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More detail about the scanning specification.

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Colour depth

Colour depth refers to the extent to which the range of the colour scale is sub-divided into intermediate shades. For example, in the grey scale 8 bit colour depth renders 256 shades from black to white. If 8 bit colour depth is applied to each of the three primary colours of RGB, usually referred to as 24 bit colour depth, the total number of colours possible is about 16 million (accurately, 16,777,216 colours).

[The calculation for the number of colours available is 2 to the power of the colour depth, thus 2^8; = 256, and 2^{24} = 16,777,216]

For practical purposes assume that colour images will be scanned at 24 bit colour depth in RGB format, and monochrome images at 8 bit colour depth in greyscale format.

If however there are non grey tints in a monochrome image that it is important are recorded - sepia prints, for example, or perhaps old, yellowed papers - then colour scanning should be used.

Of course, any monochrome image can be scanned as RGB with 24 bit colour depth, but because there are three colours to be captured instead of one, the file will be three times as big.

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File size

The size of an image file is determined by the amount of information it contains. The more information stored about an image, the bigger the file will be.

The factors which determine the size of a scanned image file are :-

- Scanned (input) resolution;
- The size of the object scanned (or the format size of a digital camera);
- Colour depth;
- Colour format - Greyscale, RGB or CMYK;
- Scaling factor;

To calculate scanned file sizes it is generally easiest to work back from the output required. First decide on the colour format and colour depth required - usually Greyscale or RGB at 8 bit depth per colour, then consider the scaling factor required for a given output resolution.

Rather than detail the file size formulae here we have a **scanning calculator**

which you can use. For simplicity it assumes 8 bit colour depth per colour - so that's 8 bit for greyscale and 24 bit for RGB.

File compression
Having scanned an image, compression techniques can be used to remove unnecessary information, thus reducing the size of the file for storage purposes. The amount of reduction that can be achieved depends mostly on the image. An image that has large areas of identical colour for example is susceptible to very high levels of compression - a reduction in file size of 20 or more times is possible without visible degradation. However, an image with many areas of subtly graduated adjacent colours, such as might be found in a watercolour, might only be capable of a compression factor of 3 to 10 before visible degradation occurs.

The **scanning calculator** includes a selection of compression factors to enable storage requirements to be considered.

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Resolution

Resolution is the number of dots or pixels per inch scanned, printed or displayed on screen. In short - the higher the resolution, the more detail available, the bigger the file.

Ideally the resolution should be matched to the output device. If the resolution of the image is less than the setting of the output device the display software will take an average of adjacent dots (or pixels) and fill in the gaps. (This is known as interpolation). More interpolation means more definition will be lost. On the other hand, if the resolution is higher than necessary the output device will discard information - the image will be fine, but you are storing more information than is necessary.

So - when deciding at which resolution to capture the image, the most important thing to consider is what the scanned image will be used for. There may be a number of different uses planned, in which case select the highest resolution that will be required.

1. Scaling factor
Scaling refers to the output size required with respect to the scanned original. If for example an A5 size image is to be printed at the same size, the scaling factor is 1, if it is to be printed at twice the size the scaling factor is 2, and if at half the size the scaling factor is 0.5.

For example, if an A5 image is required to be printed as A4 at 150 dpi, it should be scanned at two times the resolution - 300 dpi.

Below are some common uses of scanned images and some rule of thumb suggestions for appropriate resolutions to use. In all cases the resolutions refer to the output so if, for example, an image is to be printed at twice it's original size the scaling factor is 2 and thus the input or scan resolution should be double the figure.

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2. Resolution for screen display
Presently computer screens can be set to display between approximately 70 and 100 pixels per inch.

So for screen display a resolution of just 150 dpi is more than sufficient. Where the smallest practical file size is needed, for example on a web site, the resolution could be as low as 75dpi.

For example, a screen 10" high and 13.3" wide set to 1,024 by 768 pixels resolution will have a ppi of 76.8. Thus an image 300 pixels high and 200 wide displayed on it will appear 3.9" high and 2.6" wide, or the same image created 600 pixels high and 200 wide will be displayed at twice the size i.e. 7.82" high and 5.2" wide.

In practice though it is rare that images are scanned solely for screen display, it is more usual to scan at a higher resolution, then create lower resolution files for screen display as required - this process is known as re-sampling. We call these sets of lower resolution files "Multi-Packs" - typically they consist of thumbnail (150 x 150 pixels), preview (450 x 450 pixels) and full screen (800 x 800 pixels) images - though any required sizes can of course be supplied.

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3. Resolution for printing

Ink jet printers can generally print at a resolution of up to 150 or 300 dpi, and laser printers up to 300 or 600 dpi. For the very high quality demanded for publishing purposes, imagesetting machines can print at 1200 dpi, 2400 dpi, or even higher.

For non publishing purposes a print resolution of 300 dpi is usually more than sufficient for good quality printing from either ink jet or laser printers, but if a 600 dpi printer will be used for images containing exceptional detail, then capture for that resolution.

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4. Resolution for archiving

Fundamentally, how much digital information to capture for the purpose of creating an archive? This is a subject of much debate and there is no definitive answer - purists might say "as much as possible", because digital storage costs money (though these costs are continually falling), the finance officer might say "as little as possible", and the technologist might say "as much as but no more than is necessary" - which is usually our advice.

But how to determine the "necessary" amount?

If original objects - say an oil painting, a piece of porcelain and an etching are to be captured directly with a high end digital camera, the answer is mostly concerned with the format (captured image size) of the camera and the amount of detail inherent in the object.

If however, as is often the case, there is an existing archive of film negatives, transparencies or prints - then there is no point in capturing at a resolution higher than that of the film or printing technique used, otherwise all that will be seen at high zoom will be the grain of the film's emulsion. And of course, the required output size and devices to be used will also need to be considered because the point of digital archives is often to make their contents available for viewing, either on screen or as printed copies.

In practice, for most requirements it is found that assuming an output of 300 dpi for printing at A4 size will satisfy most purists, the finance officer and the technologist.