider the resolution of the output device. *1,200 dpi.* Consider the required number of gray levels. *257.* Calculate the maximum lpi this printer/gray levels combination can produce.

$$\text{maximum} = \frac{1200}{\sqrt{257 - 1}}$$
$$= \frac{1200}{\sqrt{256}}$$
$$= \frac{1200}{16}$$
$$= 75$$

The printer/gray levels combination can produce 75 lpi while the process/substrate combination requires 50 lpi. Always choose the smaller of the two lpi's—in this case 50 lpi—to produce the highest quality halftone that the particular process/substrate combination can handle without the printer causing banding. Choosing an lpi that is higher than the maximum lpi of either the printer (laser printer or imagesetter) or the printing process will lead to unacceptable results.

3. From the File menu, choose Page Setup. The Page Setup dialog box appears.
4. Click the Screen button, then change the halftone screen specifications to 50 lpi, 45-degree angle, ellipse shape, then click OK to close the Halftone Screen dialog box and OK again to close the Page Setup dialog box.
5. From the Image menu, choose Image Size. The Image Size dialog box appears. Be sure Resample Image is *not* checked.
6. Click Auto, then in the Screen field, type "50".
7. Click the Best Quality radio button.
8. Click OK. Make sure the Resample Image option is *not* selected.

   Look at the New Width and Height fields. The photograph is too small, so you must change the quality level to increase the dimensions of the image.
9. Click Auto again, then click the Good Quality radio button.

10. Click OK. Make sure the Resample Image option is *not* selected.

    Look at the New Width and Height fields. The photograph is close to the desired size.

11. At the bottom of the dialog box, be sure the Constrain Proportions option is selected. Select the Resample Image option by clicking its checkbox, then choose Bicubic from the pop-up menu.

    Selecting Constrain Proportions insures that the proportions of a photograph remain constant if you change one dimension. Selecting Resample Image will allow Photoshop to change the image's dimensions while keeping the same resolution.

NOTE

An illustration of cropping appears in Figure 1.14. The procedures to be used in Photoshop to crop an image are given in Chapter 8.

12. Type "5" in the Width field in the Print Size section of the Image Size dialog box (Figure 1.30).

    Notice that the height automatically decreased in size to 3.338" and the resolution remains constant at 75 ppi. This new height proportionately matches the new width. If you keep the dimensions proportional to their original dimensions, you cannot make the photograph exactly 3" × 5" without cropping some of the image.

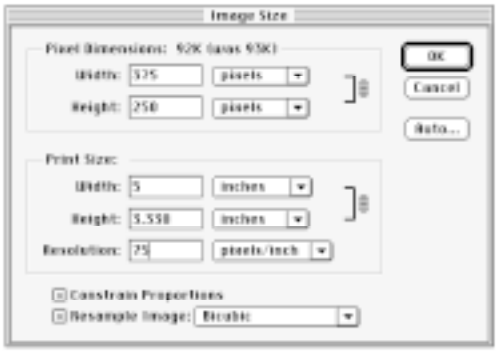


Figure 1.30
The completed Image Size box

13. Click OK. The Image Size dialog box closes and you are returned to the C1exercise.tiff image.

A Start-to-Finish Checklist for Planning and Setting LPI and Image Resolution

This section serves as a review of the processes you should follow when planning and setting the lpi of a given photograph. Use the process in Table 1.6 immediately after you open an image for the first time.

Table 1.6 A recommended process for planning and setting lpi and image resolution

Step	Check	Process
1	❑	Find out the printing process and substrate that will be used to print the job. In particular, find out the range of lpi' s that can be used for this combination, the desired screen angle, and the desired dot shape.
2	❑	Find out the planned dimensions of the printed photograph.
3	❑	Consider the distance between the printed image and the viewer. Images that are viewed from a distance can use lower lpi screens than those viewed close up.
4	❑	Determine the desired number of gray levels. Sixty-five gray levels can be used for lower-quality reproductions while 257 gray levels are typically used for higher-quality images.
5	❑	Determine the resolution of the output device—laser printer or imagesetter.
6	❑	Calculate the maximum lpi that the output device can produce when the desired number of gray levels is produced. Use Table 1.4 or this formula: $\text{maximum lpi a printer can produce} = \frac{\text{resolution of output device}}{\sqrt{\text{number of gray levels desired} - 1}}$
7	❑	Choose the appropriate lpi for the image and the given output device. Select whichever answer in Step 1 or Step 6 is *lower*.
8	❑	Open the Page Setup dialog box, click Screen, and set the lpi, dot shape, and angle.
9	❑	Open the Image Size dialog box. Make sure the Resample Image option *is not* checked and that the Constrain Proportions option *is* checked.
10	❑	Click Auto. Then, in the Screen field, type the lpi you determined in Step 7. Click the Best Quality radio button, then click OK.
11	❑	Check the New Width and Height fields. If the image is larger than the desired size, continue with Step 13. If the image is smaller than the desired size, continue with Step 12.
12	❑	If the image is smaller than the desired size, you must either decrease the quality (by decreasing the number of pixels per halftone dot) or obtain a higher-resolution scan. If it is permissible to decrease the quality level, click the Auto button in the Image Size dialog box. Click the Good Quality radio button, then click OK. If the image size in the New Width and Height fields is still too small, you should obtain a higher-resolution scan (upsampling should only be done when absolutely necessary). If the image size is larger than the desired size, continue with Step 13.
13	❑	If the image is larger than the desired size, you must downsample the image. Be sure the Constrain Proportions option in the Image Size dialog box is checked. Select the Resample Image option and select Bicubic from the pop-up menu. Type the desired width in the Print Size Width field. The Print Size Height changes proportionally to the new width. Alternatively, you can type the desired height in the Print Size Height field–the Print Size Width will automatically change.
14	❑	Close the Image Size dialog box. Continue with any other required manipulations.

Image File Formats

When you save a Photoshop document, you may save it in many different file formats that can be chosen from a pop-up menu in the Save This Document As dialog box (Figure 1.31). You can also open a file saved in any of the supported formats.

Figure 1.31
File formats available in the Save This Document As dialog box

Photoshop's Native Formats

You can choose to save a file in either the Photoshop (for version 3.0 and 4.0) or Photoshop 2.0 format. These formats are used exclusively by Photoshop. Other programs, such as QuarkXPress, may not be able to read files saved in Photoshop native formats. Many of the special functions of Photoshop 4.0, including guides, grids, alpha channels, and layers, can only be saved in the Photoshop format. For this reason, you might want to save files in a native Photoshop format *while you are working on them*.

Cross-Platform Considerations

Photoshop provides several file formats that can be used by different types of computer systems. If you are working on a Mac, you are probably not accustomed to appending file extensions to the end of filenames, nor limiting the length of the filename itself. However, Windows-based computers need to have three-digit file extensions so that programs can identify the type of file. For example, EPS files have the extension **.**eps. When preparing files that will be used by Windows users, Mac operators can instruct Photoshop to automatically append the appropriate Windows extension to filenames. To do so from the File menu, choose Preferences, then select Saving Files from the pop-up menu (see Figure 1.32). In the Saving Files Preferences dialog box, press the Append File Extension pop-up menu, and choose Never to save files without extensions, Always to append extensions to all filenames, or Ask When Saving to append extensions on a case-by-case basis. While the Windows 95 operating system allows filenames up to 255 characters, be aware that the conversion process from Macintosh to Windows format truncates filenames to eight characters. For instance, if you have two TIFF files created on the Macintosh named c2exercise1 and c2exercise2, after conversion to PC format, the filenames become c2exerci.tif and c2exerci.ti0. The Windows user will need to rename the converted files, changing both the name and the extension. For instance, files with ti0 or ep0 extensions do not show up in the Open dialog box because they are not acceptable format extensions.

File Format and File Size

- **lossless**
- **lossy**

The choice of file format also affects the file size. File size is a consideration when transferring data to others as well as archiving images on your own system. You can reduce the size of a file by compressing it, but you must be aware of the effect the various compression schemes have on the image data before compressing a file. There are two broad categories of compression schemes—lossless and lossy. With a *lossless* compression process, as the name implies, you lose no data on compression or decompression of the file. One type of lossless compression is known as RLE (Run Length Encoding) which can be used only for simple black-and-white images; another is LZW (Lempel-Ziv-Welch) which can be used for grayscale and color images. A *lossy*

compression technique, on the other hand, eliminates pixels during the compression process. JPEG (Joint Photographic Experts Group) is an example of lossy compression. JPEG files are highly compressed and take up very little disk space. For this reason, JPEG is often used on files that will be transmitted by the Internet. Compressing and decompressing these images makes them progressively worse so it is recommended only for images that will be transmitted electronically and viewed on screen. Do not compress a file until you have completed correcting the image in Photoshop.

Dominant File Formats

When you have completed a Photoshop file, you will most likely want to import that image into a page layout program. To do so, you must save the file in a format other than Photoshop's native format. Two file formats are currently preferred for this purpose: TIFF and EPS. If you save your files in either of these formats, you can be fairly certain that most any computer, laser printer, and imagesetter used by graphics professionals will be able to handle your files. TIFF and EPS formats can cross platforms—that is, either Macintosh or Windows computers can use them. Choosing any file format other than TIFF or EPS can be risky and may involve additional costs.

TIFF. Tagged Image File Format is a format originally designed by Aldus Corporation for saving scanned images. It is now one of the most widely used file formats because it produces excellent quality halftones. TIFF images can be either color or grayscale and can be compressed with the lossless LZW compression scheme. TIFF files are saved differently for use by Windows or Macintosh computers, but Photoshop for Windows and Photoshop for the Macintosh each can read both Windows and Mac TIFF files. TIFF images can be edited in page layout programs such as QuarkXPress. For example, QuarkXPress allows you to change the color of grayscale TIFF images and change the halftone screen specifications. You can also do minor tone and color corrections to TIFF images within QuarkXPress, but such corrections are not recommended by service providers. One drawback of TIFF: any halftone screening accomplished in Photoshop is lost when the files are transferred to a page layout program.

EPS. Encapsulated Post Script files are supported by virtually all illustration and page layout programs. However, EPS images cannot be edited within page layout programs—for example, colors cannot be changed. When saving an EPS image, you are presented with the EPS Format dialog box (see Figure 1.34). The top pop-up menu allows you to set the Preview. EPS files are mathematical formulas that cannot be viewed on the screen. Therefore, a screen-resolution preview image must be created so that you can see and manipulate the image on the monitor. You may choose None (no preview is created), TIFF (use when an EPS image needs to be transferred between a Mac and a PC), or Macintosh PICT previews (use when an image will be used only on a Mac). Either Macintosh PICT or TIFF previews can be saved as either 1-bit (black and white) or 8-bit (256 colors). Macintosh PICT previews can also be saved with JPEG compression, which can decrease the amount of space the preview takes on your hard disk (because the preview image is not printed, the lossy compression of the JPEG scheme is inconsequential). The Encoding pop-up menu allows you to choose Binary, ASCII, or JPEG. This choice affects the image file, so JPEG should not be used. ASCII files are much larger than binary files, so the clear choice here is binary.

Other Image File Formats

While the current dominant file formats are TIFF and EPS, emerging technologies may change that. In addition, there will be times when those two formats are not the best or even an available choice. Table 1.7 lists the available choices with their advantages and disadvantages. While the table lists all acceptable formats to Photoshop, the available formats for saving a specific image will depend on the original format of the image.

Table 1.7 Image file formats

File Formats	Use for	Advantages	Disadvantages
Windows 3.x Bitmap (.BMP)	Bitmapped, grayscale, True Color images	Popular Windows and OS/2 paint format. Uses RLE compression.	Not widely used by color publishers. Not directly read by Macintosh. Not appropriate for prepress activities.
CompuServe Graphics Interchange Format (.GIF)	Bitmapped, grayscale, 256-color images, Internet and other online services	Automatically compressed using LZW compression scheme.	Supports only 256 colors, so GIF color files are suitable for on-screen viewing but not suitable for color separations. Cannot be imported by page layout programs. Not appropriate for prepress activities.
Photoshop Encapsulated Postscript (.EPS)	Grayscale, color images, color separations, object-oriented graphics from programs such as Adobe Illustrator. The only format that can save clipping paths and halftone screen information.	Reliable (usually). The format of choice for color separating object-oriented graphics and images.	Large file sizes are difficult to store and transport, and image files may not be opened for changes. Can only print EPS files on a PostScript printer.
FilmStrip	Exporting animation or movie files used in Adobe Premiere.	Can edit FilmStrip files in Photoshop	Little use to graphic professionals.
Amiga IFF	Images created by Amiga computer.		Outdated.
JPEG (.JPG)	Used widely in distribution of photographs using the Internet. Also useful for compressing large image files so that they can fit on transportable disks.	Take up little disk space because of lossy compression scheme. JPEG photos can contain millions of colors and, in most cases, appear better on-screen than GIF images that contain only 256 colors.	Images saved in the JPEG format suffer quality loss due to the lossy compression scheme it uses. Not appropriate for prepress activities.
MacPaint	Capturing and placing black and white Macintosh screen shots		Outdated. Not appropriate for prepress activities.
PC Paintbrush (.PCX)	Bitmapped, grayscale, True Color images, color separations (the current PCX format supports True Color).	Used by a large number of PC applications.	Older programs only support 256 colors in PCX format; avoid these. Cannot be read directly by Macintosh. Not appropriate for prepress activities.

Table 1.7 Image file formats, continued

File Formats	Use for	Advantages	Disadvantages
PDF (Portable Document Format)	Electronic publishing format used by Adobe Acrobat®. Files can be read by Macintosh, Windows, UNIX, and DOS.	PDF images can contain both object-oriented and bitmapped graphics. PDF images can contain hypertext links and an electronic table of contents. Appears to be an up-and-coming format for transmitting documents electronically. PDF files can be included in Internet Web pages.	The contents of PDF pages cannot be directly imported into all page layout programs. Photoshop 4.0 will only open Adobe Photoshop PDF file–it will not open files distilled in Acrobat Exchange. Not yet appropriate for prepress activities.
PICT	Macintosh object-oriented images.	Primary format when printing to non-Postscript devices or for multimedia projects.	Cannot be read directly by PC. PICT images often cause problems when printed using an imagesetter. Not appropriate for prepress activities.
PICT Resource	Application startup screens and icons	Useful for computer programmers.	Macintosh only. Not appropriate for prepress activities.
Pixar	Transfer files to PIXAR workstations and programs.	Used for three-dimensional images and animation.	Not appropriate for prepress activities.
PNG	Alternative to CompuServe GIF.	Uses a lossless compression scheme.	Not appropriate for prepress activities.
Raw format	Supports import or export of grayscale and color for transfer between computer systems.	Last resort alternative.	Photoshop can only read if file originally saved as binary, not hexadecimal, data. Not appropriate for prepress activities.
Scitex Continuous Tone, (.SCT)	Quality color scans. Used only on Scitex systems.	Use for image transfer to and from a Scitex system.	Huge files.
Truevision (.TGA/TARGA)	Grayscale, color images, color separations.	Reliable format that supports compression.	Not compatible with many programs. Several subformats exist.
TIFF (.TIF)	Bitmapped, grayscale, True Color images, color separations.	Can be used by large number of Macintosh and PC applications. Images can be lossless compressed with LZW. TIFF is the format of choice for most digital photographic work in electronic prepress work.	PC and the Macintosh have different versions of TIFF so may need to be converted when cross platforms. Photoshop can read and write both versions. Halftone screening performed in Photoshop is lost when file transferred to desktop publishing applications.

Exercise 1.15 Saving a File in the EPS Format

In this exercise, you will save your photograph in an EPS-format file.

1. From the File menu, choose Preferences, then select Saving Files. The Preferences dialog box appears.

Skip to Step 3.

2. Press the Append File Extension pop-up menu and choose Always (Figure 1.32). Then, click OK.

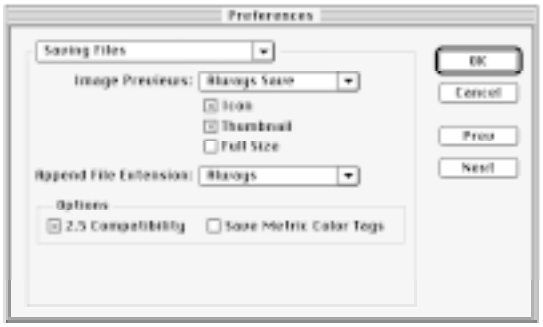


Figure 1.32 The completed Saving Files Preferences dialog box

3. From the File menu, choose Save.

   A message appears that states "Could not save 'C1exercise.tiff' because the file is locked..."

From the File menu, choose Save.

A message appears that states "Could not save 'C1exercise.tiff' because the file is locked. Use the Properties command in the File Manager to unlock the file." Instead of changing the read-only attribute, you will save the document with a different name.

4. Click OK.

   Because the original file is locked, you will need to save the file with a different name. To do this, you will use the Save As dialog box.

5. From the File menu, choose Save As. The Save This Document As dialog box appears.

From the File menu, choose Save As. The Save As dialog box appears.

6. Navigate until the name of your Photoshop Files 1 disk appears at the top of the dialog box, or navigate to the Photoshop Files 1 folder in your allocated space on the hard drive or network.

In the Save in drop-down box, navigate to your Photoshop Files 1 disk or folder.

7. In the Save This Document As field, type Project1.

- In the File name field, type Project1.

8. Press the Format pop-up menu, then choose Photoshop EPS (Figure 1.33).

- Click the Save As drop down arrow, then choose Photoshop EPS.

  Notice that the extension .eps is automatically appended to the file name.

Figure 1.33
The completed Save This Document As dialog box

9. Click Save. The EPS Format dialog box appears

10. In the Preview pop-up menu, choose TIFF 8 bits/pixel. Then, click the Include Halftone Screen option checkbox because you specified a particular screen in the Halftone Screen dialog box. Leave all the other defaults unchanged.

- In the Preview drop-down field, choose TIFF 8 bits/pixel, change the Encoding field to Binary, then select the Include Halftone Screen checkbox (Figure 1.34).

Figure 1.34
The completed EPS Format dialog box

11. Click OK. The file is saved.

Exercise 1.16 **Changing a File's Format to TIFF**

In this exercise, you will save another copy of your photograph in a TIFF format file.

1. From the File menu, choose Save As. The Save This Document As dialog box appears.
2. Press the Format (Save As) pop-up menu, then choose TIFF. Notice that the extension automatically changes to .tif to indicate the new file format.
3. Click Save. The TIFF Options dialog box appears (Figure 1.35).

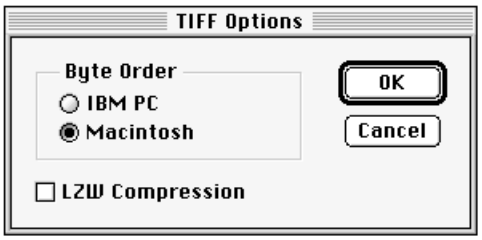


Figure 1.35
The TIFF Options dialog box

4. Click the Macintosh radio button, then select the LZW Compression checkbox.

Click the IBM PC radio button, then select the LZW Compression checkbox.

5. Click OK.

   The file is saved in the TIFF format and you are returned to the document window. Note that the title bar has changed to reflect the new name of the document.

6. Quit (Exit) Photoshop.
7. Double-click the icon of your Photoshop Files 1 disk or folder.

   Notice that there are two copies of the same file and that they both have small icons depicting the contents of the file. These preview icons make it easier for you to find the picture files you need.

Launch Microsoft Explorer or Windows File Manager, then navigate to your Photoshop Files 1 disk or folder.

Notice that there are two copies of a file with the same name, but with different extensions.

8. Close your disk by clicking the close box in the upper-left corner of the window.

- Close Microsoft Explorer or Windows File Manager, then exit Windows.

9. Put away your disk by dragging its icon to the trash.

- Do not throw your disk in the trash. You'll need it again. Those Mac people do some strange things.

Chapter Summary

In this chapter, you learned that Photoshop is a program that serves two different worlds: that of the graphic designer and that of the professional publisher/printer. Publishers are usually more interested in preparing a photograph for reproduction than using Photoshop to create images. Photographs must be transformed into halftones before printing. There are many terms and conventions associated with the halftoning process, including halftone dot percent size, dot shape, screen angle, and lpi. Photoshop's tools can be used to examine and adjust each of these items. A step-by-step process was provided to help you to choose the correct lpi for a given substrate/printing process and printer/gray levels combination. The chapter also covered the file formats Photoshop can use, which ones are preferred for use in the printing and publishing industry, and how to save files using different formats. Finally, a process was given to help you make sure a scanned file has enough data to reproduce halftones with the desired lpi.

Self-Evaluation Review Questions

True/False Questions

____ 1. Professional publishers/printers and graphic artists use Photoshop in the same way.

____ 2. Square-dot halftones are appropriate for photographs of people.

____ 3. PostScript can reproduce up to 1,000 different sizes of halftone dots.

____ 4. You can increase an image's size by decreasing screen lpi.

____ 5. If you select Include Halftone Screen in the EPS Format dialog box, the halftone specifications you set in Photoshop will override those set in a page layout program.

Multiple-Choice Questions

6. Which of these is the best definition for lpi?
   - A the percentage of the paper covered by dots
   - B the angle at which rows of dots align
   - C the number of halftone dots per linear centimeter
   - D the number of halftone dots per linear inch

7. Which of these printing processes would be the best choice to print one million copies of a magazine?
   - A flexography
   - B gravure
   - C offset lithography
   - D screen printing

8. Which of the following lpi's would be best for printing with offset lithography on uncoated paper?
   - A 50
   - B 75
   - C 120
   - D 250

9. Which of these file formats allows you to transfer the halftone screening specifications set in Photoshop to page layout programs?
   A PICT
   B TIFF
   C PCX
   D EPS
10. Which of these compression schemes is lossy?
   A Photoshop
   B RLE
   C LZW
   D JPEG

Fill-in-the-Blank Questions

11. To create various sizes of halftone dots, a laser printer or imagesetter must use groups of printer dots known as _____.
12. Which palette should always be displayed when Photoshop is being used for tone and color correction? _____.
13. How many shades of gray is an 8-bit scanner capable of sensing? _____
14. Which type of scanner uses photomultiplier technology? _____
15. _____ is a term referring to the process of choosing the part of a photograph to scan.

Short Projects

1. Examining halftone dot values

1. Open ShortProjectC1.tiff (SPC1.TIF), found in Photoshop Student Files folder.
2. Use the Eyedropper tool and the Info palette to measure the halftone dot values of the model's teeth, face, and the pupils of her eyes.
3. Record the halftone values below. If there is a range of values, list both the high and low.

   Teeth: _____ – _____ percent
   Face: _____ – _____ percent
   Pupils: _____ – _____ percent

2. Specifying halftone dot lpi, angle, and shape

1. Open the Page Setup dialog box, then click Screen to open the Halftone Screen dialog box.
2. Set the Halftone Screen Frequency to 65 lpi.
3. Set the Halftone Screen Angle to 75°.
4. Choose an ellipse-shaped dot.
5. Click OK to close the Halftone Screen dialog box.
6. Click OK to close the Page Setup dialog box.

3. Saving a file in the EPS format

1. From the File menu, choose Save As.
2. Navigate to your Photoshop Files 1 disk or folder.
3. Change the Format to Photoshop EPS.
4. Name the file ShrtPro1.EPS. Note: If you have not changed the Saving Files Preferences, the .EPS extension will automatically be appended to the file name.
5. Click Save.
6. Choose a TIFF 8-bit Preview and select the Include Halftone Screen check box.
7. Click OK to save the file on your disk.

4. Calculating File Size

1. Open the Image Size dialog box.
2. Record the size values below.

File Size: _____

Width: _____

Height: _____

Resolution: _____

3. Close the Image Size dialog box by clicking Cancel.
4. Calculate the file size that would be necessary to reproduce this grayscale photograph using a 133 lpi screen with best quality at a size of 5" high and 3.25" wide. Place your answer here: _____
5. What would happen if you tried to print the existing ShortProject1.eps file with a 133 line screen?
6. Close ShortProject1.eps.

In-Depth Project

Planning and Setting the LPI and Resolution for a Photograph

Assume that a client provides you with the file InDepthProjectC1.tiff (Idprojc1.tif), found in the Photoshop Student Files folder. You are to plan and set the halftone screening specifications and resolution for the photograph based on the following variables:

- The photograph will be output using a 2,400 dpi imagesetter.
- The printing process to be used is offset lithography.
- The substrate is uncoated paper.
- 257 gray levels are needed.
- The image needs to be 3.25" high.
- The customer desires best-quality resolution.
- You are to use a 45-degree elliptical screen.

Using the given information, make all the decisions regarding the halftone specifications to be applied to this image (use the exercises in this chapter as a guide). Make all necessary changes to the file and save it as an EPS file to a new disk or folder (name the disk or folder In Depth 1) using the filename Indepth1.eps. Be sure to Include Halftone Screen and choose a TIFF 8-bit Preview.