Canadian Heritage   Patrimoine canadien

How to Scan Photographic Transparencies and Photographic Negatives – Supplement

Ern Bieman

Disclaimer

The information in this document is based on the current understanding of the issues presented. It does not necessarily apply in all situations, nor do any represented activities ensure complete protection as described. Although reasonable efforts have been made to ensure that the information is accurate and up to date, the publisher, Canadian Heritage Information Network (CHIN), does not provide any guarantee with respect to this information, nor does it assume any liability for any loss, claim or demand arising directly or indirectly from any use of or reliance upon the information. CHIN does not endorse or make any representations about any products, services or materials detailed in this document or on external websites referenced in this document; these products, services or materials are, therefore, used at your own risk.

Table of contents

- List of abbreviations
- Introduction
- Objects for digitization that are addressed in this document
- Imaging concepts
  - Dynamic range (imaging concepts)
- Slide and still image negative scanning equipment
- Understanding the advantages and disadvantages of various forms of equipment
  - Planetary scanners
  - Digital cameras
  - CMOS still image scanners
  - CCD still image scanners
  - Flatbed scanner with backlit lid
  - Scanner features
    - Resolution
    - Bit depth
    - Dynamic range (scanner features)
- Unwanted scanner features
  - Non-uniformity / streaking
  - Flare and illuminance non-uniformity
  - Colour misregistration
- Other equipment required for film scanning
- Workflow

Canada

  - Step 1: Select materials
  - Step 2: Evaluate condition
  - Step 3: Catalogue and create metadata
  - Step 4: Prepare for digitization
    - Calibration and setting a colour profile
  - Step 5: Digitize
    - Infrared scanning
    - Flatbed transparency scanning
    - CCD slide scanning
  - Step 6: Post-processing
    - Preset colour curves
    - Adjusting colour using a colour curve in GIMP
    - Using preset colour curves in GIMP
  - Step 7: Quality review
  - Step 8: Archive
  - Step 9: Publish
- Common transparency scanning issues
  - Skew
  - Image artifacts
  - Moiré
  - Focus
  - Newton's rings
- Acknowledgements
- Glossary
- Bibliography
- Further readings

List of abbreviations

ANR	anti-Newton ring glass
CCD	charged coupling device
CHIN	Canadian Heritage Information Network
CMOS	complementary metal oxide semiconductor
Dmax	quantitative expression of the maximum optical density of film (or in the context of digital imaging, the darkest shades discernible in an image)
Dmin	quantitative expression of the minimum optical density of film (or in the context of digital imaging, the lightest shades discernible in an image)
FADGI	Federal Agencies Digital Guidelines Initiative
GIMP	GNU Image Manipulation Program
ppi	pixels per inch
RGB	red, green, blue

Introduction

This guide is a supplement to *How to Scan Reflective Objects Using a Flatbed Scanner* (the flatbed scanning document). Photographic slides and negatives can be scanned using certain types of flatbed equipment, and digital imaging and colour theory are similar for both forms of media. Therefore, this supplement contains deep links that refer readers to sections of the flatbed scanning document. Readers are encouraged to read that document first. This supplement will address the use of scanning technologies for transparencies (slides and negative film) up to 4 × 5 inches, but it will be assumed that readers know colour and scanning theory, as outlined in the flatbed scanning document. It will focus primarily on the different skills and knowledge that are required to digitize transparencies.

As with the flatbed scanning document, this guide focuses on technical details related to scanning software and equipment. It adheres and refers to existing imaging standards, including the United States Federal Agencies Digital Guidelines Initiative (FADGI) *Technical Guidelines for Digitizing Cultural Heritage Materials* (PDF Format), which will be cited throughout.

Objects for digitization that are addressed in this document

This supplement covers digitization using light transmission for the following objects, up to 4 × 5 inches:

- monochrome slides
- colour slides
- monochrome negatives (still image film)
- colour negatives (still image film)

This document does not cover other transparencies, particularly larger ones, but the information it contains may be useful for anyone intending to digitize such items.

Imaging concepts

Please refer to the flatbed scanning document for general information on imaging concepts, including modes of image capture and storage; image bit depth; colour space, colour models and colour gamuts; colour accuracy and colour distance.

Dynamic range (imaging concepts)

Further to the concepts described in the flatbed scanning document, you must understand dynamic range in order to scan transparencies. In the context of photographic transparencies, dynamic range refers to a photographic film's ability to record a range of light intensities, also known as luminance.

The film's clarity dictates how little light is necessary to produce a given reading, yielding a minimum optical density (Dmin). Conversely, the film's potential opacity defines the maximum amount of light that can be blocked through its darkest sections, yielding a maximum optical density (Dmax). The darker the film can be made, the greater the Dmax.

In a transparency scanning device, dynamic range refers to the device's ability to reproduce the darkest (Dmax) and lightest (Dmin) sections of a transparency. Often, a scanner manufacturer will report only the device's Dmax. Although it is the most important end of the range to note, as it is the most difficult to obtain in scanning equipment, it is better to know both the Dmin and the Dmax, if possible.

Where both are reported: Dynamic range = Dmax - Dmin

With respect to dynamic range, FADGI recommends the following:

- To scan 35-mm to 4 in. × 5 in. photographic transparencies and negatives, a dynamic range of at least 3.5 is acceptable, and a dynamic range of at least 4.0 is ideal.

Note that while other FADGI requirements are often met in reasonably priced scanning equipment, it is rare for an affordable transparency scanning device to have a dynamic range of 4.0. Verifying a device's dynamic range is beyond the scope of this document. However, when checking the results of an IT8 target scan (described in the Setting a colour profile section of the flatbed scanning document), if the scan cannot detect the variances in dark sections of a transparency, as it should, then the dynamic range is probably lacking.

For more information on performing a grey patch test to detect illuminance non-uniformity, consult Appendix B of the flatbed scanning document.

Slide and still image negative scanning equipment

This guide will limit examples to the use of film scanners and flatbed scanners. However, all of the following hardware is recommended for scanning photographic transparencies from 35 mm to 4 × 5 inches:

- planetary scanners
- digital cameras
- flatbed scanners
- film scanners

Understanding the advantages and disadvantages of various forms of equipment

This section summarizes various forms of still image film scanning equipment, how they work and the relative advantages and disadvantages of each.

Planetary scanners

Planetary or *orbital* scanners are a form of digital photography equipment involving a copy stand, at least one digital camera that may be integrated into the stand and that is typically operated through a computer, and, in the case of transparencies, some form of backlighting. Planetary scanners are useful for scanning large and fragile objects.

Digital cameras

Digital cameras can be used to photograph still images by various means. One method involves a macro-lens fixture with an integrated light box that allows transparencies to be inserted into the box located at the end of the lens. Advantages of this setup include the ability to make use of existing high-end equipment, as well as speed, as a digital camera can reproduce a still image at the rate of its shutter speed.

CMOS still image scanners

Complementary metal oxide semiconductor (CMOS) still image scanners are consumer-grade film and slide scanners typically sold in box stores for less than $100. They are often advertised as requiring no computer equipment, and instead have a port so that digitized images can be written to flash memory cards or USB sticks.

These simple devices work by shining a light source through the photographic transparency, then through a lens to a two-dimensional (rectangular) CMOS sensor that is similar to the CMOS sensors found in the back of a digital camera.

Advantages of such a device are speed and low equipment cost. However, this equipment is not recommended, as the CMOS sensors available in these devices often have lower resolutions than are typically recommended by FADGI and invariably have poor signal-to-noise ratios. In other words, the images they produce have a high ratio of randomness (noise) relative to the desired information (signal). Manufacturers could use more accurate and more expensive lenses and CMOS sensors in such devices, but because the image being scanned is still, it is more affordable to obtain a higher quality result by using a single-dimensional charged coupling device (CCD) similar to those found in flatbed scanners and to scan the transparency using this CCD to record information one line at a time. CCD still image scanners are described as follows.

CCD still image scanners

These scanners are similar in appearance to CMOS still image scanners but are different in that they are explicitly marketed as using a CCD. They are typically used in conjunction with a computer and are generally bundled with scanning and image editing software. At the time this guide was published, the cost of CCD still image scanners started at $300 for lower-end, consumer-grade scanners. A CCD slide scanner is similar to a CMOS still image scanner in that all components are contained in a light-proof box and a slide or film is inserted into the box one image at a time, where it is backlit using an internal light source. Unlike a CMOS still image scanner, the CCD device then reads image information one line at a time, typically by components across the transparency surface, as with a flatbed scanner.

A CCD scanner has the following advantages over the CMOS version:

- CCD slide scanners typically yield higher effective resolutions than CMOS slide scanners.
- The light source is typically LED, ensuring more consistent output and lower temperatures in the device.
- The device uses film and slide trays, allowing more materials to be loaded at a time and ensuring greater control of the slides as they are moved into the scanner.
- Generally, the CCD scanners capture the image as well as a portion of the surrounding frame or slide mount, ensuring the entire image is fully captured. CMOS scanners often do not.
- Some versions use cogs for control of film and negatives, ensuring greater control of film as it is moved through the box.
- Components are better designed and constructed, keeping ambient light to a minimum.

The advantage of a CCD scanner over other setups is that it is a piece of equipment specifically designed to digitize still image transparencies. Therefore, its resolution and overall image quality tend to be higher than that of any other setup of comparable pricing, including flatbed scanners.

Flatbed scanner with backlit lid

These scanners are similar to those described in the flatbed scanning document but include a movable light source in the scanner lid. When scanning transparent objects, a panel in the lid is removed to expose this light source. This provides backlighting for any transparent object that is placed on the platen beneath it. As the object is being scanned, the light source in the lid moves to backlight the corresponding area of the original object.

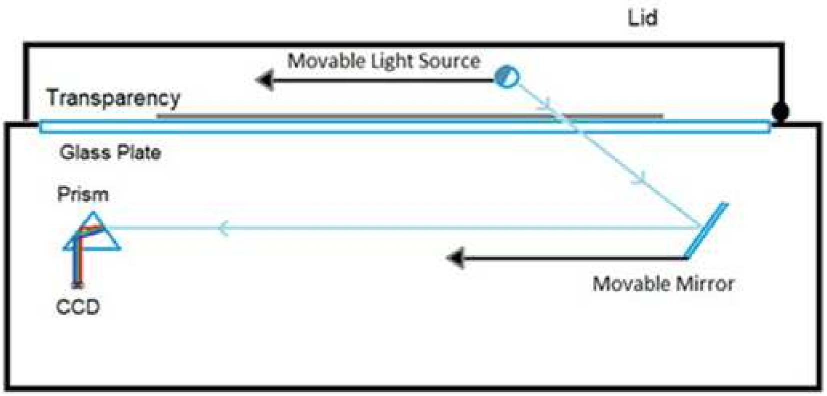


Figure 1. Diagram of a backlit flatbed scanner for scanning transparencies.

There are many online conversations about jerry-rigging light sources for flatbed scanners that do not have a purpose-built backlight. Do not assume your scanner can be converted this way. The two greatest barriers to converting a flatbed scanner this way are resolution and optics. Conversions are not recommended, but if you do attempt one and obtain what appear to be successful results, be sure to test for flare, colour uniformity and misregistration across the scan area. For tolerance levels for these and other image features, consult the FADGI image specifications in the next section.

Backlit flatbed scanners use trays to hold film and slides for various photographic transparency formats. These trays hold the transparencies in place, often at the necessary height from the platen, to properly align them and place them correctly under the backlit area.

While flatbed scanners tend to produce poorer results than dedicated CCD film scanners of the same price, they do have advantages. For example, they accommodate a greater range of transparency sizes, are able to scan multiple transparencies at once, and perform double duty as reflective object scanners.

Scanner features

The following features should be considered when choosing between a CCD film and slide scanner or a backlit flatbed scanner.

Resolution

Resolution (sometimes called spatial resolution) refers to the number of pixels per inch of the original object that can be recorded by the scanning device. Both optical and hardware resolution for flatbed scanners are covered in depth in the Scanner resolution section of the flatbed scanning document.

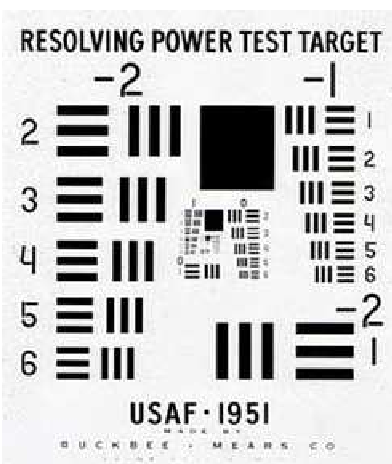
For CCD scanners, the distinction between optical and hardware resolution is often not made, and sometimes only a single value is given. However, CCD scanners do have both an optical resolution, determined by the density of light sensing capacitors in the CCD array, and a hardware resolution, determined by gearing and a stepper motor. The hardware resolution is the most affordable to design at higher values and may be the promoted resolution for the scanner. Be diligent in determining the optical resolution of the CCD array, as this will be the limiting factor in the scanner's resolution.

- For scans of photographic transparencies and negatives from 35 mm to 4 × 5 inches, FADGI recommends scan resolutions of 1000 ppi (minimum) to 4000 ppi (recommended).

Verify also that resolution claims are not for "interpolated" or "software enhanced" resolution, as this just means the software is guessing at image information between the pixels that were actually recorded.

Finally, before scanning transparencies, it is a good practice to verify the resolution of the scanning equipment, as the effective resolution, that is, the resolution that can be measured when the equipment is tested, at these higher requirements often does not meet the manufacturer's claimed values.

To test resolution, a specially designed transparency with image details grouped by decreasing size, called a resolution target, is scanned at the highest resolution claimed by the manufacturer. The resulting image is then inspected to identify the smallest group of details discernible. A table is then consulted to match that group with the scanner's effective resolution. Resolution targets typically cost $50 to $100 and come with instructions. An example target and instruction manual can be found at this commercial site: SilverFast Resolution Target (USAF 1951) by LaserSoft Imaging.



© Setreset, 2013. (Available on Wikimedia Commons)
Figure 2. Copy of a 1951 United States Air Force resolution target that is still used to verify the resolution of various optical devices.

Bit depth

Bit depth is the number of bits used to record light information for a given pixel. Bit depth is covered in detail in the flatbed scanning document. The guide states that nearly all devices can operate at 24 bits (8 bits for the red colour channel, 8 bits for green and 8 bits for blue). Many will also be said to operate at 48 bits. However, all scanning hardware and software would have to be functional at that level of precision before any relevant difference between 24-bit output and 48-bit output is noticeable. If in doubt, try the following:

- In 48-bit mode, scan a photographic slide or negative that contains a smooth colour gradient across an uninterrupted space, a blue sky at sunset or sunrise, for instance. Next, scan the same slide in 24-bit mode. In VueScan, under the “Color” menu, set “Color Balance” to “none.” Under the “Output” menu, make sure “Tiff” file is checked, and set “Tiff file type” to “24 bit RGB” or “48 bit RGB.”
- In your image editor, crop the image so that only the portion with the colour gradient is visible. For instance, for a sky at sunset, crop out all but the blue gradient in the image. This can be done either during the scanning process or with a cropping tool in an editor such as the GNU Image Manipulation Program (GIMP).
- Inspect the image in an editor to determine the number of colours used. In GIMP, select the “Colors” menu, then “Info,” then “Color Cube Analysis.”

Randomness (noise) within the equipment means that no two scans will contain the same number of colours. However, a scan of photographic film or slides that shows nothing but an even gradient and that is truly performed at 48 bits will show a quantity of colours that is several times greater than a 24-bit scan, if all equipment in the system is capable of 48-bit image capture.

- To scan photographic transparencies and negatives from 35 mm to 4 × 5 inches, FADGI recommends 8 bits per channel as a minimum and 16 bits per channel as ideal.

Dynamic range (scanner features)

As per the Dynamic range (imaging concepts) section of this supplement, dynamic range is needed to accurately capture luminance, and consequently colour, at the brighter and darker ends of the spectrum.

- To scan photographic transparencies and negatives from 35 mm to 4 × 5 inches, FADGI recommends a dynamic range of 3.5 to 4.0.

As previously stated, a test for dynamic range is beyond the scope of this document. However, insufficient dynamic range can be detected by measuring the colour distance of greyscale swatches in a scanned IT8 target. To learn more about IT8 targets and how to perform these operations, consult Appendix A and Appendix B of the flatbed scanning document. If, after setting a colour profile for the scanner, the colour distances between the target and anticipated values are found to be greater at the extreme ends than they are in the middle, then poor dynamic range is likely the issue.

Unwanted scanner features

This section lists scanner features that are to be avoided.

Non-uniformity / streaking

This unwanted feature is covered in detail in the Streaking section of the flatbed scanning document. It applies to both backlit flatbed scanners and CCD film scanners.

- FADGI does not recommend a specific colour accuracy for photographic transparencies or negatives. Where the colour accuracy of the original transparency is to be maintained, CHIN recommends using FADGI's tolerances for special collection reflective objects instead: a mean colour distance between 3 and 8. To perform these measurements, consult Appendix A and Appendix B of the flatbed scanning document.

Flare and illuminance non-uniformity

Both flare and illuminance non-uniformity are potential problems in transparency scanning equipment. They are covered in detail in the flatbed scanning document, as are the use of greyscale and grey patch tests to identify such problems.

- For photographic transparencies and negatives from 35 mm to 4 × 5 inches, FADGI recommends that illuminance non-uniformity be less than 8 percent but ideally less than 1 percent.

Colour misregistration

Colour misregistration is a potential problem in transparency scanning equipment. It is covered in detail in the flatbed scanning document.

- For photographic transparencies and negatives from 35 mm to 4 × 5 inches, FADGI recommends that colour misregistration be no greater than 1.2 pixels but ideally less than 0.33 pixels.

Other equipment required for film scanning

The following is a list of other items needed to scan photographic transparencies and negative film:

- A computer with an optical (CD) drive, as described in the Other equipment required for flatbed scanning section of the flatbed scanning document.
- Scanning software, as described in the Other equipment required for flatbed scanning section of the flatbed scanning document.
- Image editing software, as described in the Other equipment required for flatbed scanning section of the flatbed scanning document.
- IT8 scanning targets in 35 mm slide format, which are similar to the reflective targets described in the Other equipment required for flatbed scanning section of the flatbed scanning document.
- A manually operated air blower with squeeze bulb for dust removal from objects being scanned, as described in the Other equipment required for flatbed scanning section of the flatbed scanning document.
- Lint-free cloth suitable for cleaning optics, to clean the scanner platen.
- Reagent grade isopropyl alcohol or a dedicated lens cleaner, to clean the scanner platen.

Workflow

As with reflective objects, the FADGI workflow can be used for transparency digitization projects.

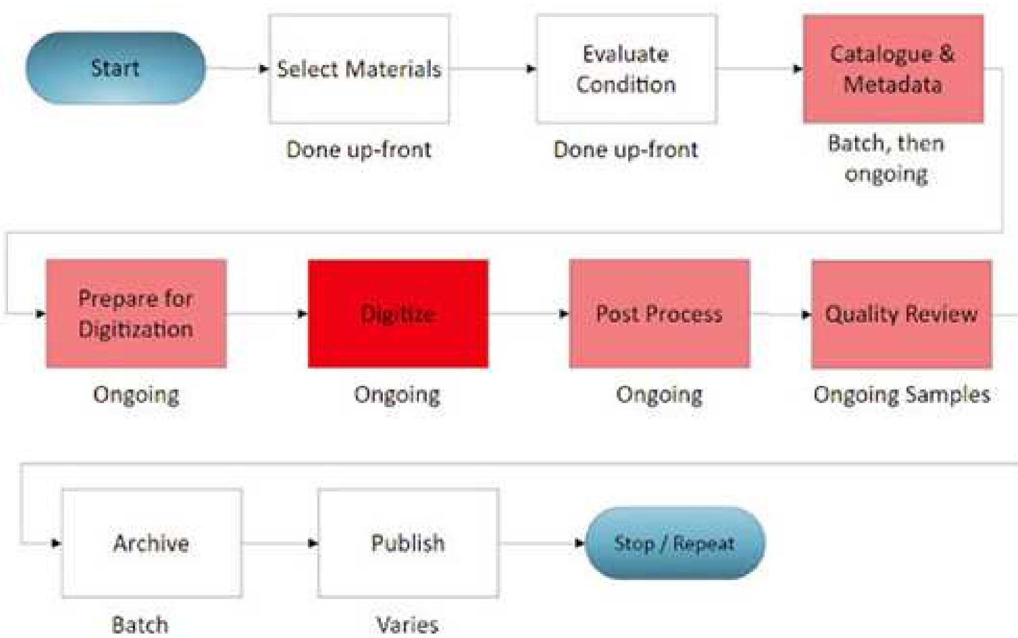


Figure 3. Digitization workflow diagram.

The flatbed scanning document covers each of these steps in detail. This supplement covers only details that apply uniquely to transparencies.

Step 1: Select materials

Handle objects as little as possible.

- Use clean gloves when handling film.
- Handle film by its edges. Handle slides by their mounts.
- Carefully organize and clearly label all objects. Label sleeves or containers where possible. Avoid writing on film. You can write on slide mounts using a felt tip pen.
- Make sure furniture used to examine objects has smooth surfaces, is easy to clean and is large enough to hold objects. Avoid cleaning products that may leave an oil or wax residue.

Step 2: Evaluate condition

Evaluate the condition of all materials. If materials are decomposing, antiquated, have evidence of mould or are otherwise compromised, refer to the recommendations made in the Canadian Conservation Institution (CCI) Technical Bulletin 35 *Care of Plastic Film-based Negative Collections*. Address these issues before proceeding.

To manage and treat mould, refer to Technical Bulletin 26 *Mould Prevention and Collection Recovery: Guidelines for Heritage Collections*.

Step 3: Catalogue and create metadata

For museum collections, slides and negatives should be accessioned in the museum's collections management system. Digital copies should be tied to these records using the accession number in the image's file name.

Step 4: Prepare for digitization

Workspace requirements are similar to those found in the reflective object scanning document. However, eliminating dust is of greater concern given the scan resolutions involved. Vibration may also be a larger issue, as the higher resolutions require more precise control of the scanning equipment. Avoid placing scanning equipment in areas with ambient vibration such as near heavy machinery or shipping bays. Consider placing scanning equipment on a vibration dampening surface such as foam or rubber matting.

If object labelling is incomplete, complete it at this point: object accession numbers, image descriptions, file formats, resolution, capture mode (colour or monochrome), bit depth and any other relevant information. Slide mounts can accept sticky notes or other forms of temporary labelling and can be written on directly using an indelible fine tip pen or marker. Refer to Table 12 and related text in Technical Bulletin 35 *Care of Plastic Film-based Negative Collections* for information on directly marking film strips or negatives. Items can also be labelled at a group level, such as slide boxes or similar.

Calibration and setting a colour profile

As with flatbed scanning, two other steps are performed at this stage: calibrating equipment and setting colour profiles.

First, check the scanner's manual to see if the scanner has a calibration feature. Typically, this resets the scanner's moving parts to position them properly. If your scanner has a calibration feature and it is not run automatically prior to any scan, run it at this point.

Next, you need to set a colour profile. The method here is the same as the one used in the flatbed scanning document. However, the IT8 targets used in this case are slide transparencies, which you can get from a number of sources. Color-aid, for instance, offers IT8 targets as 35 mm slides in a number of common film types. It is ideal but not necessary to set a profile for the type of film being scanned.

The process in VueScan is identical to that described in Appendix A of the flatbed scanning document, but the "Mode" option in the "Input" menu is set to "Transparency," and "Media" is set to "Slide film."

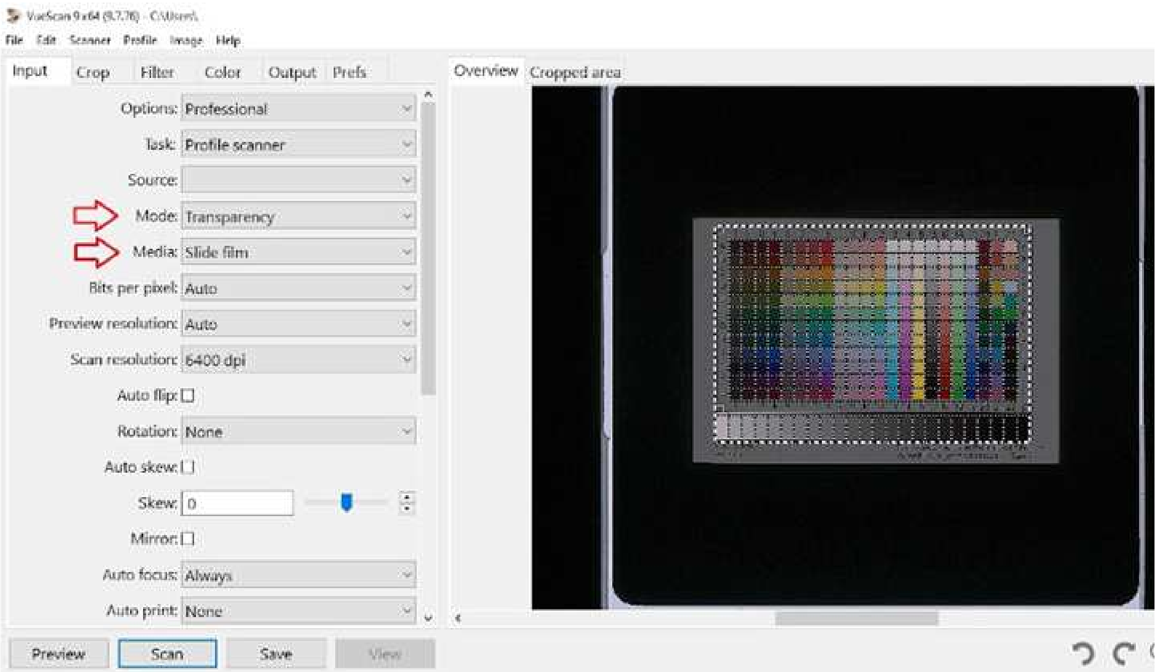


Figure 4. Screenshot showing a colour profile being set for slide transparencies in VueScan.

To set a colour profile in a CCD slide scanner, use the same settings as those previously described. Note that the “Source” under “Input” will default automatically to your CCD scanner when it is plugged in and turned on.

Step 5: Digitize

This is the actual process of scanning. Because of frequent backlog, this process is run constantly.

Infrared scanning

Some transparency scanning hardware is equipped with infrared light, which is used to identify artifacts such as dust, dirt and scratches in or on the transparency’s surface. When an artifact is detected, a filter is applied to reduce its appearance. Filters that modify the original information produced by a scan can be applied during post-processing but should not be applied to the original scan. Infrared is an exception, as it must be used during the scanning process.

In making the decision to use infrared, it is necessary to consider whether the scan is meant to capture an image of the transparency as an artifact or the image born by the transparency. If the former, infrared should not be used, because you want to retain every scratch or similar detail on the transparency. If the latter, infrared should be used. The latter case is the most common. If in doubt, complete the process twice, once with infrared and once without.

Both the CCD scanner and the flatbed scanner referred to in this supplement have infrared capabilities. VueScan can use that information to apply a filter. The settings that follow demonstrate how to use this feature.

Flatbed transparency scanning

For flatbed transparency scanning, proceed as follows.

1. Remove the light cover

Figure 5. Removing the light cover.

2. Clean the platen (described in the [Digitize](#) section of the flatbed scanning document). Repeat this step only if required in future iterations.
3. Use a manually operated air blower with a squeeze bulb to clean the slides or film in the tray. Do not use your breath to blow on the slides, as you may leave droplets of saliva on their surface.
4. Load the slide or film tray on the scanner platen and add the film or slides. Note that the orientation of slides within their mounts is generally consistent within any given batch. However, the orientation of slides and mounts between batches can be nearly random. Mounts may be upside down or backwards relative to the image they house. Inspect the slides in each batch to determine the correct orientation. In general, the dull side (the side with emulsion) of film and slides is placed upwards on a flatbed scanner. Check the manufacturer instructions and experiment to determine the correct orientation of film and slides for your equipment.

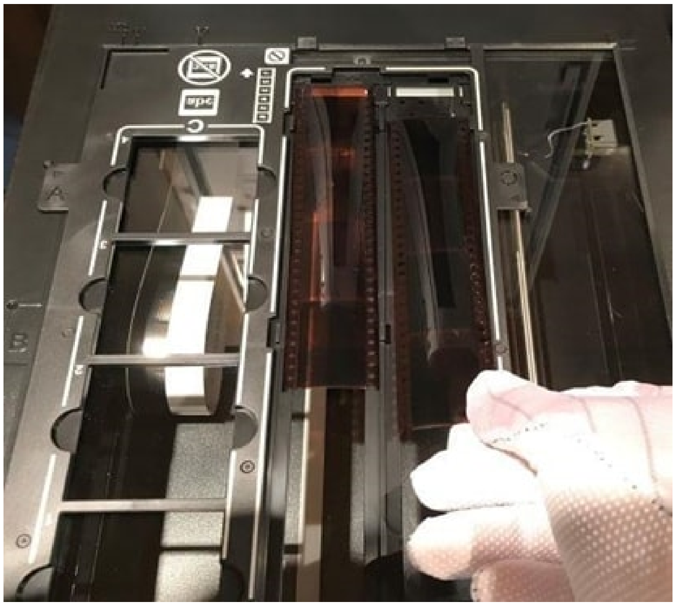


Figure 6. Loading film into the film tray. Note gloves for handling film. Note also in the top left corner of the photo, there is a tab on the tray bearing the letter “A.” The tray came with the scanner and the tab on the tray fits into a slot along the moulding of the scanner body so as to properly align the tray and correctly place the film under the scanner’s backlighting area.

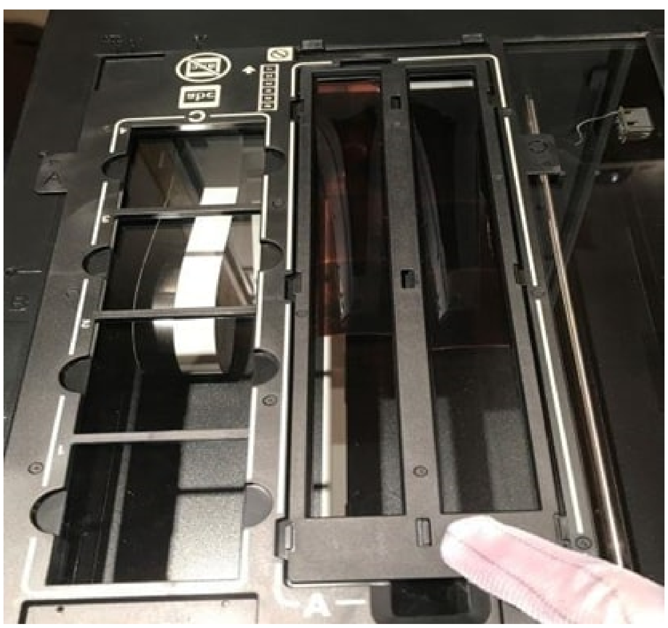


Figure 7. Closing the cover on the film tray. The cover holds the film in place and reduces curvature.

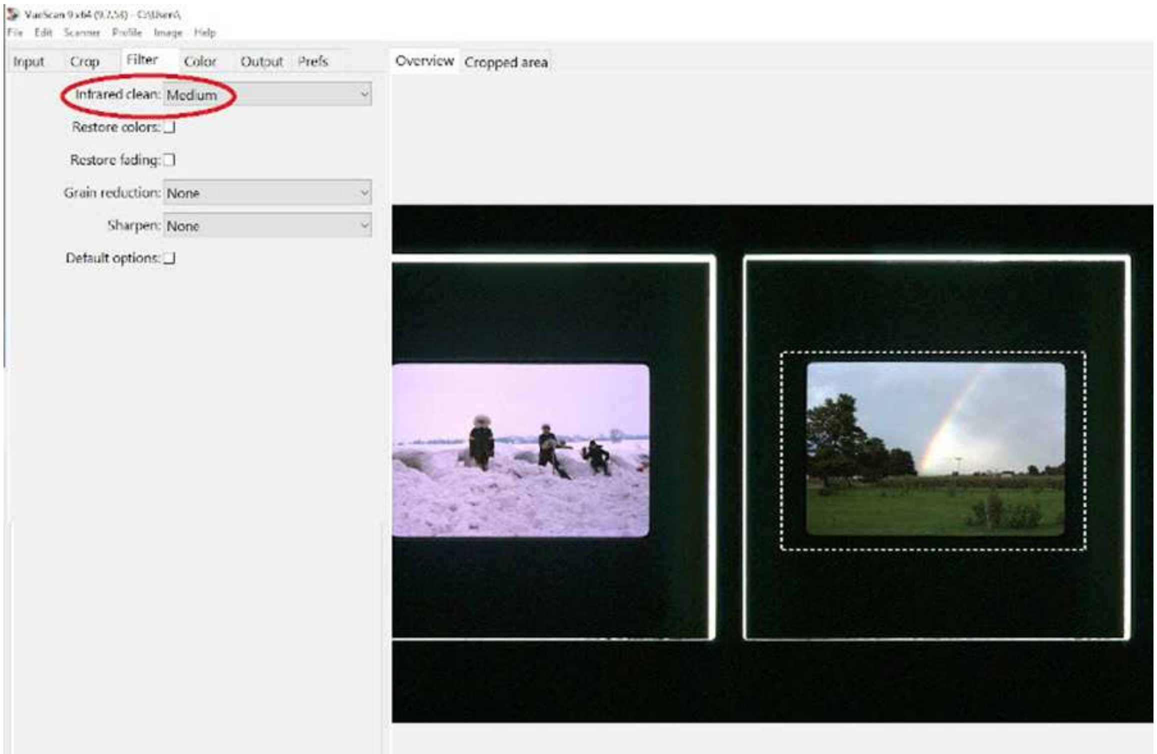
© Government of Canada, Canadian Heritage Information Network. 133977-0009
Figure 8. Loading slides into the slide section of the transparency tray. Make sure your hands are clean and dry. Handle the slide mounts only. Note that the tray has been reversed and the “C” tab is now placed in its respective slot, in the scanner body at the edge of the platen. This ensures that slides are placed correctly under the backlit area.

5. Run a scan preview by selecting the preview button in VueScan.
6. Drag the scan area to select a specific image to scan. Make sure at least some frame or film border is captured around the entire image.
7. Specify the image output file name and destination. Make sure all scan settings are correct.

For slides and film, the VueScan settings are identical to the settings for reflective objects, with the following exceptions:

- Under the “Input” tab, set “Mode” to “Transparency.” Set “Media” to “Image,” “Slide film,” “Color negative” or “Black and white negative,” as the case may be.

- Under the “Filter” tab, set “Infrared clean” to “Light,” “Medium” or “Heavy” if your scanner has this option and if you are scanning colour transparencies.



(Photos courtesy of private individuals)
Figure 9. Selecting an image from the preview of a flatbed slide scan using VueScan. Note the filter setting on the left for infrared clean. This is the only filter recommended during digitization, as it must be used at the time of the initial scan. Apart from this filter, it is better to manipulate image features in post-processing and save the results as a production master so that changes are not “baked” into your archival master image.

8. Click the “Scan” button to complete the scan.
9. Repeat steps 7 through 9 until all images on the tray have been scanned.

CCD slide scanning

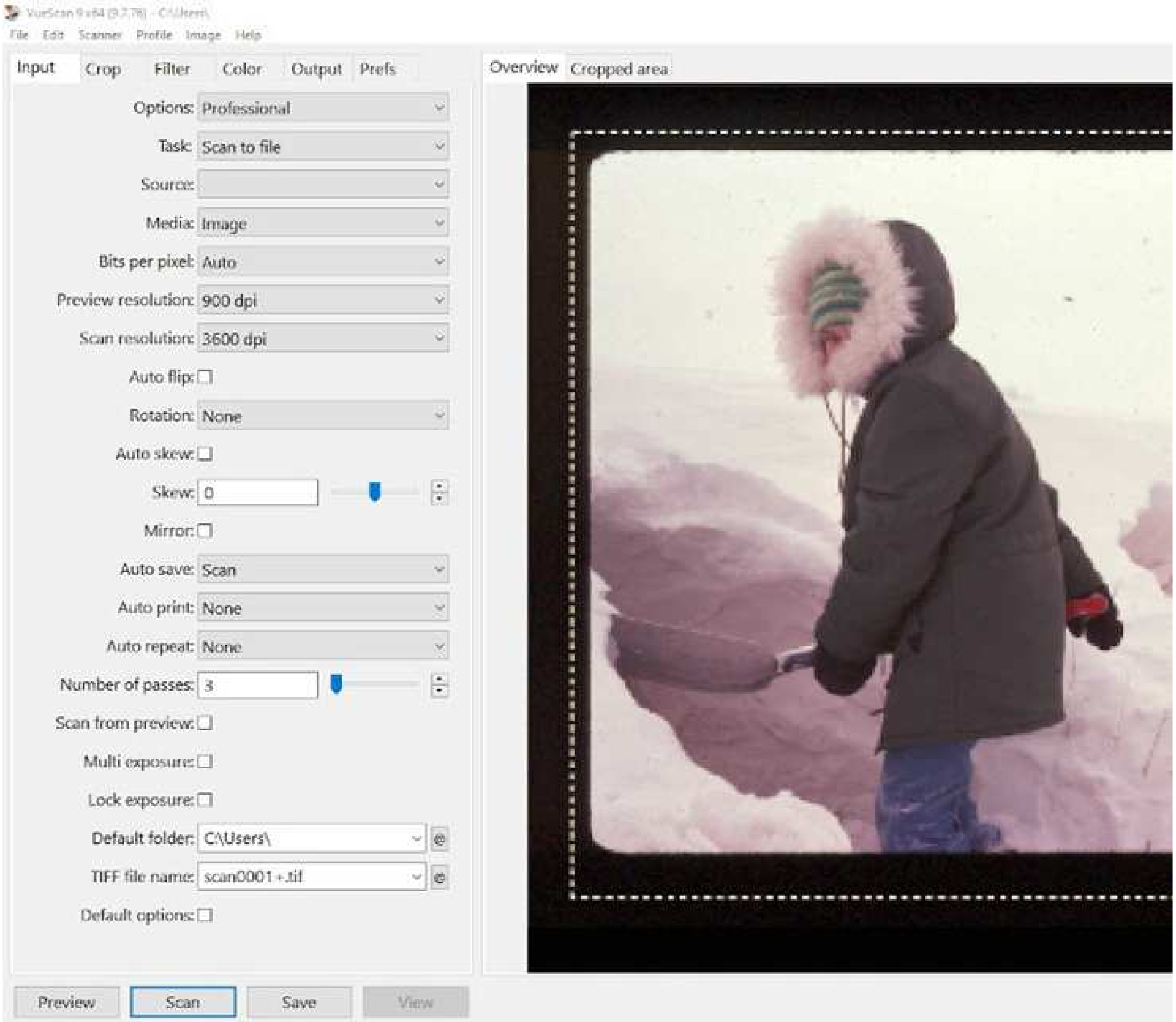
For slide and film scanning using a CCD film scanner, proceed as follows.

1. Load the film or slide into the CCD feeder tray. Follow the manufacturer’s instructions for that particular scanner to ensure proper orientation of slides, film and negatives.

2. Use a manually operated air blower with squeeze bulb to clean the slides or film in the tray. Do not use your breath to blow on the slides, as you may leave droplets of saliva on their surface.
3. Insert the tray into the scanner. The process will vary by model. Follow the manufacturer's instructions.

Figure 10. Loading a slide tray into the CCD scanner.

4. Run a scan preview in VueScan.
5. Drag the scan area to select a specific image to scan. Make sure to capture at least some frame or film border around the image.



© Government of Canada, Canadian Heritage Information Network. 133977-0013
(Photo courtesy of a private individual)
Figure 11. Previewing a slide scan from a CCD scanner in VueScan.

6. Specify the image output file name and destination. Make sure all scan settings are correct as per step 8 in the Flatbed transparency scanning section. Make only the following changes to these settings:
   - VueScan should automatically detect your CCD scanner and set it to the default Source (under the “Input” tab).
   - Also under the “Input” tab, set “Media” to “Image,” “Slide film,” “Color negative” or “Black and white negative,” as the case may be.
   - Under the “Filter” tab, set “Infrared clean” to “Light,” “Medium” or “Heavy” if your scanner has this option and you are scanning colour transparencies.
7. Click the “Scan” button to complete the scan.

8. Move the tray to the next image. Repeat steps 4 through 6 until all slides, film or negatives have been scanned.

FADGI recommends saving all transparencies under 4 × 5 inches using the following specifications:

- File format: TIFF
- Resolution: 1000 ppi (acceptable) to 4000 ppi (ideal)
- Bit depth: 8 bits per channel (acceptable) or 16 bits per channel (ideal)

Step 6: Post-processing

At the post-processing step, images are modified to improve usability and accessibility. Once the adjustments have been made, they cannot be undone. For that reason, it is a best practice to keep both an unedited archival (preservation) master file and a post-processed production (service) master.

Keep a border around the image in the archival version. This border may be retained or cropped in post-processed versions, as per your institution's policy.

The following are typical post-processing activities.

- Adjust files to a standard image specification.
  - grey and white balancing
  - de-skewing
  - cropping image and standardizing dimensions
- Document technical metadata.
- Standardize file format.
- Standardize file naming and directory structure.

Details on these steps can be found in the Post-processing section of the flatbed scanning document. The steps presented here are identical to those outlined in that document, with the exception of the recommended file format, which is the TIFF format, as described at the end of the Digitize section of this supplement.

Preset colour curves

In addition to the previously described post-processing activities, slides or negatives may show effects of aging or, in the case of reproductions, offsets in colour that are common to all slides or film in a batch.

It is common at the post-processing stage to adjust colour in individual images or batches so they more accurately represent the subject depicted by the transparency. However, the process is subjective and involves a degree of interpretation. Be sure to save the original archival master and the production master separately.

Changing colours to suit an individual's perception also assumes that the monitor on which the image is being viewed is accurately depicting colour information. Monitor calibration is beyond the scope of this document. The following sources may help:

- Calibrate your monitor to give your video the best possible color (Adobe)
- How to calibrate your monitor (B&H Photo)

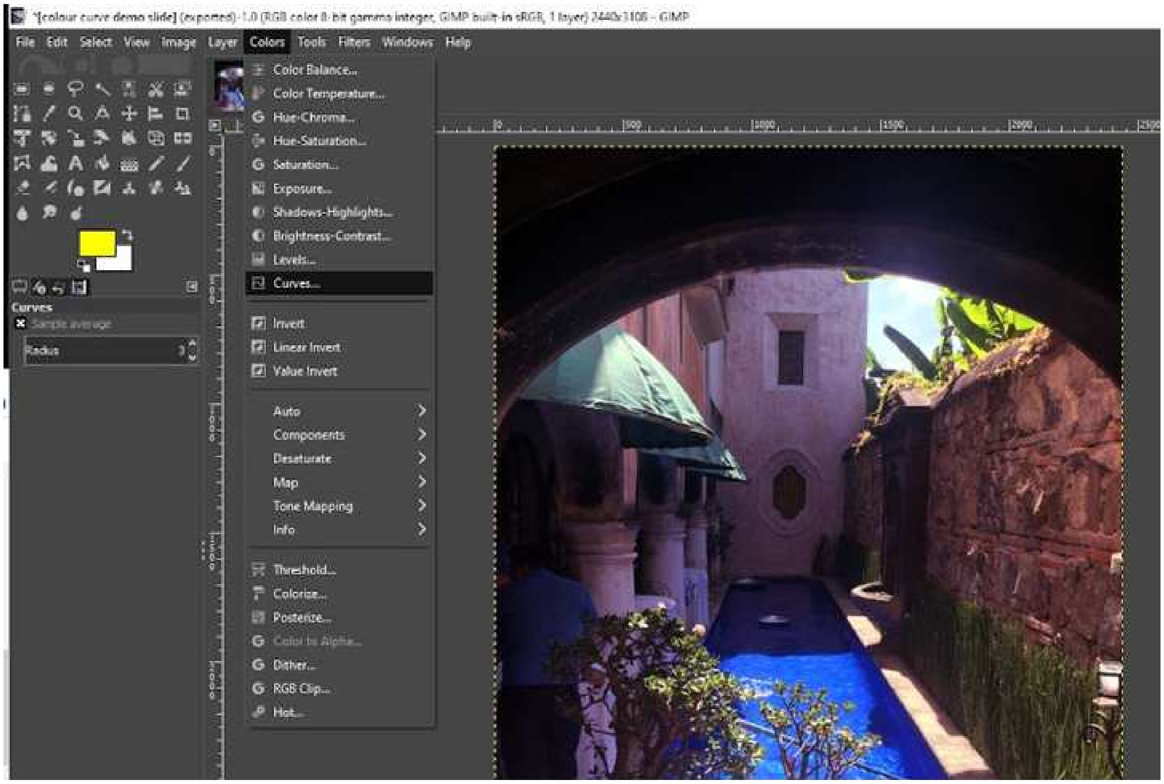
Note that any monitor calibration solution must involve an objective metric such as a colorimeter. Without such a metric, calibration cannot be accurate.

Most image editors allow some form of batch processing to address these shifts in colour or luminance en masse. For GIMP, colour curve presets can be used. The following section explains how to create and use a colour curve preset.

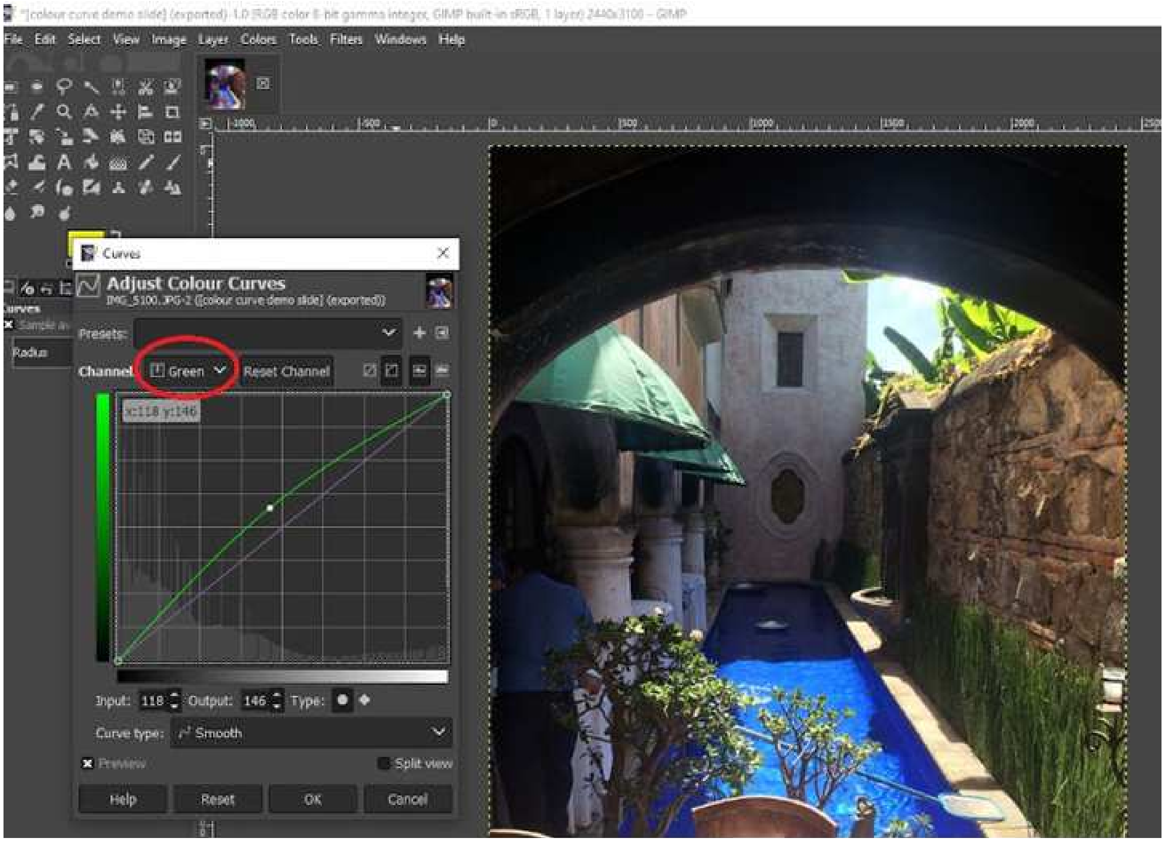
Adjusting colour using a colour curve in GIMP

Image editing software has several tools to modify colour information. In GIMP, one tool modifies colour curves. In the following example, the green channel is lower than red and blue for a batch of photos. To modify colour information for the green channel, proceed as follows.

1. Load the photo and determine the degree to which the green value must be increased.



(Photo courtesy of a private individual)
Figure 12. Screenshot of photo in GIMP. The red and blue channels are vibrant, but green is washed out. To adjust the green colour curve, select “Curves” from the “Colors” menu.



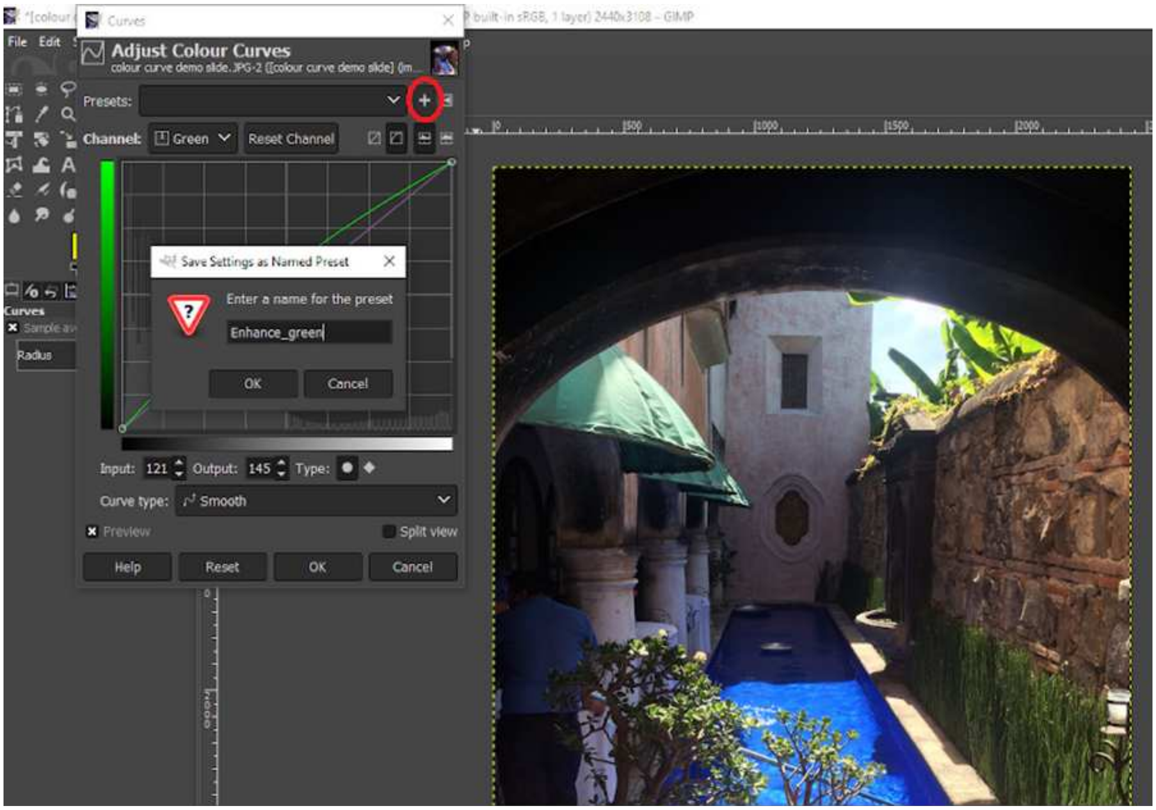
(Photo courtesy of a private individual)
Figure 13. Adjusting a colour curve. Once you have selected the "Curves" option, select the green channel (circled in red), then drag the green curve to change values.

2. Once you are satisfied with the green curve, save the change. Then save the image as a production master or derivative.

Using preset colour curves in GIMP

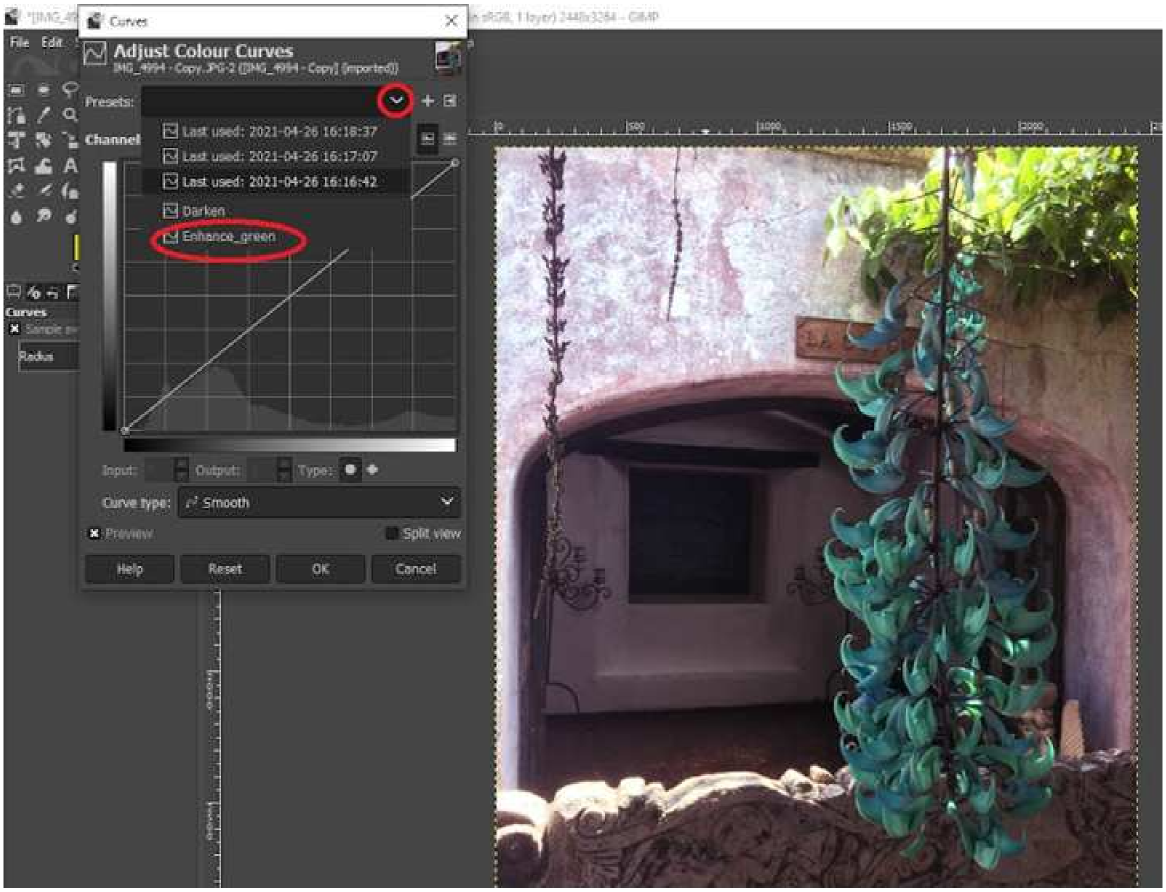
Preset colour curves can be applied to any image imported into GIMP. They allow you to correct batches of images with the same fading, bluing or errors in reproduction. To create a preset colour curve and apply it to multiple images, proceed as follows.

1. Load the first image, then adjust the necessary colour curve. Save the curve as a preset, then apply the curve to that image. Save the image as a production master or derivative.



© Government of Canada, Canadian Heritage Information Network. 133977-0019
(Photo courtesy of a private individual)
Figure 14. Saving a colour curve as a preset. After editing colour curves but before applying them, click on the "+" button (circled in red) to add a colour curve preset. A dialogue box will appear. Give the colour curve a name (in the example, "Enhance_green"). Click "OK" on the dialogue box to save the preset, then click "OK" on the "Adjust Colour Curves" dialogue box to apply the changes to the current image. For future images, you can choose the "Enhance_green" preset from the list of saved presets.

2. Load a second photo. Select and apply the preset colour curve. Save the resulting image as a production master or derivative.



(Photo courtesy of a private individual)
Figure 15. Loading a second image that also requires green enhancement. This image, which is part of the batch that has underdeveloped green, has been loaded to apply the same “Enhance_green” colour curve. After selecting “curves” from the “Colour” menu, the “Adjust Colour Curves” dialogue box appears. By clicking on the down arrow (circled in red) a “presets” box, a pick list of existing colour curves, appears. Scrolling to the bottom reveals the “Enhance_green” preset. Select this curve, and click “OK” at the bottom of the “Adjust Colour Curves” dialogue box to apply the curve.

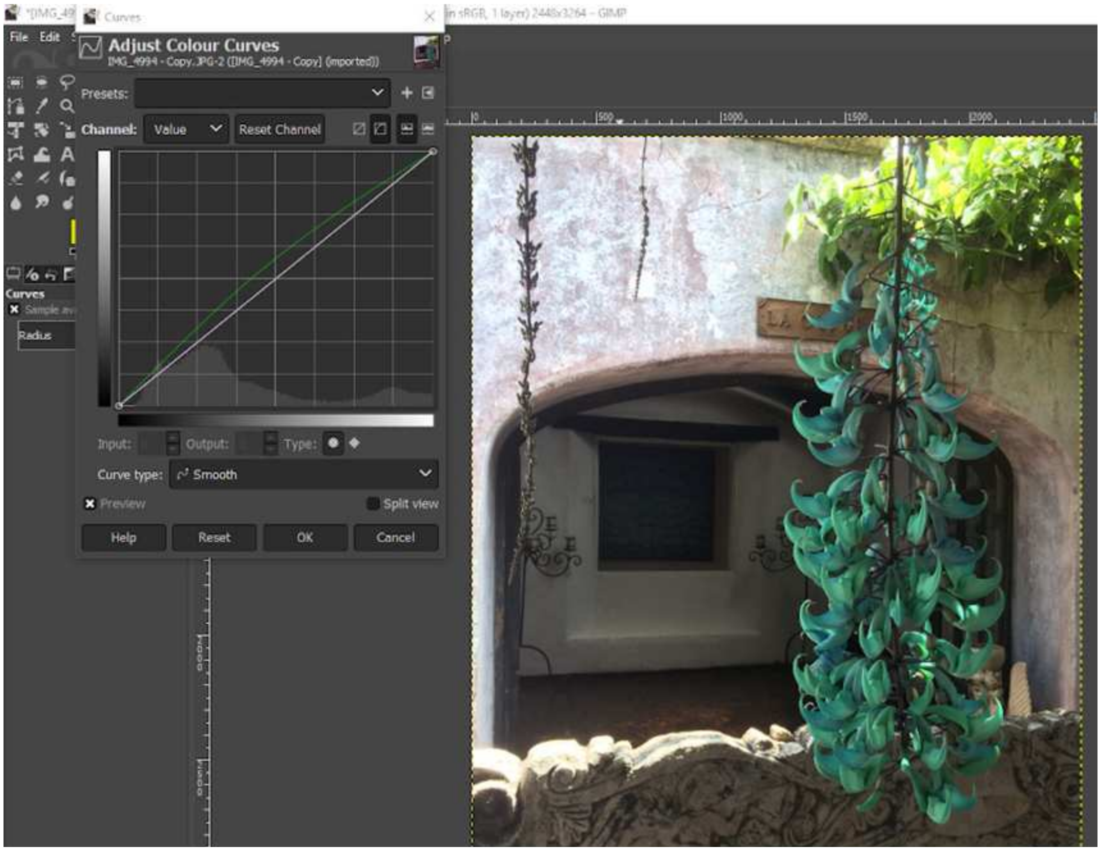


Photo courtesy of a private individual)
Figure 16. Adjusted image after "Enhance_green" colour curve has been applied. Note the stone sculpting behind the jade vine now appears grey.

3. Repeat step 2 for subsequent photos in the batch.

Step 7: Quality review

This step is typically done to a sample section of digitized materials after several have been digitized and post-processed. Activities, including periodically reviewing scanner output, are identical to those described in the Quality review section of the flatbed scanning document.

Step 8: Archive

Archiving is carried out at regular intervals and varies according to the nature of the institution. Both archival (preservation) masters and production (service) masters should be saved for long-term preservation. For more details on long-term preservation, consult CHIN's Digital Preservation Toolkit.

Step 9: Publish

This activity is typically the end goal of any digitization process. It varies according to the institution's technology and how it intends to use the digitized content. In general, publishing is performed outside the typical digitization workflow. However, it may be included if a digital asset management (DAM) system is available.

Master files are generally too "heavy" for online publication. Instead, lower-resolution derivatives (or "access copies") are used for publication.

Common transparency scanning issues

A number of scanning issues can arise with transparencies. This section summarizes the issues that can occur.

Skew

Although the use of trays reduces the likelihood and degree of skew in small transparencies, it can occur. The process for de-skewing is described in detail in the Skew section of the flatbed scanning document.

Image artifacts

Because small format transparencies are scanned at higher resolutions, problems with image artifacts such as dust, dirt and scratches are more common than with reflective objects. Cleaning the platen with a lint free cloth and using an air blower on the transparency are two ways to reduce these artifacts. Infrared can also be used to filter out the appearance of artifacts, if your scanner has infrared capability. These techniques are described in the Digitize step of the workflow.

Moiré

Moiré, as described in the flatbed scanning document, can occur with transparencies. Solutions are more limited. You may be unable to change the scanning resolution or skew the subject, as trays are designed to maintain proper alignment. A de-screening filter such as a Gaussian blur can be used in post-processing. This type of filter is available in GIMP.

Focus

Some larger format film and negatives may have undue curvature, and a tray may not provide sufficient control to keep the film or negative flat. This can lead to poor focus over some sections of the frame.

Anti-Newton Ring (ANR) Glass, a thin glass with frosting on one side, may be used to help control curvature where the film is not fragile. CHIN has not tested this method but recognizes it as a viable solution.

For fragile film or negatives with curvature, consult Technical Bulletin 35 *Care of Plastic Film-based Negative Collections – Polyester film base*.

Newton's rings

Newton's rings appear when the object being scanned touches the glass platen. Photographic trays (described and depicted in the Digitize step) will raise the transparency away from the glass. If rings still appear, the transparency may be curved to a point that it still touches the platen. This is more common with large format film.

First, try to reverse the film in its mounting tray, then rescan. Note that the image will need to be reversed, which you can do in VueScan or during post-processing.

If the rings persist, you can use ANR glass to flatten the film. CHIN has yet to test this method but recognizes it as a viable solution.

Newton's rings do not occur in CCD scanners, as there is no glass surface with which slides, film or negatives may come into contact.

Acknowledgements

CHIN would like to thank the following people for their invaluable contributions to this guide:

- Cassandra Tavukciyan, Canadian Museum of History
- Kathleen Brosseau, Canadian Museum of History
- Jillian Staniec, City of Red Deer, Information Technology Services
- Jean-Luc Vincent, Parks Canada

Glossary

complementary metal oxide semiconductor (CMOS)
: This is the base technology for the image sensor found in the back of a digital camera.

charged coupling device (CCD)
: This forms the basis of most flatbed scanners, as well as higher end film scanners. CCD arrays require a longer exposure time than CMOS sensors but tend to produce higher quality results when scanning still images.

colour gamut

A range of colours that can be expressed by a colour model that is mapped onto a colour space. The number of colours in a gamut is always equal to or less than the possible number of colours within a colour space.

colour model

A collection of numeric values that, when mapped onto a colour space, provide a colour attribution for any value in the model.

colour space

A collection of possible colours, typically bounded by parameters such as luminance, or specific colours within the light spectrum that define the model. Colours within the space can be numerically expressed using a colour model.

derivative files (or access files)

Copies of a master file that are used for various projects. They may be edited in different ways and are not saved for long-term preservation.

Federal Agencies Digital Guidelines Initiative (FADGI)

An American group dedicated to creating and promoting best practices and standards for digitization.

preservation master (or archival master) file

This is the original scanned file. Apart from some basic cropping, possibly to segregate the subject from other subjects captured in the same scan, the file has not been edited in any way. The preservation master is always saved for long-term preservation.

production master (or service master) file

This file has been edited. Colours may be balanced, tone levels may be optimized, the image may be de-skewed, dimensions may be normalized and filters may be applied to “clean up” the image’s appearance. The production master is saved for long-term preservation.

reflective scanning

Scanning light information reflected off the surface of a medium, such as paper.

transmissive scanning

Scanning light information transmitted through a medium, such as film, slides or transparencies.

Bibliography

Adamo, M. “The FADGI Still Image Standard: It Isn’t Just About File Specs.” *Bitstreams* (blog), June 17, 2016.

BCR’s CDP Digital Imaging Best Practices Working Group. *BCR’s CDP Digital Imaging Best Practices Version 2.0* (PDF format). Aurora, CO: Mountain West Digital Library, 2008.

Bieman, E. *How to Scan Reflective Objects Using a Flatbed Scanner*. Ottawa, ON: Canadian Heritage Information Network, 2022.

Fielding, G. *Digital ICE: Defect Detection and Correction Using Infrared-enabled Scanners*. Rochester, NY: Eastman Kodak Company, n.d.

Hill, G. *Care of Plastic Film-based Negative Collections*. Technical Bulletin 35. Ottawa, ON: Canadian Conservation Institute, 2019.

LeFurgy, B. "Information or Artifact: Digitizing Photographic Negatives and Transparencies, Part 2." *The Signal* (blog), October 18, 2011.

Rieger, T. *Technical Guidelines for Digitizing Cultural Heritage Materials: Creation of Raster Image Files*, revised (PDF Format). Washington, D.C.: Federal Agencies Digital Guidelines Initiative, September 2016.

Roemer, C. "Cleaning Tips before Digitizing Slides and Photos." *Aperture* (blog), n.d.

Wagner, P. *Device Classes at Film Scanners*. Munich, Germany: ScanDig, n.d.

Wueller, D. "Measuring Scanner Dynamic Range" (PDF format). In *IS&T's PICS 2002 Image Processing, Image Quality, Image Capture Systems Conference, Portland, Oregon, 7–14 April 2002, Preprints*, vol. 5. Spingfield, VA: The Society for Imaging Science and Technology, 2002, pp. 163–166.

Further readings

Kavanaugh, T., and G. Holtz. Calibrate your monitor to give your video the best possible color. San Jose, CA: Adobe, n.d.

Taylor, J. How to calibrate your monitor. New York, NY: B&H, 2014

Published by:
Canadian Heritage Information Network
Department of Canadian Heritage
1030 Innes Road
Ottawa ON K1B 4S7
Canada

Cat. No.: CH57-4/59-2023E-PDF
ISBN 978-0-660-46505-0