Canadian Conservation Institute
Institut canadien de conservation

Lighting Methods for Photographing Museum Objects

by Carl Bigras, Mylène Choquette, and Jeremy Powell

Canadian Heritage Patrimoine canadien
Canada

Table of Contents

Foreword

This manual discusses lighting techniques for photographing cultural objects. It demonstrates how lighting can shape and bring out the features of an object in a photograph — features that might not be seen if the photograph was taken in ambient light or with an on-camera flash (see Figure 1). Fifteen lighting techniques are covered, all of which are illustrated with examples. These techniques should meet the needs of most objects in a museum collection.

The manual is intended to assist in the creation of effective photographic documentation of cultural objects. It includes some basic information on photography, but is not meant to be an introductory guide to photography or a substitute for a photography course or workshop. For additional information on photography, or definitions/explanations of the photographic terms used in the manual, please refer to the Bibliography (p. 59).

Figure 1. This textile sampler was photographed to document its condition and texture. Note the different details that were captured depending on the lighting technique used: (a) normal light; (b) low-angle light; (c) raking light. Textile sampler (creator and date unknown) from the CCI Training Collection.

Introduction

Photography is an important tool for recording and sharing information about cultural properties. It is used to create registration records, museum databases, educational materials, marketing products, and publications.

For the curator, photography is an essential research and communication tool for exhibitions, scholarly articles, lectures, and seminars. For the conservator, it allows the condition of objects to be documented before, during, and after treatment (the emphasis here is on the precise and accurate recording of the object's condition, which differs somewhat from exhibition catalogue photography). For the conservation scientist, it provides a means to document the location from which samples are removed from objects for analysis.

Photographs are indispensable for exhibitions that travel, providing a record of the condition of the objects (including any damage that may occur in transit) for liability and insurance purposes. They are also an invaluable tool for identifying and recovering lost or stolen objects and, in cases of art fraud, for documenting fakes and forgeries.

Photographic documentation (photodocumentation) of cultural objects should always be of the highest possible quality. This accurate and efficient technical photography requires advanced knowledge of photographic methods — including lighting techniques. The rapid advances in digital technology make it difficult to predict how cameras, digital media, and related technologies will evolve, but the lighting principles described in this manual are unlikely to change. They will help to produce good photographic results with film or digital cameras.

Note: Although the lighting methods described in this manual are used mainly for cultural objects, they can be adapted for other types of objects and specimens, and can be applied outside the field of cultural heritage.

Acknowledgements

The authors would like to thank the following individuals for their help with this publication:

- Ian N.M. Wainwright for his collaboration with technical writing
- Garry Carter, Louise Renaud, Robert Lavoie, Suzanne Loranger, and Michel Élie for reviewing the manuscript and making helpful comments and suggestions
- Tim Smiglicki and Emily Leonoff for assistance in taking photographs
- the museums and private collectors who have generously allowed their objects to be used to illustrate photographic techniques
- other CCI staff members for providing support in their respective fields

Determining Photographic Requirements

All photographic studios — whether they are large dedicated workrooms or small shared spaces — require cameras, lenses, lighting systems, computers, and software. However, when planning and installing a studio, it is important to choose the right type of equipment for the photography that will be carried out.

Choosing a camera

The choice of camera depends on the size of the objects to be recorded, the extent of documentation to be done, and the image quality to be produced. In all cases, the right camera can help to ensure that the photodocumentation procedure is efficient and accurate. However, finding a camera that meets all of the technical requirements and is still within the given budget can be a difficult task.

As a general rule, higher quality equipment is more expensive. A digital single lens reflex (DSLR) camera is more expensive than a point & shoot (P&S) camera, and has more features and advantages. For example, a DSLR camera might support both Adobe RGB 1998 and sRGB colour spaces (Adobe RGB 1998 provides a larger colour gamut than sRGB). This may be an important function if the photographs are to be posted on the Internet or published in printed materials (see the Bibliography on p. 59).

Because the principal goal of photodocumentation is to create photographic images repetitively and consistently, it is important that the camera chosen allow the user to:

- manually focus the camera lens
- control the camera exposure system
- adjust the "white balance" setting of the camera when used with different light sources

Note: Makes and/or models of cameras change frequently; therefore, the following information on types of cameras is generic.

Types of cameras

Point-and shoot (P&S) cameras

P&S cameras are inexpensive and typically have low to moderate optical quality. These cameras have smaller image sensors than DSLR cameras, and the lenses are more prone to chromatic aberration (cyan/red fringing), exposure vignetting, and curve field and barrel distortion. The viewfinder has a different optical path from the lens, so looking through it is not as accurate as viewing images on the LCD screen. Older P&S cameras have some lag time between depressing the shutter release button and capturing the image.

P&S cameras can be divided into three categories:

- **Pocket cameras (ultra compact)** have the fewest capabilities; their functions are very limited.

- **Compact cameras** usually have more features than ultra compact cameras (e.g. shutter and aperture control), but are still quite limited.
- **Advanced P&S cameras** have all the features of ultra compact and compact cameras plus some additional ones such as manual focussing, external flash capabilities, and RAW file format option.

Digital single lens reflex (DSLR) cameras

DSLR cameras and lenses are the most versatile and can deliver high optical quality at modest cost. The optical path of a DSLR camera is the same for viewing and for exposing — "what you see is what you get". Exposure and depth of field can be controlled. With DSLR cameras, it is easy to attach lenses of different focal lengths to vary the angle of view and change the visual perspective.

Medium format cameras and digital backs

Digital medium format cameras are generally more expensive than DSLR cameras. They have all the advantages of DSLR cameras and provide a larger image sensor with greater resolution and higher dynamic range. The name "medium format" is derived from an analogy with film sizes of 6 cm x ~ 4.5 cm / 6 cm / 7 cm / 9 cm (120/220 film format).

Some traditional (film) medium format cameras can be changed to a digital format through the addition of a digital back. Upgrading old equipment in this manner is less expensive than purchasing a new camera system.

Large format cameras

Large format cameras are the most expensive — and the best quality. Although they require time-consuming setup, they allow for better perspective control through adjustments of the camera components (tilt and swing, shift of lens and back planes). The most common formats are 10.2 x 12.7 cm (4 x 5 in.) and 20.3 x 25.4 cm (8 x 10 in.).

As with medium format cameras, large format cameras can be adapted with digital backs.

Large format cameras can also be adapted with DSLR camera bodies using special stitching adaptor backs. This allows the photographer to take a number of images and then stitch them together using specialized software, thereby capturing an even larger image with no perspective distortion.

Types of lenses

There are more than a dozen different types of lenses, but only seven (normal, wide-angle, telephoto, zoom, macro, macro-zoom, and perspective control) are used for photographing museum objects.

Normal

Normal lenses have approximately the same angle of view as the human eye, with no magnification or reduction. The focal length of a normal lens is calculated based on the camera sensor's diagonal dimension. Normal lenses are manufactured with a wide aperture (small f-stop number), making them ideal for low light conditions.

Wide-angle

Wide-angle lenses have a wider field of view and a shorter focal length than normal lenses. They are useful for photographing large subjects within limited space. However, they can cause perspective distortion when photographing three-dimensional objects, where they are likely to be used at a close distance to the subject.

Telephoto

Telephoto lenses have a narrower field of view and a longer focal length than normal lenses. They are used to photograph subjects from a distance, making them appear magnified. Their narrow field of view is useful for minimizing lens flare (unwanted stray light) and unwanted perspective distortion.

Zoom

The focal length (angle of view) of zoom lenses can range from super wide-angle to super telephoto. These lenses can vary widely in price and quality.

Macro

All of the previous lenses have a curved focussing plane, i.e. when the centre of an image is in focus the corners will be slightly out of focus. The optics of macro lenses are corrected to provide a flatter focussing plane so that both the centre and corners of an image will be in focus. When using a macro lens (known as photomacrography in America and macrophotography in Britain), some exposure compensation is required (refer to the instruction manual of the camera for more information). If the macro lens has a reproduction scale on the lens barrel, the correct exposure factor can be found in Table 1.

Table 1. Exposure compensation for macro lenses

Ratio of reproduction	Exposure factor	Exposure increase in f-stops
1:10	1.2	1/4
1:8	1.3	1/3
1:6	1.4	1/2
1:4	1.6	2/3
1:3	1.8	3/4
1:2	2.2	1
1:1.75	2.5	1 1/4
1:1.5	2.8	1 1/2
1:1.25	3.3	1 3/4
1:1	4	2

Macro-zoom

Macro-zoom lenses combine the properties of macro and zoom lenses, i.e. they have a flatter focussing plane and a variable focal length. These all-in-one lenses are very popular and are included (either built-in or as a camera kit) with most P&S and DSLR cameras purchased today.

However, macro-zoom lenses do not generally perform as well as lenses with a fixed focal length (see Figure 2). This is true at all focal lengths. Because their maximum magnification in macro mode occurs when the lens is set at the widest angle, the object must be very close to the lens (1–3 cm) and the lens barrel can create a shadow (Figure 2a). Also, the design of the lenses can lead to optical distortion (Figure 2b). For example, curvature of field (i.e. the centre of the image is in focus but the corners are not) can occur when photographing flat artwork, as can barrel or pincushion distortion (i.e. the object's straight lines turn into curved lines at the edge of the photograph).

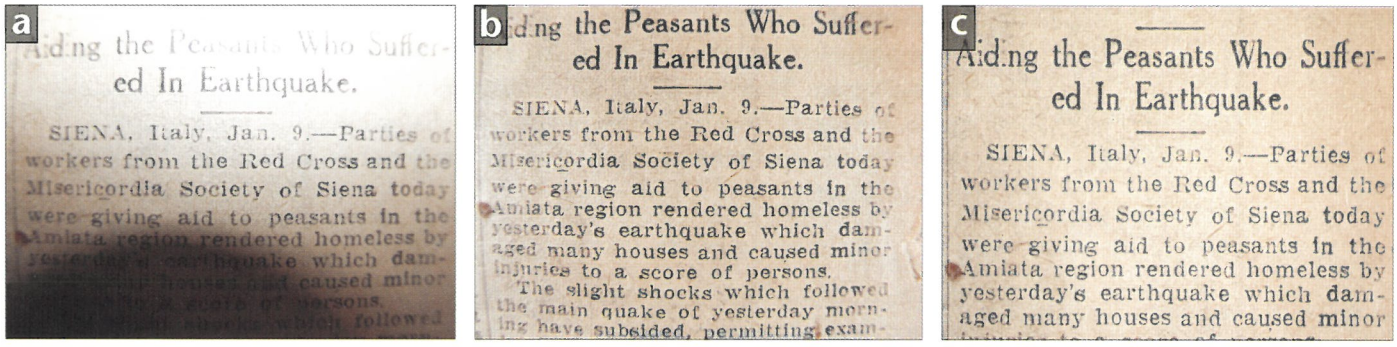


Figure 2. Photographs of a newspaper clipping from 1921. (a) This image was taken with a P&S camera; the camera's macro-zoom lens was set at 24 mm wide-angle equivalent, the lens-to-subject distance was 2.5 cm, and the built-in flash was used. Note the shadow and uneven lighting. (b) This image was taken with the same camera and setup except that normal light (see p. 22) was used instead of the built-in flash. The shadow has been eliminated but the corners are still out of focus due to barrel and curved field distortion. (c) This distortion-free image was taken under normal lighting, using a DSLR camera with a 60 mm macro lens and a lens-to-subject distance of 10 cm. Newspaper from the CCI Training Collection.

Perspective control

Perspective control (PC) lenses (see Figure 3) eliminate the skewing of an image that is observed with a regular lens when it is not positioned perpendicular to the object, i.e. they provide perspective correction with DSLR cameras. PC lenses are generally expensive and infrequently used, but they can be advantageous in some applications. For example, when photographing a mirror, a PC lens allows the camera to be positioned off to one side so as not to be reflected in the mirror. They are also useful when shooting artworks on location with limited space or obstructive architecture, and for perspective correction in architectural photography.

Figure 3. PC lenses of different focal lengths: 28 mm and 35 mm shift lenses, and 85 mm tilt & shift lens (far right).

Depth of field

The depth of field is the zone in front of and behind the focussed subject plane that remains in focus. For a lens of a given focal length, the depth of field is determined by the distance from the camera to the subject, and the lens aperture. The closer the object is to the camera, the shallower the depth of field. Smaller camera apertures (higher aperture numbers in f-stops) increase the depth of field but may also reduce the sharpness of the image due to lens aberration (diffraction). The depth of field can be increased by switching to a lens with a shorter focal length as long as the distance from the camera to the subject remains the same. Changing the focal length will affect the perspective.

Exposure

Exposure compensation is required for objects that are lighter or darker than average; without it, details in the highlights or shadows are lost. Exposure

bracketing refers to taking additional photographs of the object with a range of under and over exposures to ensure that the best possible image is captured. Some cameras can be set to bracket exposures automatically.

The ISO sensitivity setting of digital cameras can be raised to increase the light sensitivity of the camera and permit faster shutter speeds or smaller apertures. However, raising the ISO sensitivity also results in more image noise and images with a lower dynamic range (less exposure latitude).

Image sensors

Digital cameras have largely replaced film cameras for most applications. They work on the same optical and mechanical principles as conventional film cameras, but replace the film with an image sensor that converts light to electrons. The characteristics of the image sensor (size, resolution, ISO sensitivity, noise, and dynamic range) are integral to the quality of the image the digital camera produces.

Smaller sensors have a greater concentration of pixels, resulting in higher noise and lower dynamic range. Therefore, P&S cameras (which have smaller image sensors than professional DSLR cameras) produce poorer quality images than DSLR cameras even if they have the same pixel resolution.

Image resolution

The output resolution of images can be calculated in two ways. For printed documents, the output terminology is Dots Per Inch (DPI), which is based on the number of ink droplets used. For camera or scanning resolution, the term used is Pixels Per Inch (PPI). The required image resolution depends on how the photographs are used.

- Images for Web sites should be optimized for fast downloading rather than high resolution. As a general guideline, images that are approximately 600 pixels wide are adequate. How the image size is actually displayed depends on the end user's monitor resolution and its settings.
- Images for reports, presentations, museum catalogues, and databases of intermediate size require medium-size images, about 1200–1500 pixels in the longest dimension. These images have somewhat more detail than Web site images and allow for reasonable size prints at 150 PPI. However, remember that insertion of larger images into wordprocessing or presentation software increases the size of the document file.
- There is no maximum size for images in print publications or advanced databases. Instead, the size depends on software and hardware specifications. As a rule, images in print publications must have a resolution of at least 300 DPI. Therefore, a printed image that is 10 inches in the longest dimension should be at least 3000 pixels in that dimension.

Various cultural organizations have developed resolution and digitization standards to meet their requirements. Several of these guidelines are available online:

- Canadian Heritage Information Network (CHIN). www.pro.rcip-chin.gc.ca

- Canadian Museum of Civilization Corporation (CMCC). *Digitization Standards for the Canadian Museum of Civilization Corporation*. 2006. http://cyberboutique.civilization.ca
- U.S. National Archives and Records Administration (NARA). *Technical Guidelines for Digitizing Archival Materials for Electronic Access: Creation of Production Master Files-Raster Images*. 2004. http://archives.gov/preservation/technical/guidelines.pdf
- UPDIG. *Universal Photographic Digital Imaging Guidelines (UPDIG) Version 4.0*. 2008. www.updig.org

Testing a new camera

Newly acquired camera equipment should always be tested before it is used for photodocumentation. Features to check include:

- **Lens distortion**. Distortion can be barrel (concave) or pin cushion (convex). Most P&S lenses and DSLR wide-angle lenses have some barrel distortion (see Figure 2b on p. 4). To test a camera, the lens axis must be perfectly perpendicular to the subject in both axes. Photographing different-sized picture frames or architectural features can illustrate various degrees of distortion. Specialized software is available to correct lens distortion if it is too noticeable.
- **Image vignetting**. Vignetting refers to uneven brightness, i.e. the images are brighter in the centre than in the corners. It is usually caused by poor lens design, a lens hood that does not match the lens, or too many filters in front of the lens. To test for vignetting, photograph an evenly lit white wall and check for a brightness gradient from the centre to the corners in the resultant image (see Figure 4).
- **Lens sharpness**. To test for lens sharpness, photograph a newspaper page and check for overall sharpness. Some lenses produce a softer focus in the corners or an overall softer image when used at smaller apertures.
- **Colour accuracy**. The accurate reproduction of colour in a digital photograph depends on the colour reproducibility of the camera as well as the colour management systems of the computer, software, and output devices.

Image file formats

Image files can be stored in various formats (e.g. JPEG, JPEG 2000, TIFF, and RAW). Because the files can be very large, some of these formats (e.g. JPEG and JPEG 2000) have been developed to compress the files to make them more compact for storage or transmission as e-mail attachments. The compressed files expand to their original size when they are opened in photo editing software or inserted in a document.

DSLR cameras are capable of storing images in more than one file format, e.g. non-compressed proprietary formats (RAW) or compressed formats (JPEG), with optional compression levels (e.g. low, medium, or high compression).

For cultural collections, photographic images are often stored for archival and accessibility purposes. Because it is necessary

Figure 4. This image was taken with a camera with a large image sensor and an unmatched wide-angle lens. Note the vignetting and distortion. Wooden box (craftsman and date unknown) from the CCI Training Collection.

to retain the resolution and colour information of the original image, image quality is usually more important than file size. Therefore, the format in which the image was originally captured should be retained unmodified as the archival version. There is no advantage in converting a JPEG file to a TIFF file unless the image is to be repeatedly edited in multiple sessions.

The most common image file formats are explained below.

JPEG (Joint Photographic Experts Group)

JPEG (or JPG) has become the universally accepted file format. Its small file size is advantageous, and it is integrated into almost all digital cameras. JPEG uses a file compression method referred to as "lossy", an algorithm that reduces file size by discarding non-essential data and lowering the visual quality of the image. For this reason it is inappropriate for multiple editing sessions.

JPEG 2000

JPEG 2000 (filename extension .jp2) is a more recent standard. It offers improved lossy compression, and may include new features in lossless compression (no loss of information). Many photo editing software programs and image management systems now offer the capacity to save an image in JPEG 2000 format.

TIFF (Tagged Image File Format)

TIFF (or TIF) files are normally uncompressed; the size of the file is equivalent to the resolution of the image in pixels, multiplied by three (RGB colour channel at 8 bits each), i.e.:

Formula:	width	x	height	x	3	=	file size in bytes
Example:	3000 pixels	x	2000 pixels	x	3	=	18 million bytes or 18 megabytes

Because TIFF files are uncompressed, they can be saved and re-saved during multiple editing sessions with no loss of image information. Hence they are ideal for photo editing software.

TIFF also supports an optional compression method, but this may degrade images and may not be compatible with other software applications.

Note: JPEG and TIFF files may lose some colour information if they are opened and re-saved on more than one computer (this occurs because colour profiles are not set up consistently from one computer to another).

RAW

The RAW file format is to digital imaging what the negative is to film photography — an image that cannot be manipulated. It assures accuracy in recording because the original image data cannot be altered and re-saved over the original file. The RAW file is an unprocessed image captured by the camera's sensor retaining all of the image data in a non-destructive format, i.e. bit depth, colour data, and

metadata. White balance, exposure, contrast, and tonal range are not compromised, as they are when images are saved as JPEG or TIFF files. RAW images with modified settings can always be reset to their initial state as originally captured by the camera. Another advantage of the RAW format is that it has a large dynamic range and can record more detailed information in highlights and shadows.

Every camera manufacturer has its own proprietary RAW image format and file extension (Nikon uses .nef, Canon uses .crw, Epson uses .erf, etc.). Adobe introduced the Digital Negative (DNG) format in an attempt to standardize the RAW format, but acceptance has been slow. The lack of a standard RAW format is a concern for digital preservation management as the files produced with today's cameras may not be supported by future technology (software could change, camera manufacturers could merge or go out of business, etc.). Because of this problem, RAW files are not the best choice for archives. However, saving RAW files for future reference or until technology forces change is still worthwhile.

Digital asset management

Before taking a large number of digital images, it is important to establish photographic guidelines and to set up an image information management system. The following considerations need to be addressed:

- image life cycle (temporary or archival)
- file naming standards
- storage media (CDs, DVDs, hard drive, or tape)
- metadata requirements (technical documentation)
- access restrictions (within the organization or by external users)
- regular backup routine of images and metadata

Standard information management systems are commercially available, and can be customized to suit specific user needs. A good estimate of the volume of image data that will be generated annually can help to ensure adequate storage space.

Images that are to be archived should be stored on a server with a backup system. However, if the images will be used only temporarily, they can reside on local or shared computers for the period required. Images and metadata can be stored separately if financial resources are limited, but it is crucial to establish a file naming standard to prevent file duplication and accidental overwriting. Should image enhancement be required, a copy of the original file should be saved under a different name and referenced to the original. Read/write access should be limited to a specified group of users to avoid loss of images.

The following software is necessary:

- image capture software to control the camera directly from a computer and to store images directly to media (bypassing the camera's memory card)
- photo editing software to convert RAW files and modify images
- cataloguing software to store and retrieve images including metadata

The Bibliography (p. 59) includes references that are helpful in planning and implementing storage and retrieval systems. Information on this subject is also available from the Canadian Heritage Information Network (www.pro.rcip-chin.gc.ca).

Light sources

Knowledge of the different light sources that can be used to illuminate an object is essential for good photodocumentation. Only with appropriate lighting will the surface detail, texture, and shape of the object be revealed.

Good photographic lighting requires a room that can be darkened. This helps to ensure full control and standardization of lighting as well as safety and security of the objects. It also helps to avoid problems with competing or mixed light sources (e.g. indoor fluorescent lighting, skylights, window lights, or modeling lamps).

When photographing museum objects:

- choose tungsten light or electronic flash (natural light or other types of artificial lights are not recommended)
- match the light source with the digital camera's white balance function to ensure that the photographs accurately record the colour of the object
- use at least two lights to ensure the object is evenly illuminated

Tungsten light

"Tungsten lights" — also known as tungsten-halogen lights or quartz lights — provide a continuous, controlled source of illumination with a small to modest initial capital outlay. Their nominal colour temperature is 3200 K (although this value decreases with use), and their orientation and intensity can be easily and closely controlled by moving the lamps on light stands. The only drawback of tungsten lights is their high temperature and subsequent heat radiation. When working with tungsten lights, take care to ensure the artifact(s) being photographed do not suffer heat damage.

Electronic flash

Electronic flash is the best choice for photographing museum objects. The flash intensity of studio flash units can be varied and they usually include model lamps to help visualize shadows and highlights. For photographers with lower budgets, camera flash units with triggering slaves can be used.

The colour temperature of electronic flash is 5500 K, and it is constant for the life of the tube. This allows for accurate colour rendition that is reproducible from session to session. Also, because the light output from an electronic flash is very high, small lens apertures (which optimize the depth of field) can be used. The initial capital cost of electronic flash is high; however, the operating cost per flash is minimal.

Light source adaptations

The quality of the light illuminating an object can be refined to better reveal the surface detail, shape, and texture. However, the tools and gadgets to adapt a light

source as required may not be commercially available. Good photography requires imagination and ingenuity, and in some cases it may be necessary to invent and fabricate the desired accessories.

The following equipment can transform a light source to meet various requirements.

- **A silvered reflector bowl** is the most widely used accessory. Reflectors are available in many sizes and with a range of light beam angles and surface textures, but the most popular ones are 17.8 cm (7 in.) in diameter with a 45–65° light beam.
- **Umbrellas** and **soft boxes** (see Figure 5a) produce broad, diffused light. Gold umbrellas are meant for warming up skin tones, and are not recommended for photographing museum objects.
- **Reflector cards** bounce light from the primary light source and create a fill (or secondary light source) that produces a more natural effect. Reflectors can be purchased or improvised using aluminized emergency blankets ("space blankets" or "Mylar blankets"), white cardboard, or aluminum foil mounted on cardboard.
- **Gobos** and **barn doors** (see Figure 5b) shape the light beam to prevent spillage onto surfaces where light is unwanted. Gobos are thin masks made of opaque material (such as black cardboard or fabric); they can be purchased commercially or improvised. Placed at a safe distance from the light source, they block light from falling onto surfaces other than the object. Barn doors are a metal assembly of two to four leaves that are attached in front of a reflector.
- **Snoots** and **honeycomb grids** (see Figure 5b) fine-tune a light source. They are mostly used for separating an object from its background (rim light) and selectively lighting parts of an object (accent light). A snoot is a rigid hollow metal tube that is mounted in front of a silver reflector bowl; it projects a narrow, sharply focussed (~5°) light beam. Honeycomb grids project a softer (20–30°) light beam, the details of which depend on the pattern and size of the grid.
- **Diffusers** are sheets of semi-transparent or — to varying degrees — translucent material that soften and diffuse the light source. When used in combination with an umbrella, they provide extra diffusion to soften specular reflection. Diffusers are commercially available in sheets or rolls; they can also be fashioned from light white fabrics or fluorescent light fixture diffusers.
- **Tents** produce uniform light on an object and eliminate unwanted reflections from surrounding surfaces (depending on the shape and reflectivity of an object, the camera lens may still be reflected from the object). However, tent lighting also minimizes shadows and can make an object appear featureless. Therefore, it should be used only for glassware and metal ware. Tents can be purchased commercially or custom-made. For small objects, a tent can be made from a white translucent 4-litre bottle (cut a whole in the bottom of the bottle large enough for the camera lens to fit through and then cut off the top of the bottle so that it fits over the object). For more information, see the section on lighting with cone diffusers (p. 50).

Light meter

A multi-purpose light meter that can measure flash and ambient light sources in incident and reflected modes is a useful tool.

In the reflected light reading mode, a light meter is similar to a camera's light meter — it measures the amount of light reflected from an object. It can also measure light from a light box, which is useful when photographing transparent objects such as stained glass, glass negatives, or photographic transparencies.

In the incident light reading mode (the most common usage in a photographic studio), a light meter measures the amount of light falling on an object using an integrated hemispherical dome diffuser. Exposure compensation can then be calculated or determined by making several bracketed exposures.

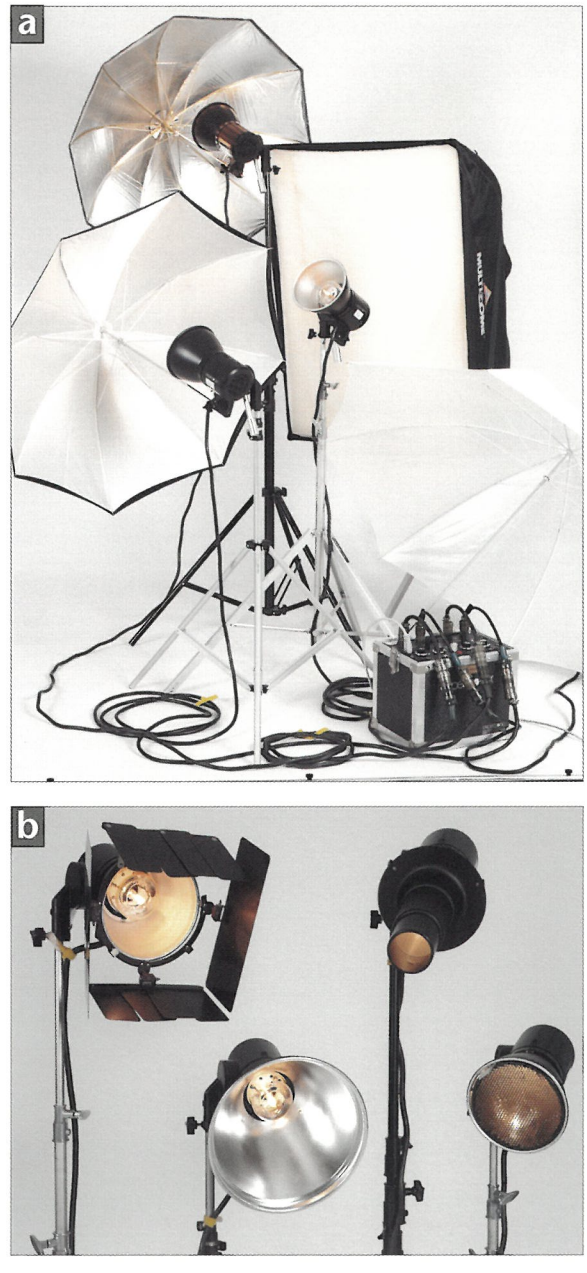


Figure 5. Equipment that can be used to transform a light source. (a) Umbrellas and soft boxes. (b) Barn door, reflector bowl, snoot, and honeycomb grid.

Standard inclusions

Standard inclusions such as object identification, measurement scale, colour reference target, and grey scale can be tailored to meet the scale and complexity of the photographic work.

Identification

All photographs should include a label to identify the object. The information on the label will vary depending on the object, but should typically include data such as:

- accession number
- specimen number
- archaeological site number
- project number
- date
- object status [codes such as BT (before treatment), DT (during treatment), and AT (after treatment) can be used for objects undergoing conservation treatment]

Measurement scale (metric)

All photographs should include a scale (a metric scale is recommended) to record the dimensions of the object. For most museum objects, a 10- or 30-cm ruler graduated in centimetres and millimetres is a good choice; for large objects, measuring poles can be purchased from manufacturers or distributors of surveying equipment. Place the scale near the object at the focussing plane, making sure that it does not touch or overlap the object or cast a shadow on it. Keep enough space between the scale and the object to permit the scale to be cropped out of the photograph for publication.

Note: Depending on the size of the objects and the volume of photographic work, it may be convenient to combine the identification information and the measurement scale on one card.

Colour reference target and grey scale

All photographs should include an accurate colour reference target and/or grey scale to monitor and assess the reproducibility of colour throughout the photographic workflow. The grey scale will help to establish the camera's white balance under any illumination.

Colour reference targets should be stored away from light, as they will lose colour over time. They should also be cleaned and replaced on a regular basis, as stains or dirt will show up in the photograph.

During the photographic setup, place the colour reference target and/or grey scale:

- close to the object but positioned so that it could be cropped out of the photograph if necessary
- parallel and flat to the surface of the object but not in its shadow

In some cases, the colour reference target and/or grey scale can be mounted on a clear plastic block (see Figure 29 on p. 31).

Colour reference targets and grey scales such as those made by X-Rite and QPcard are recommended for work with museum objects. Additional products are likely to be developed in the future.

As of 2010, there are no known reference products to calibrate white balance with transmitted light photography. Therefore, when using any of the three transmitted light techniques discussed in this book (see pp. 44, 46, and 48), start by photographing a colour reference target at the back of the object and use this as a point of reference to set the white balance for all subsequent photographs within the same session (be sure to use the same camera and lighting technique for all of the photographs).

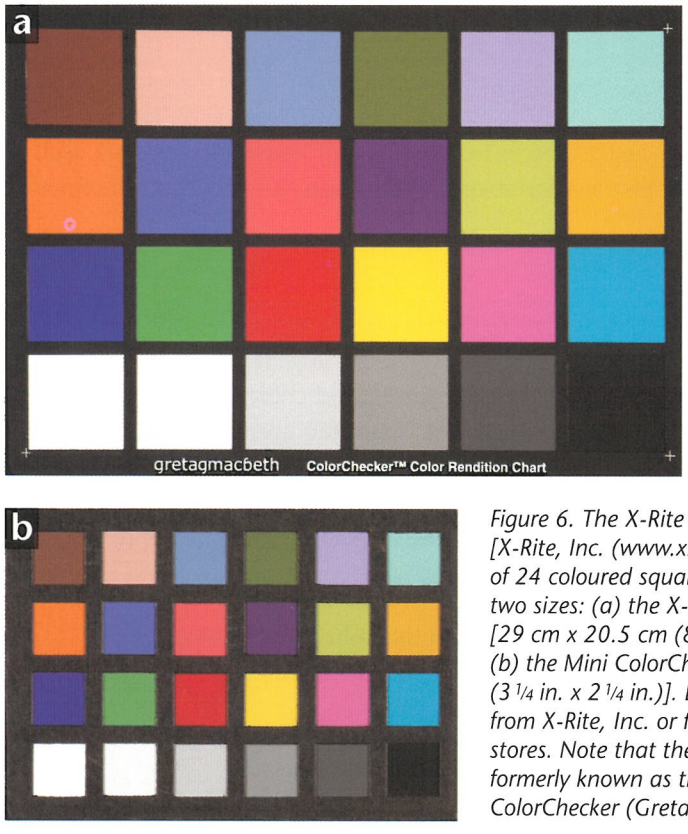


Figure 6. The X-Rite ColorChecker [X-Rite, Inc. (www.xrite.com)] consists of 24 coloured squares and is available in two sizes: (a) the X-Rite ColorChecker Chart [29 cm x 20.5 cm (8 1/2 in. x 11 in.)] and (b) the Mini ColorChecker Chart [8 cm x 5.5 cm (3 1/4 in. x 2 1/4 in.)]. Both are available online from X-Rite, Inc. or from specialty photographic stores. Note that the X-Rite ColorChecker was formerly known as the Gretag/Macbeth ColorChecker (GretagMacbeth AG/LLC U.S.A.).

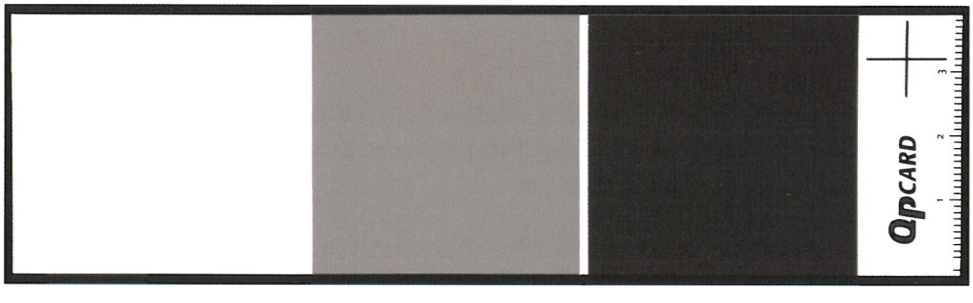


Figure 7. The QPcard [QPcard AB, Göteborg, Sweden (www.qpcard.se)] is 4 cm x 12 cm, with three squares of black, grey, and white including a 4-cm scale.

In the past, when museum and conservation photographs were taken with film cameras, a Kodak 18% reflectance grey card, a Colour Separation Guide, and a graduated 19-step Grey Scale were often used. While these non-calibrated products were suitable for film photography, they are not appropriate for digital photography and colour management, and have been discontinued.

Setup checklist

Adhering to the recommendations in the following setup checklist will help to ensure good results when photographing a museum object:

- ☑ Use a tripod and cable release to eliminate or reduce vibration.
- ☑ Check that the camera's white balance setting is appropriate.
- ☑ Place the colour reference target and/or grey scale, object identification card, and a metric scale on the same plane as the object.
- ☑ Determine the correct exposure compensation for situations where this is required, e.g. raking light photography, photomacrography, very bright objects, camera bellows extension.
- ☑ Mark the location of lamps and their distance to the object on the floor using adhesive tape. This will make it much easier to repeat the same photographic setup. For difficult or complex objects, keep a written record of lamp positions and camera settings and draw a diagram of the setup.
- ☑ Avoid unwanted reflection on the object from the tripod, camera, photographer's clothing or jewellery, etc. Keep the object far enough from the room walls to avoid unwanted reflections or colour cast. Ideally, the room walls should be painted a neutral grey.
- ☑ When studio space is limited, place wide paintings in portrait (vertical) orientation. This will eliminate or reduce the problem of light reflecting on the outer edges of the painting, which is more common in the landscape (horizontal) orientation (see Figure 8).

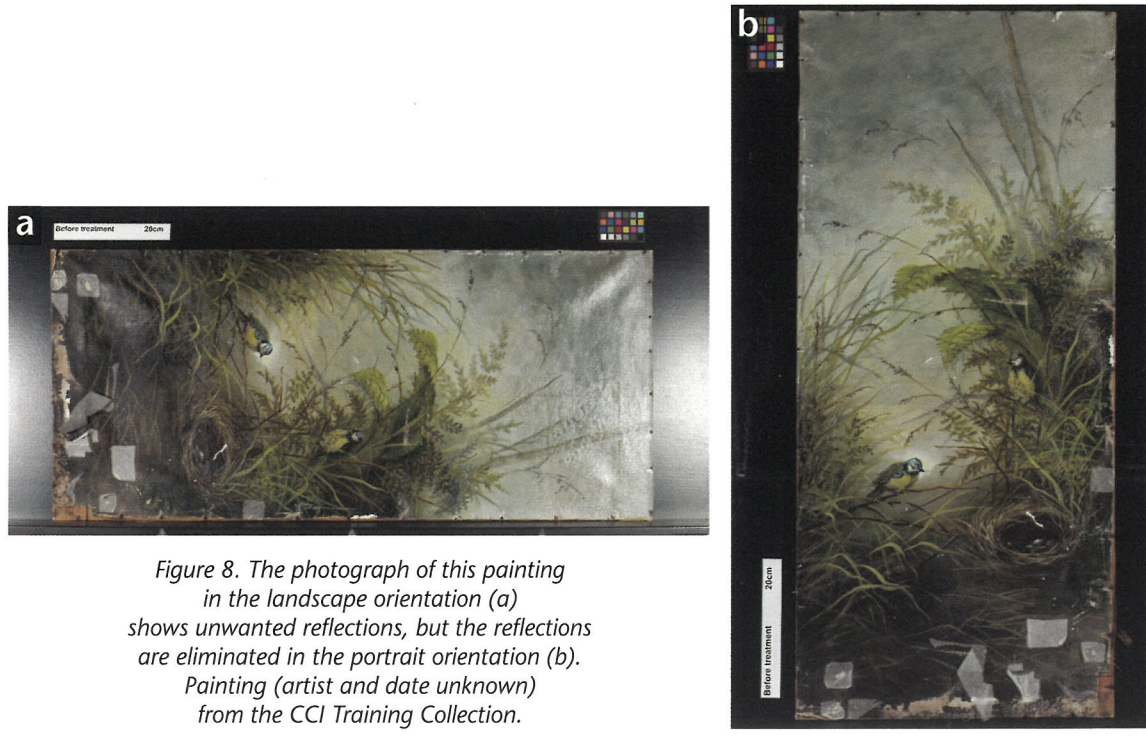


Figure 8. The photograph of this painting in the landscape orientation (a) shows unwanted reflections, but the reflections are eliminated in the portrait orientation (b). Painting (artist and date unknown) from the CCI Training Collection.

Studio backgrounds

Place a background behind the object to be photographed to avoid any physical distractions, reflections, and unwanted colours. Backgrounds can be made of paper, plastic, or a fabric such as black velvet (which absorbs light), and can be portable or part of the studio infrastructure. Backgrounds used in photodocumentation must be neutral so as not to cast any colour onto the object; the most popular colours are white, black, or neutral grey. It is important to store and maintain backgrounds appropriately to ensure they remain clean and free of creases. Translucent plastic sheet material can be used to make a backlit surface or to build a shadowless table.

The examples in Figure 9 illustrate the influence of a backdrop on how clearly the details of an object can be seen in a photograph.

Common problems and solutions

As with any technical operation or procedure, problems can sometimes arise in photography. However, most problems can be anticipated and avoided with appropriate adjustments to the camera, flash, or setup. This is especially important with automatic cameras, which will continue to operate with incorrect settings. Some of the common problems and their solutions are discussed below.

Inappropriate colour shift

This occurs when the camera's white balance is not set properly. For example, using a daylight setting on the camera while illuminating the object with tungsten artificial indoor lighting produces reddish coloured images. To avoid this problem, ensure that the white balance mode selected on the camera matches the lighting that is being used. It is also helpful to avoid mixing various light sources (e.g. windows, fluorescent lights, and other sources), which can result in more than one colour cast.

Figure 9. Details of this glassware that are lost with a black backdrop (a) are clearly visible with a light backdrop (b). Glassware from a private collection.

Flash not synchronized with camera

The shutter speed of DSLR cameras is too fast for complete synchronization with an external studio flash or non-dedicated flash. The solution is to increase the exposure time (from 1/250 to 1/125) to the camera manufacturer's specifications.

Images underexposed by built-in flash

Miscalculating the maximum distance at which a built-in flash can illuminate an object results in darker (underexposed) images. The solution is to decrease the distance between the flash and the object, or add more flash power.

Flash reflected off surfaces

Unwanted specular reflection can occur when the flash is aimed perpendicular to an object. This can happen with all object surfaces, but it is especially prevalent with glass, mirrors, and paintings with a varnish layer. The solution is to reposition the flash off-centre.

Silhouette or outlined objects

This problem occurs when an object is photographed in front of a window or other bright background. The light meter (especially one in an automatic camera) reads the bright light rather than the darker condition of the object, and therefore produces an underexposed image. The solution is to use fill flash, or simply reposition the object or camera.

Partially focussed image

The gradual transition of an image from sharp to un-sharp may be due to the focal length of the lens, the aperture, the distance between the camera and the object, or the depth of the object. One solution would be to increase the depth of field (sharpness in foreground to the background) by increasing the f-stop number (e.g. from f5.6 to f8) and compensating with a longer exposure time (see Figure 10).

Electronic camera lock-up

Most electronically controlled cameras lock up when the batteries die or become weak in cold weather. To avoid this problem, check the power level of the camera's battery regularly and have spare batteries available.

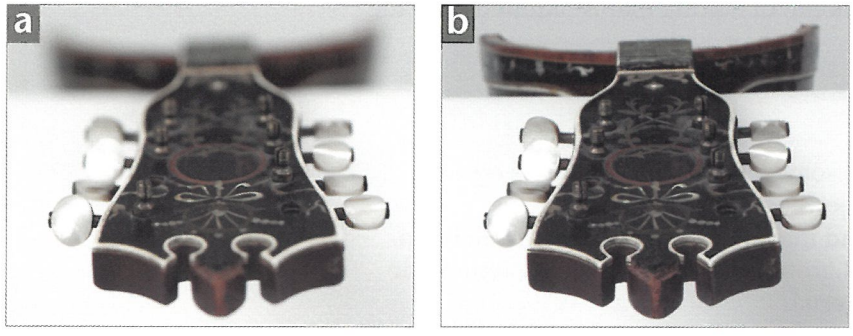


Figure 10. Both photos of this mandolin head were focussed at the same point and taken with flash at a shutter speed of 1/125. However, the first image (a) was taken at f4½ whereas the second image (b) was taken at f22, resulting in a greater depth of field. European mandolin, Delta Museum and Archives, Delta, B.C., Accession No. DE1988.149.

All objects are three-dimensional ("3D"), but flat objects are considered two-dimensional ("2D") for photographic purposes. These 2D objects (e.g. works of art on paper, paintings, and textiles) require a different lighting approach than 3D objects (e.g. sculptures, carvings, ethnographic and archaeological objects, furniture, wood or metal musical instruments, and pottery). Some flat objects (e.g. carvings, icons, and bas-reliefs) incorporate significant relief and are physically 3D, but they are still lit using 2D techniques.

Light reflection or absorption properties vary greatly for each type of object, and exposure corrections should be made as required. Achieving the perception of shape in a photograph requires adjustment and modification of the lighting setup. The greatest variation can be achieved by turning off the ambient lights (room lights) and using modelling lights to visualize highlights and shadows. However, it is important to note that the basic techniques discussed in this book are just a starting point; it is only through experimentation that a photographer can acquire the expertise to obtain optimal results.

Light sources follow the inverse-square law, i.e. the intensity of the light at the surface of an object is inversely proportional to the square of the distance of the light from the object. In other words, when the distance from a light source to an object is doubled, the light intensity at the surface of the object is reduced to one-quarter of its original value. In photographic terms, this means that if a light source at 1 m measures f32, at 2 m it measures f16 (or 2 f-stops less). Doubling the distance again to 4 m gives a reading of f8. There are, however, some practical exceptions to this rule, e.g. stray light bouncing off the walls, ceiling, and floor can result in a slightly higher light reading.

Photographing 2D ("flat") objects

For photodocumentation of paintings, watercolours, prints, drawings, maps, photographs, and flat textiles:

- use a good photographic easel or copystand
- mount the camera on a tripod (or to a copy table) to eliminate camera movement and reduce vibration
- adjust the camera angle so that it is square (perpendicular) to the object
- insert object identification, measurement scale, and colour reference target and/or grey scale along the border of the image area and away from shadows cast by the object
- make final adjustments to position and frame the object in the camera viewfinder

Standardizing these procedures serves to produce better photographs, save time, eliminate mistakes, and reduce the amount of editing that is required after the photo has been taken.

Photographing 3D objects

For photodocumentation of furniture, some textiles (e.g. costumes on a mannequin), sculptures, glassware, jewellery, and silverware:

- use a good copy table or background material set up from the wall down to the floor of the studio (other background setups could be custom-made to suit fragile, wet, or oversized objects)

- place the object well in front of the seamless backdrop's curve to avoid unwanted and distracting shadows
- use the same lighting method as for 2D objects for good reproduction, or change the lighting ratio (the ratio of key light level to fill light level) between a set of lamps or add a third light to give the object dimension, shape, and depth

There are four different types of lights that can be used, and they should be introduced in the following order:

1. The **key light** (the main light) is the dominating light. It highlights the shape and texture of an object and casts the strongest shadows.
2. The **fill light** is used to lighten the shadows cast by the key light and to reduce the overall contrast. The fill light must not create a shadow.
3. **Accent lights** are used to enliven parts of the object by adding highlights. Use accent lights sparingly (e.g. hair light, rim light).
4. **Background lights** (optional) are used to separate the object from the background, to create the illusion of space, and to eliminate shadows on the background.

Examine the features of a 3D object carefully to obtain a good sense of direction in building the lighting setup. Start by lighting the object with the key light. Observe where the object's shadows fall (e.g. the shadow of the nose of a sculpture falling on the cheek). Introduce a second light (fill light) with half the intensity (2:1) of the main light to reduce the shadow contrast. The fill light should not overpower the main light. Add an accent light to create a rim effect around the object to separate it from the background. If required, position a background light behind to illuminate the background.

There is no limit to the number of lights that can be used in a photographic setup. However, it is better to keep the number of lights to a minimum.

Figure 11. The effects of different types of lights: (a) photo taken at f16 with key light only; (b) photo taken at f8 with fill light only; (c) photo taken at f81/2 with accent light only; (d) photo taken at f16 with key light, fill light, and accent light.
Dame malawite avec son enfant *(artist and date unknown), Sisters of Charity of Ottawa, Ottawa, Ont., unaccessioned.*

Studio Lighting Methods

Matrix

This chart offers guidance on lighting methods. However, it is only a partial list and should be used as a starting point and a reference.

Object Category	Lighting Method														
	1. Normal light	2. Raking light	3. Normal light with polarizing filters	4. Key light with reflector	5. Low-angle light	6. Lighting with umbrellas	7. Lighting with soft boxes	8. Specular light	9. Transmitted (direct) light	10. Transmitted (indirect) light	11. Dark field illumination	12. Lighting with cone diffusers	13. Tent lighting	14. Axial lighting	15. Customized lighting for mirror-like sufaces
Page Number	22	24	26	30	34	36	38	40	44	46	48	50	52	54	56
2D Objects (Flat)															
Paintings, paper artifacts, photographs (unframed)	•	•	•		•			•	•	•					
Illuminated manuscripts	•					•		•				•			
Daguerreotypes					•										
Negatives, transparencies										•					
Textiles: samplers, quilts, tapestries, flags	•	•		•	•	•									
Etched flat glass											•				
Stained glass, lantern slides, ruby ambrotypes	•								•	•					
2D Objects (with Relief)															
Frames (gilded)	•		•			•	•	•							
Paintings, paper artifacts, photographs (framed without glazing)	•		•												
Paintings, paper artifacts, photographs (framed with glazing)	•				•										
Paintings, paper artifacts, photographs (framed under convex glass)					•										
Carvings, wooden objects, earthenware		•				•	•								
Feathers, porcupine quill panels	•			•	•										
Bas relief, decorative frieze (plaster, wood, metal)					•	•	•								
Lithics (arrowheads, tools)	•			•	•										
Coins, medals, medallic art (highly polished or newly minted)				•								•		•	
Worn archaeological coins		•		•	•										
Coins, medals, medallic art (incuse)												•		•	
Coins, medals, medallic art (proof, mirror-like surface) (†)														•	•
Framed mirrors (†)	•					•	•								
3D Objects															
Argillite sculptures						•	•						•		
Books, scrolls	•					•									
Sculptures: polychrome sculptures	•					•	•					•			
Furniture	•		•			•	•								
Masks, musical instruments (wood)	•			•		•	•								
Masks, musical instruments (metal)							•					•	•		
Gilded objects						•	•								
Silverware (flatware)							•					•	•		
Silverware (hollowware)							•						•		
Glassware							•			•	•		•		
Stone carvings, ceramic objects with high gloss							•						•		
Costumes (mannequins, hats, dolls)	•			•		•	•								
Archaeological low gloss (ceramics, pottery)	•			•		•	•								
Archaeological (wet or waterlogged)	•					•	•					•			

† Large format camera shift or perspective control (PC) lenses for DSLR cameras.

Sample objects and notes on light exposure and camera settings

Lighting Method

Page Number	1. Normal light	2. Raking light	3. Normal light with polarizing filters	4. Key light with reflector	5. Low-angle light	6. Lighting with umbrellas	7. Lighting with soft boxes	8. Specular light	9. Transmitted (direct) light	10. Transmitted (indirect) light	11. Dark field illumination	12. Lighting with cone diffusers	13. Tent lighting	14. Axial lighting	15. Customized lighting for mirror-like surfaces
	22	24	26	30	34	36	38	40	44	46	48	50	52	54	56

1. Normal light

Introduction

Normal lighting ("standard illumination") is used when photographing 2D objects (e.g. paintings, works of art on paper, photographs, and some textiles) and some 3D objects (e.g. baskets, sculptures, and costumes) to document their general condition: to show surface dirt, discoloured varnish, and cracked or cupping paint prior to conservation treatment. It is the most basic lighting technique, and is widely used in museum photodocumentation work. Normal lighting can be adapted for either vertical or horizontal setup — on a copy stand or on an easel using a tripod. Photographers sometimes refer to it as a "copy board setup".

Procedure

Keep the lighting setup as simple as possible — only two lights of the same power with identical reflector bowls and possibly umbrellas are required. For objects with reflective surfaces (such as paintings under flat glass, glossy prints, etc.), it is also necessary to block unwanted reflection from the camera, jewellery on the photographer's hands, ceiling fixtures, etc. This can be achieved by cutting a hole in a sheet of matt board and fitting the camera lens through it. This technique, using either a black or a white matt board, can also enhance the appearance of engraving on metal surfaces. The lighting setup itself does not change.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"] to set up the shot, being sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- Position two lights, one on each side of the camera and equidistant from it.
- Place both lights at the same height as the camera, viewed from the side.
- Keep the angle of incidence (the angle between an imaginary line drawn from the plane of the object and a line drawn from the centre or the edge of the object to the lights) the same for both lights, viewed from the top. This angle should not be more than about 35–45° to avoid direct reflections.
- Aim each light head slightly beyond the farthest edge of the object.
- Illuminate the object evenly. *Tip*: The farther the light source is from the object, the more even the illumination will be across the surface of the object.
- Use barn doors to provide better light control.

Exposure determination

- Check that the object is evenly illuminated by:
  - taking light readings from the centre of the object with an incident light meter facing each light in turn
  - comparing the two light readings and adjusting the light distances so that both readings are identical
  - taking light readings from each corner with the meter facing the camera
  - comparing the readings and feathering (swivelling) the light head by a few degrees inward or outward until all readings are identical
- To determine the camera exposure, take a light meter reading from the centre of the object, facing the camera.
- Objects with a "typical" range of light and dark tones will be photographed correctly at the exposure determined.
- Lighter-toned objects may require less exposure and darker-toned objects more exposure.

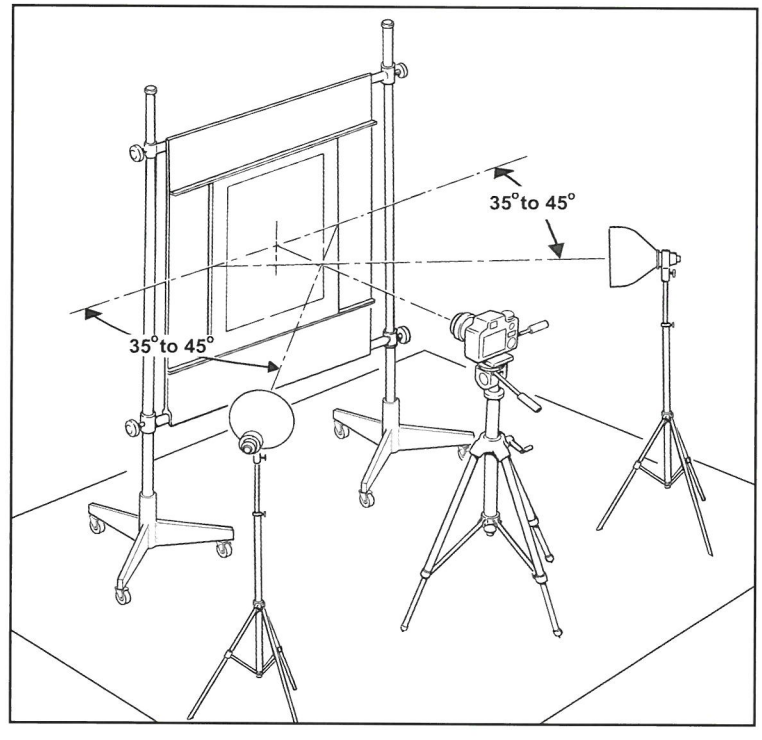


Figure 12. Normal light photography setup.

Figure 13. Painting photographed in normal light. Moccasin Seller *(oil on canvas by Cornelius Krieghoff, ca. 1853–1863), Collection of the MacKenzie Art Gallery, gift in memory of Norman Ratner, Regina, Sask., Accession No. 2002-52.*

Figure 14. Underside of a sewing table lid photographed in normal light. Sewing table (manufacturer and date of production unknown), Billings Estate National Historic Site, Ottawa, Ont., Accession No. 1978.0002.0444.

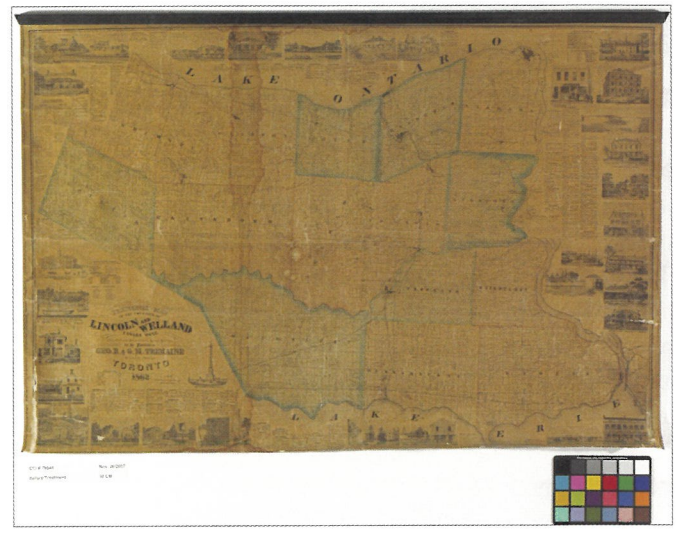


Figure 15. Large map photographed in normal light. Lincoln & Welland Counties Map (Geo.R. & G.M. Tremaine, 1862), West Lincoln Historical Society, Smithville, Ont., Accession No. 2001-00129-034 M.

Figure 16. Painting photographed in normal light. Portrait of a Ship "Ellen A. Read" *(oil on canvas by unknown artist, 1886), Yarmouth County Museum and Archives, Yarmouth, N.S., Accession No. S39.*

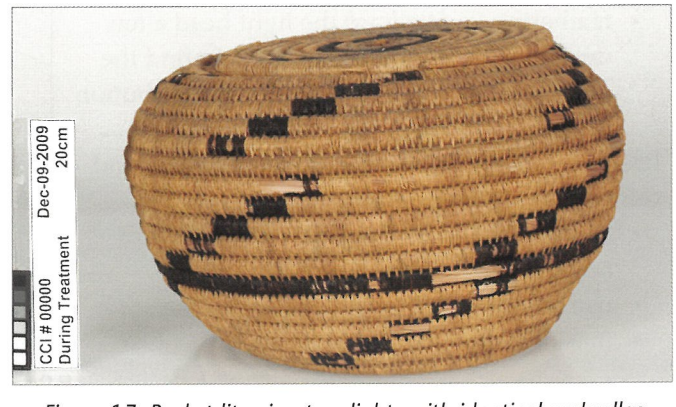


Figure 17. Basket lit using two lights with identical umbrellas. Basket (maker and date unknown) from the CCI Training Collection.

2. Raking light

Introduction

Raking light is used when photographing 2D objects (or the surfaces of 3D objects) to record the surface topography: to show surface defects, surface anomalies, folds, distortions of the support, undulations in a canvas, raised paint, craquelure, impasto, cockling, cupping, and brush strokes. It is especially useful for documenting the condition and treatment of paintings, prints, drawings, and watercolours.

Procedure

Position the light source at a shallow angle to the surface of the object, and keep it as far away from the object as possible (this will keep the light intensity as even as possible from one side of the object to the other). The size of the photographic studio is therefore a factor with this technique.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects"] to set up the shot, being sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- Use one light, typically positioned at 10 o'clock.
- Keep the angle of incidence at approximately 5°.
- Illuminate the object as evenly as possible from the corner nearest the light source to the farthest corner by:
  - keeping the light as far away from the object as possible (the farther the light source is from the object, the less the differential light fall-off from the nearest to the farthest corner of the object)
  - feathering (swivelling) the light head a few degrees inward or outward to help find the position with the most even light distribution across the object
- Prevent light reflected off of the walls, floor, and ceiling from reaching the object by:
  - controlling the light source with a shallow angle reflector bowl
  - using barn doors
  - masking surrounding surfaces
- Experiment with, and adjust, the basic setup for each object as the distance, height, and angle of the light can change according to the nature of the object and the results required.

Exposure determination

- With the light meter facing the camera, take five light readings — one in the centre and one in each corner of the object.
- Ensure that all of the light readings are within $^{2}/_{10}$ f-stop for a painting of average size (although they can vary up to $^{1}/_{2}$ f-stop for large paintings).
- Use the reading at the centre of the object to determine the camera exposure setting.
- Objects with a "typical" range of light and dark tones will be photographed correctly at the exposure determined.
- Lighter-toned objects may require less exposure and darker-toned objects more exposure.

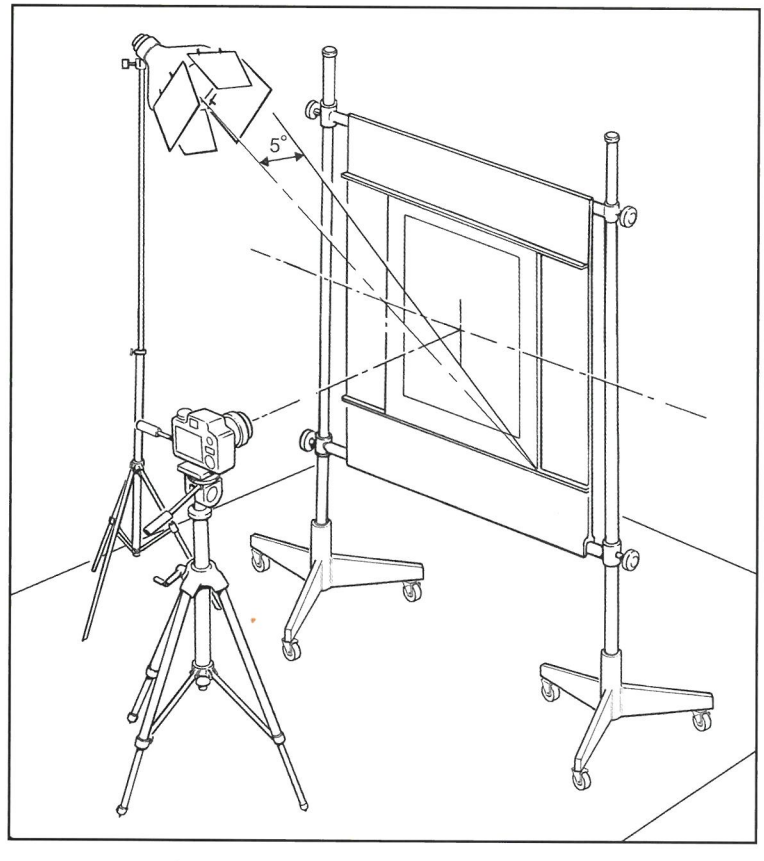


Figure 18. Raking light photography setup.

Figure 19. Painting photographed in raking light. Moccasin Seller *(oil on canvas by Cornelius Krieghoff, ca. 1853–1863), Collection of the MacKenzie Art Gallery, gift in memory of Norman Ratner, Regina, Sask., Accession No. 2002-52.*

Figure 20. Underside of a sewing table lid photographed in raking light. Sewing table (manufacturer and date of production unknown), Billings Estate National Historic Site, Ottawa, Ont., Accession No. 1978.0002.0444.

Figure 21. Large map photographed in raking light. Lincoln & Welland Counties Map (Geo.R. & G.M. Tremaine, 1862), West Lincoln Historical Society, Smithville, Ont., Accession No. 2001-00129-034 M.

Figure 22. Painting photographed in raking light. Portrait of a Ship "Ellen A. Read" *(oil on canvas by unknown artist, 1886), Yarmouth County Museum and Archives, Yarmouth, N.S., Accession No. S39.*

3. Normal light with polarizing filters

Introduction

Polarizing filters are useful for photographing paintings, furniture, and other objects with shiny coatings and surfaces. They remove glare or unwanted reflections from various surfaces (except for metals or mirrors) and they increase image colour saturation and contrast.

Procedure

Polarizing filters can be used in three ways.

- **Polarizing filter on the camera lens**. Mounting the filter directly on the lens is the simplest method. The photographer can rotate the filter and see immediately when the reflections from the object are diminished.

- **Polarizing screens on the light source**. A set of polarizing filters can be aligned in the same direction and placed in front of the reflector bowl of each light source. The filters must be large enough to cover the light completely and placed far enough away from it to prevent overheating, discoloration, and loss of polarizing properties.

- **Cross-polarization**. If neither of the above techniques can remove all the unwanted reflections, the two can be combined for cross-polarization. The light source filters must remain in alignment and should be crossed 90° to the camera filter. To determine if the camera and the light source filters are crossed 90°, remove the filter from the lens and place it in front of either light source filter. Rotate the camera filter until it appears visually darkest and record its orientation with a reference mark at the top of the filter mount. Re-mount the filter on the lens with the mark in the same orientation.

Filters used in front of a camera lens must be of the highest quality and should have a neutral colour (if they don't, the camera's white balance has to be re-measured to compensate). Sheet polarizing filters do not have the same optical quality as glass filters; they can be used in front of light sources, but should not be used in front of a camera lens.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"] to set up the shot, being sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- Place each light at the same height as the camera, viewed from the side.
- Keep the angle of incidence the same for each light, viewed from the top. This angle should not be more than 35°.
- Illuminate the object evenly.

Exposure determination

- Check that the object is evenly illuminated by:
  - taking light readings from the centre of the object with an incident light meter facing each light in turn
  - comparing the two light readings and adjusting the light distances so that both readings are identical
  - taking light readings from each corner with the meter facing the camera
  - comparing the readings and feathering (swivelling) the light head by a few degrees inward or outward until all readings are identical
- To determine the camera exposure, take a light meter reading from the centre of the object, facing the camera.
- Mount polarizing filters on camera and/or lights (if cross-polarization is required, refer to the procedure previously described to ensure filters are crossed 90°).
- The use of polarizing filters reduces the amount of light that reaches the camera lens and requires exposure compensation:
  - polarizing filters produce a light loss of up to 2 f-stops (4x less light)
  - cross-polarization can result in a total light loss of up to 4 f-stops (16x less light): 2 f-stops for the camera filter and 2 f-stops for the two light filters

Tip: Cross-polarization photography requires a lot of light. To avoid having to purchase high-powered flash equipment, increase the exposure time or set the camera on "B" (open shutter) and trigger the flash manually as many times as required to obtain the necessary amount of light. (Note that this must be done in a completely darkened room. Also, many smaller cameras do not allow for manual control of the exposure time, shutter speed, and aperture.) One flash, triggered twice, will double the amount of light reaching the camera — an increase of 1 f-stop. Triggering the flash four times will give 2 f-stops more light compared to firing it once. Triggering eight times equals 3 f-stops. Firing the flash more than this or raising the camera's ISO is not recommended as these actions would result in higher image noise. The solution would be to add more lights or more powerful flashes.

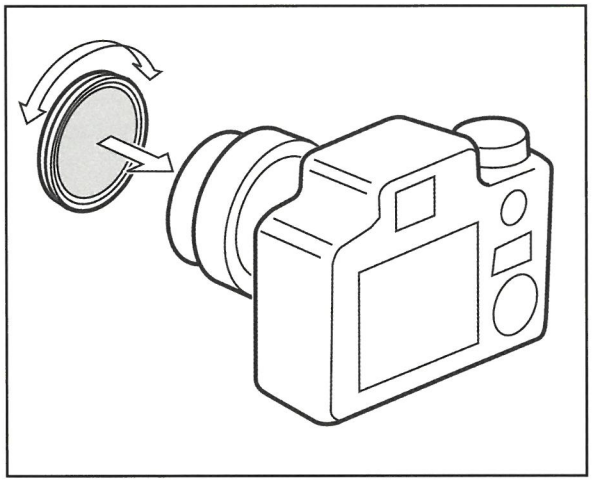


Figure 23. A polarizing filter can be mounted on a camera lens and then rotated to eliminate glare from the surface of an object.

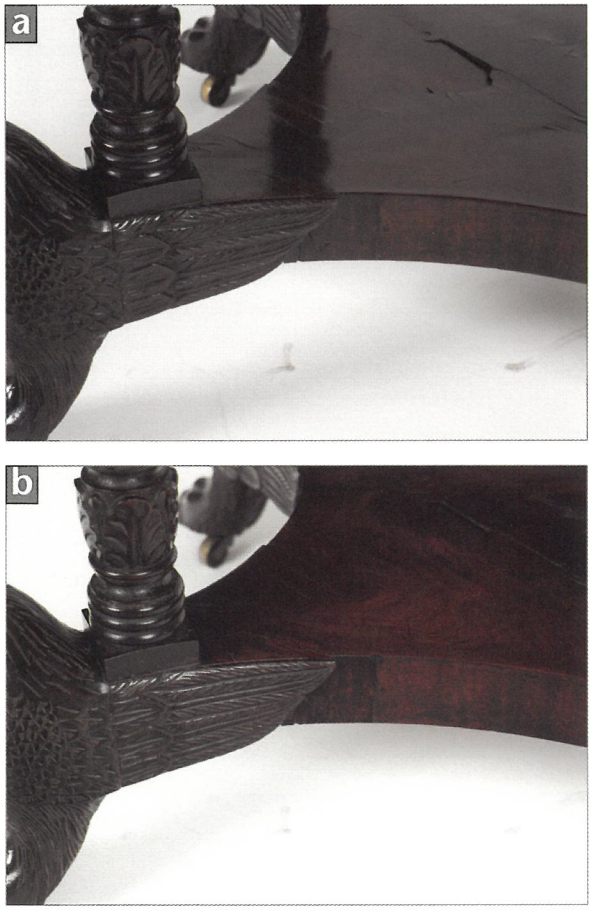


Figure 24. Table base photographed (a) without a polarizing filter on the camera lens and (b) with the filter. Sofa table (Thomas Nisbet, 1825), New Brunswick Provincial Collection, Heritage Branch, Fredericton, N.B., Accession No. GH 991.28.6.

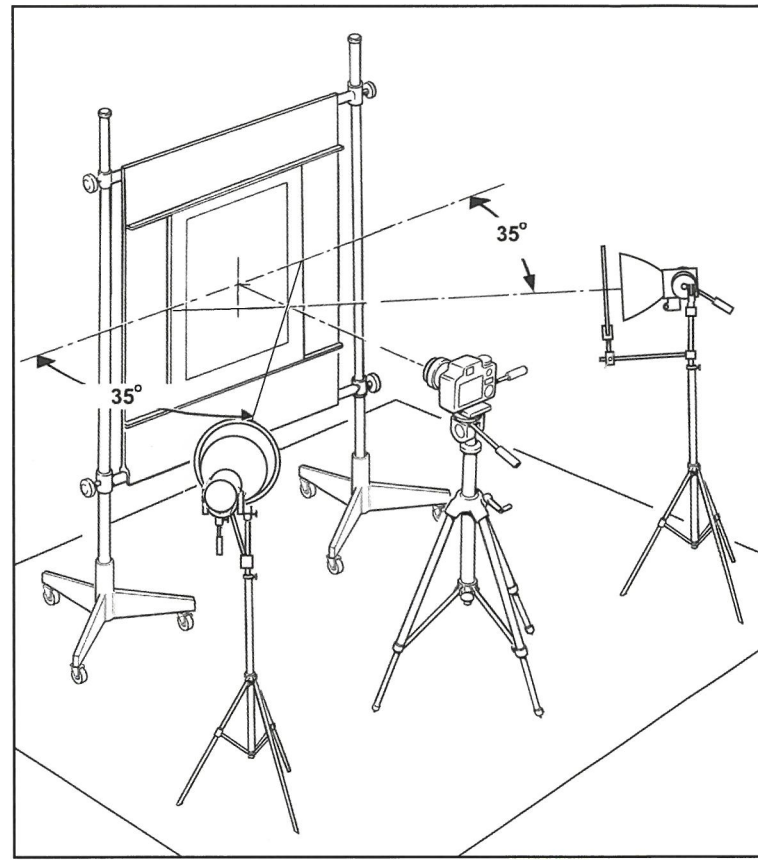


Figure 25. Normal light with polarizing filters setup.

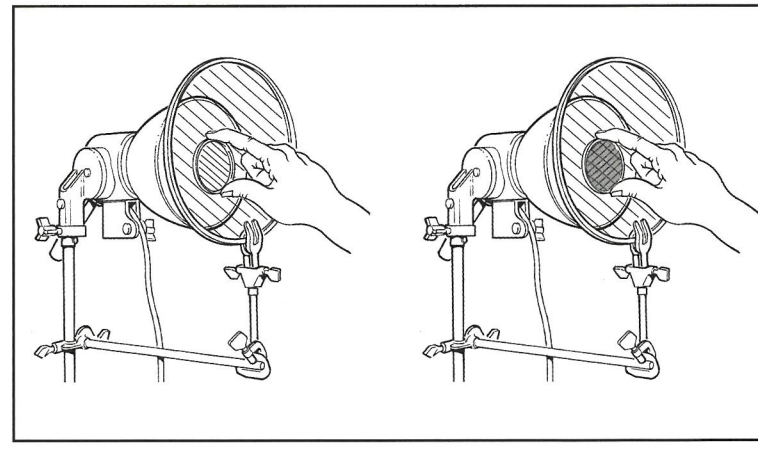


Figure 26. To determine if filters are crossed, rotate the lens filter in front of the light filter until it is completely opaque. Record and mark the orientation.

Figure 27. Painting photographed (a) in normal light and (b) with crossed-polarized filters. Note how the filters have eliminated the unwanted reflections and increased the contrast. Painting from a private collection.

Notes

4. Key light with reflector

Introduction

A single key light with a reflector is effective for emphasizing the engraving or surface features of 2D and 3D objects (e.g. coins, baskets, and statues), and can also be used in photomacrography. The one key light brings out the surface features and the reflector card fills in the shadows; different setups with the reflector produce different results.

Procedure

Position the key light source at a 10–20° angle incident to the object to give a partial raking light effect. Add a white reflector card on the opposite side of the object to define its outer edges and shape.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"] to set up the shot, being sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- Place the key light to the left of the object.
- Keep the angle of incidence at 10–20°.
- Observe the highlight reflections and shadow effects through the camera's viewfinder.
- Reposition the key light to modify the shadows and highlights so that they appear in the optimum location on the surface of the object.
- Place a white or silver reflector card on the opposite side of the object as the fill light.
- Move the reflector card closer to, or farther from, the object to fill in the shadows to achieve the best effect.

Exposure determination

- Take one incident light reading with the light meter facing the light source, and a second one with the meter facing the reflective card.
- For the coin in Figure 32a, the difference between the readings can be as high as 4 f-stops (a lighting ratio of 16:1).
- For the coin in Figure 32b, the difference between the readings can vary from 1 to 2 f-stops (a lighting ratio of 2:1 to 4:1).
- Take a reading at the centre of the object to determine the camera exposure setting.
- For photomacrography, adjust the exposure based on the exposure compensations in Table 1 (p. 3).
- More or less exposure may be required due to the reflection and absorption characteristics of the object.

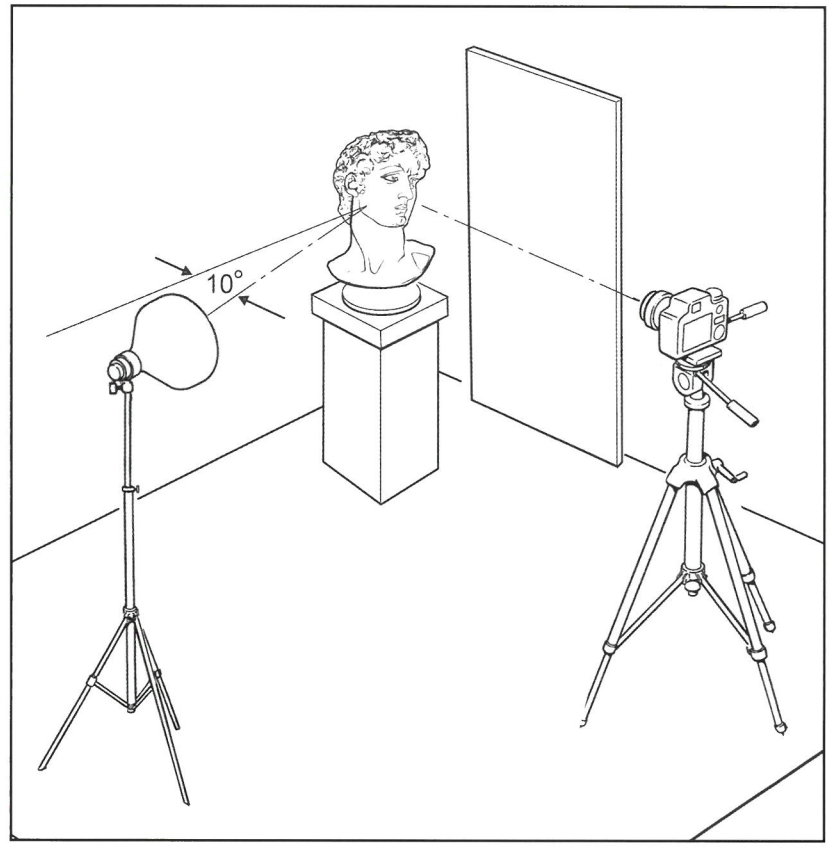


Figure 28. Key light with reflector photography setup.

Figure 29. Basket lit using one light (from left) with (a) a white reflector card on the right side, (b) no reflector card, and (c) a silver reflector card on the right side. Basket (maker and date unknown) from the CCI Training Collection.

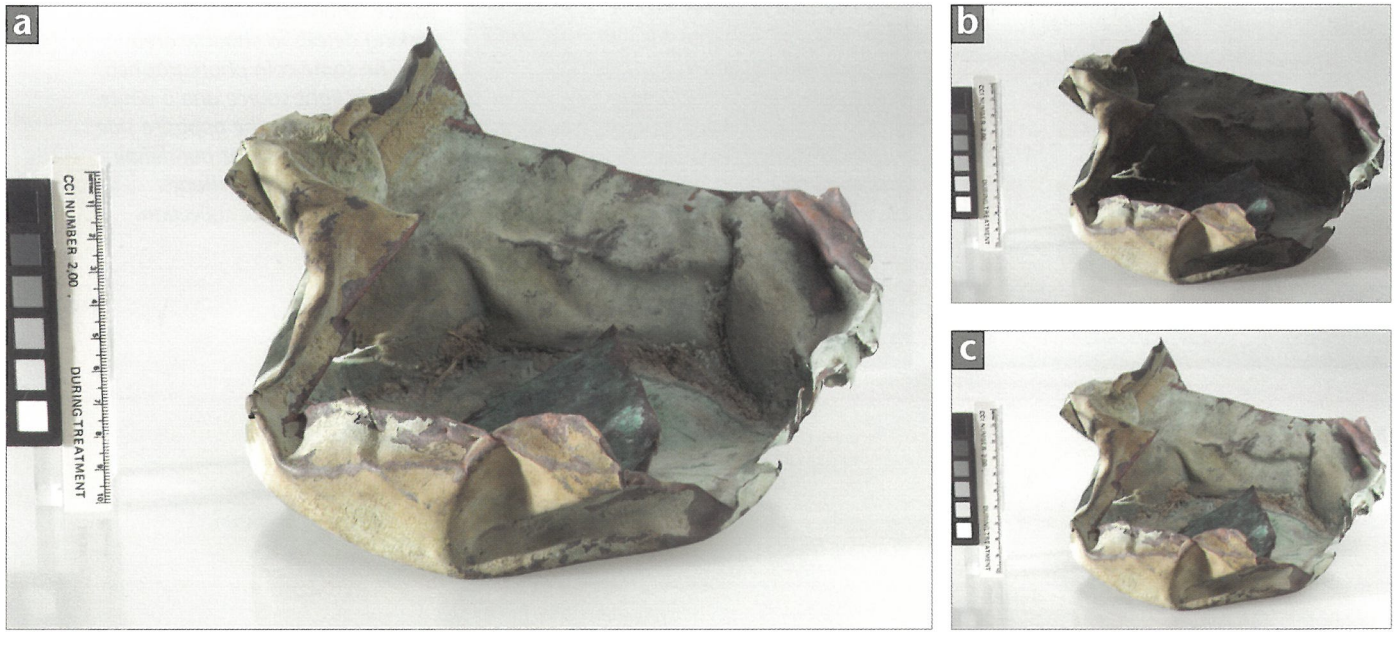


Figure 30. Copper artifact lit using one light (from left) with (a) a white reflector card on the right side, (b) no reflector card, and (c) a silver reflector card on the right side. Copper artifact (maker and date unknown) from the CCI Training Collection.

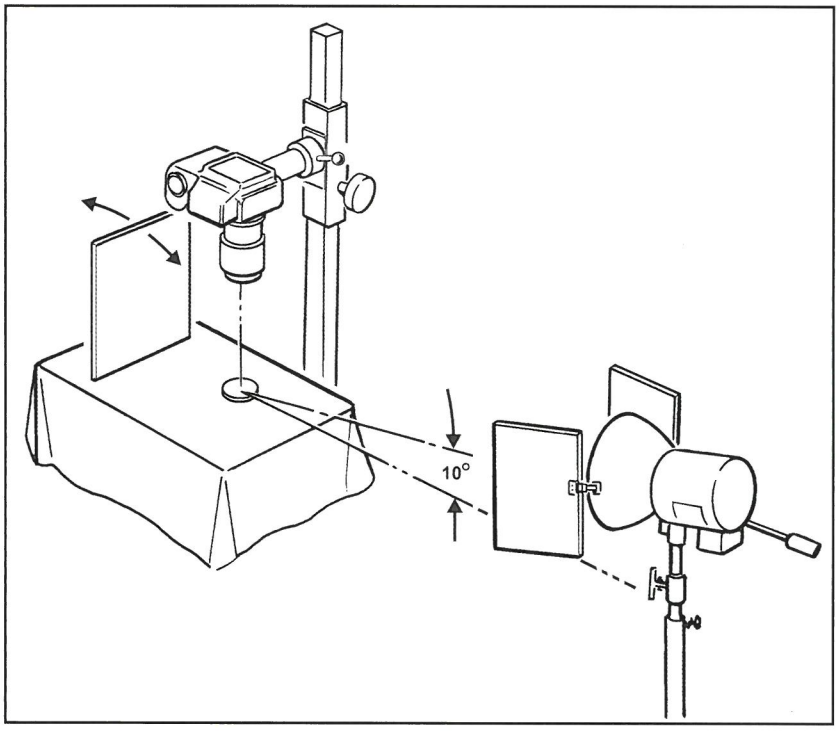


Figure 31. Key light with reflector setup for photomacrography.

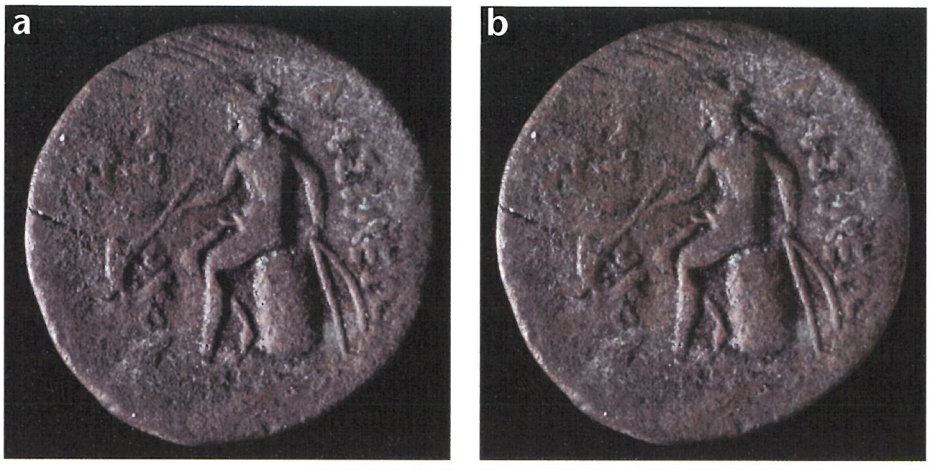


Figure 32. (a) Archaeological coin of Seleucid King Antiochus III, photographed with one light source, showing relief but lacking details in shadow area. (b) The same coin photographed with one light source and a white reflector card on the opposite side, showing less contrast but defining the outer edges and shape. Coin from a private collection.

Notes

5. Low-angle light

Introduction

Low-angle light is used when photographing framed objects under convex glass, daguerreotypes, and some ruby ambrotypes.

Procedure

Objects covered with convex glass behave the same way as a convex mirror: they reflect light coming from all directions, including the walls, the floor, and the ceiling. As with normal light photography (see p. 22), some unwanted reflections can be blocked by cutting a hole in a sheet of black matt board and fitting the camera lens through it. Masking all the reflective surfaces surrounding the setup with black cloth or boards is also effective. Ideally, the photographer should hide behind the masked-off camera and tripod. Depending on the requirements, a balance between lowering and raising the light position must be determined.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"] to set up the shot, being sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- Position two lights, one on each side of the camera and equidistant from it.
- Place both lights at the same height as the camera, viewed from the side.
- Keep the angle of incidence the same for both lights, viewed from the top. This angle should not be more than about 5–10° to the surface of the object.
- Aim each light head slightly beyond the farthest edge of the object.
- Illuminate the object evenly. *Tip*: The farther the light source is from the object, the more even the illumination will be across the surface of the object.
- Use barn doors to narrow the light beam on the object and eliminate any stray light that might illuminate the studio.

Exposure determination

- Check that the object is evenly illuminated by:
  - taking light readings from the centre of the object with an incident light meter facing each light in turn
  - comparing the two light readings and adjusting the light distances so that both readings are identical
  - taking light readings from each corner with the meter facing the camera
  - comparing the readings and feathering (swivelling) the light head by a few degrees inward or outward until all readings are identical
- To determine the camera exposure, take a light meter reading from the centre of the object, facing the camera.
- Objects with a "typical" range of light and dark tones will be photographed correctly at the exposure determined.
- Lighter-toned objects may require less exposure and darker-toned objects more exposure.

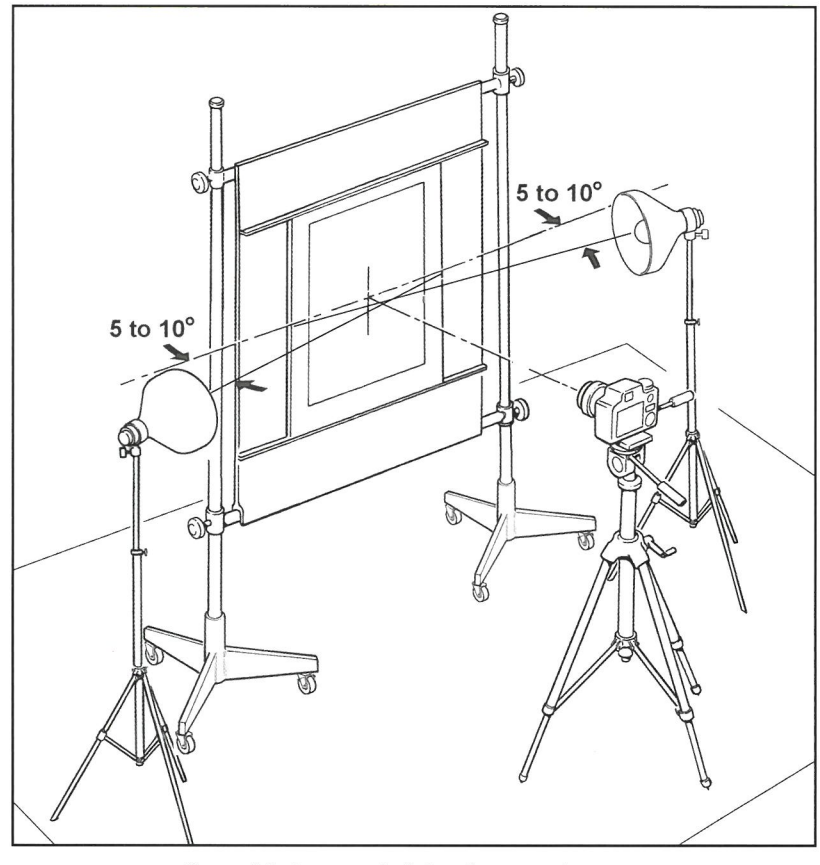


Figure 33. Low-angle light photography setup.

Figure 34. Ruby ambrotype portrait in a metallic frame photographed with two lights at a low angle, showing the finest image details. Ambrotype (portrait photographer and date unknown) from the CCI Training Collection.

Figure 35. (a) Framed portrait under convex glass photographed in normal light, showing undesirable reflections. (b) The same portrait photographed using two lights at a shallow angle, while masking all the reflection around the setup; in this case the undesirable reflections have been eliminated. Portrait from a private collection.

6. Lighting with umbrellas

Introduction

Lighting with umbrellas creates a greater light radius, which is ideal for large objects and backgrounds. Light bounces inside an umbrella to create softer shadows by means of an indirect lighting effect. Umbrellas are available in various reflective surfaces and sizes; they are more versatile and less expensive than soft boxes. Inserting diffusers between the umbrella and the object reduces the possibility that the umbrella's shape will reflect on metallic objects or shiny surfaces.

Procedure

Umbrellas of various sizes, neutral colours, and reflective properties can be used. Depending on the object's shape, the position of the lights (see Figure 36) can be adjusted to create the desired highlights and shadows.

When photographing objects with reflective surfaces (such as paintings under flat glass, glossy prints, etc.), it is important to prevent unwanted reflections of the camera, jewellery on the photographer's hands, ceiling fixtures, etc. This can be achieved by cutting a hole in a sheet of black matt board and fitting the camera lens through it.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"] to set up the shot, being sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- For 3D objects, light the object with one key light and umbrella to the left of the camera with the light falling on the object at an approximate incident angle of 30–45°.
- From the camera's perspective, observe where the highlights and shadows appear on the object.
- Reposition the key light to modify the shadows and highlights and have them appear in the most appropriate location.
- Add the fill light (a second umbrella) just to the right of the camera.
- Reposition the fill light to diminish the key light's shadows to achieve the desired effect.
- Add a diffuser sheet between a light source and the object to further eliminate reflections (remember that exposure compensation will be required).

Exposure determination

- Take an incident light reading from the key light and a separate reading from the fill light.
- Depending on the desired visual effect, light ratios can range from 1.5:1 (1/2 f-stop) up to 8:1 (3 f-stops).
- To determine the camera exposure, take a light meter reading from the centre of the object, facing the camera.
- Depending on the reflection and absorption properties of the object, bracket over and under by 1/2 f-stop increments.

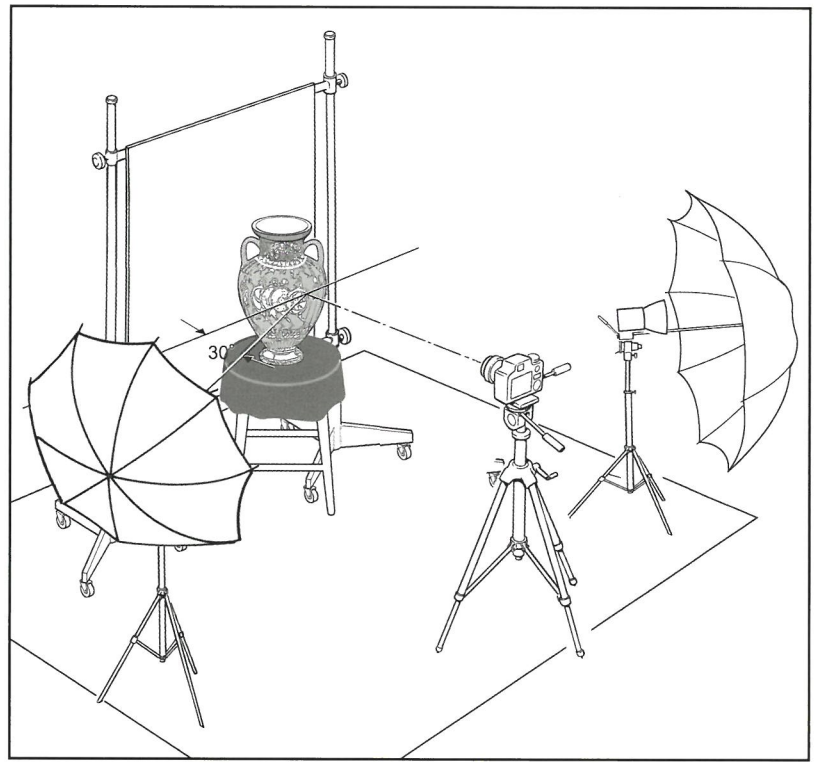


Figure 36. Lighting with umbrellas photography setup.

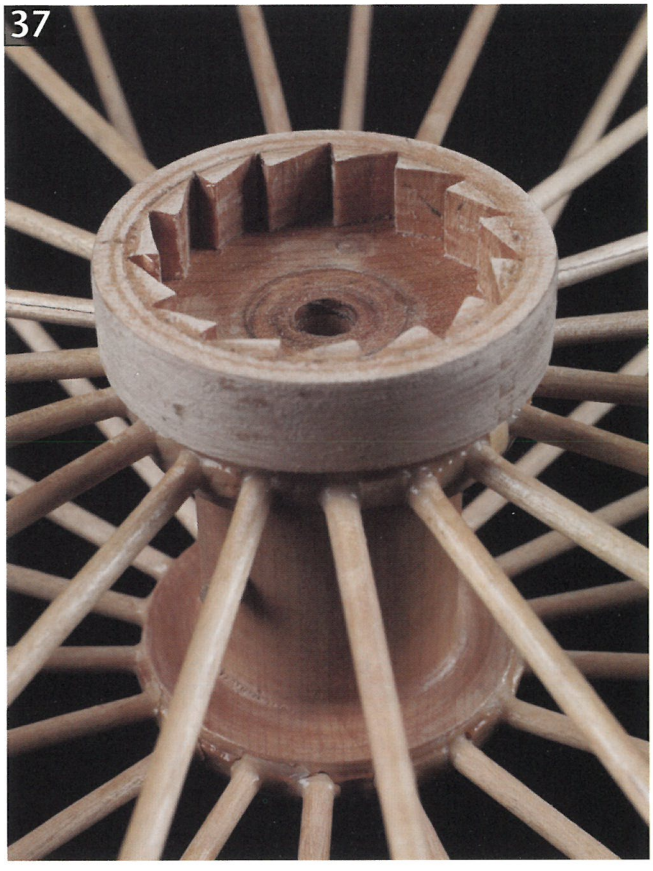


Figure 37. Wood object photographed with umbrellas. Wooden bicycle (Al Snowie, 1986), Royal Alberta Museum, Edmonton, Alta., Accession No. H87.25.1.

Figure 38. Bust photographed with umbrellas. Alexandra, Princess of Wales (Marshall Wood, 1870), Library of Parliament, Ottawa, Ont.

Figure 39. Military tunic photographed with umbrellas. Red and yellow tunic (belonged to Private Alexander Anderson, Lord Clyde Rifles Coy. T. Volunteer Brigade ca. 1863), Prince Edward Island Museum and Heritage Foundation, Accession No. HF.87.39.1.

7. Lighting with soft boxes

Introduction

Soft boxes are used when photographing objects of various shapes that require a soft lighting effect. Soft boxes differ from umbrellas in that the light reflects and bounces inside the metallized fabric of the box to cast a soft light through the diffusing material. Because the soft box components are not reflected the way the ribs (gores) of an umbrella would be, this technique is ideal for photographing mirror-like surfaces.

Procedure

Soft box lights are multipurpose: they can be used in pairs for lighting 3D objects or in other setups as a fill light. Angles can be adjusted to create the desired highlights and shadows.

When photographing objects with reflective surfaces (such as paintings under flat glass, glossy prints, etc.), it is important to prevent unwanted reflections of the camera, jewellery on the photographer's hands, ceiling fixtures, etc. This can be achieved by cutting a hole in a sheet of black matt board and fitting the camera lens through it.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"] to set up the shot, being sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- For 3D objects, light the object with one soft box key light to the left of the camera with the light falling on the object at an approximate incident angle of 30–45°.
- From the camera's perspective, observe where highlights and shadows appear on the object.
- Reposition the key light to modify the shadows and highlights and have them appear in the most appropriate location.
- Add the fill light (a second soft box) just to the right of the camera.
- Reposition the fill light to diminish the key light's shadows to achieve the desired effect.

Exposure determination

- Take an incident light reading from the key light and a separate reading from the fill light.
- Depending on the desired visual effect, light ratios between the key light and the fill light can range from 1.5:1 (1/2 f-stop) up to 8:1 (3 f-stops).
- To determine the camera exposure, take a light meter reading from the centre of the object, facing the camera.
- Depending on the reflection and absorption properties of the object, bracket over and under by 1/2 f-stop increments.

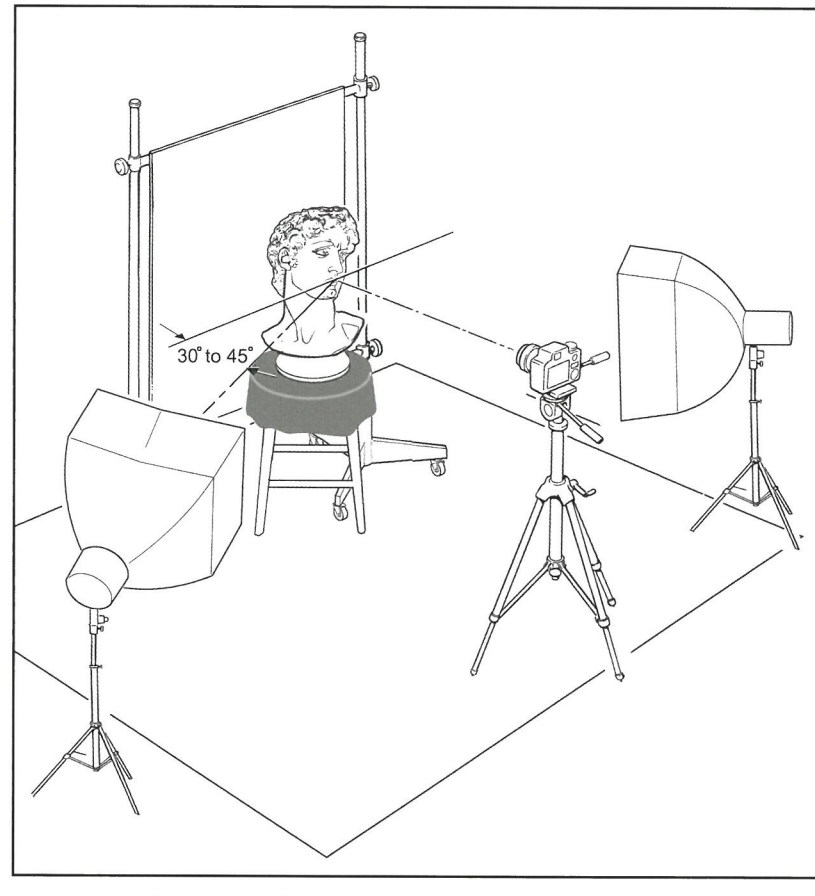


Figure 40. Lighting with soft boxes photography setup.

Figure 41. Chair photographed with soft boxes. Ottawa Mayor's chair, Bytown Museum, Ottawa, Ont., Accession No. 1917.004.01.

Figure 42. Printing press photographed with soft boxes. Iron print press (Chandler & Price, 1886), MacBride Museum of Yukon History, Whitehorse, Y.T., Accession No. 1973.1.514.

Figure 43. Brass telescope photographed with soft boxes. Dolland telescope (1820), Fort William Historical Park, Thunder Bay, Ont., Accession No. 1-R-IX-50(a).

Figure 44. Motorcycle helmet photographed with soft boxes. Motorcycle helmet (maker and date unknown), The Military Museums, Calgary, Alta., Accession No. MR 2005.86.001.

Figure 45. These photographs of an etched sword were taken with the camera lens inserted through a hole in a matt card. (a) This image, taken with a white matt card, reveals corrosion and some details of the etching. (b) This image, taken with a black matt card, reveals more detail of the etching. Sword (craftsman/manufacturer unknown, 1822), Niagara Historical Society & Museum, Accession No. 992.156.01.

8. Specular light

Introduction

Specular light is used when photographing 2D objects (or the surfaces of 3D objects) to record the surface texture and irregularities: uneven varnish application, sheen, patina, scraping and abrasion, cupping, peeling, and shrinkage. It can also be used to reveal gilded areas of illuminated manuscripts. It is not suitable for every type of painting.

Procedure

It is important to experiment with this technique as every surface is different. There are no set rules regarding the choice of light source: a pinpoint light source may be best in some situations while a large light box might be preferable in others. The use of a light meter is recommended to verify the evenness of the illumination on the surface of the object.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects"] to set up the shot, being sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- Choose an appropriate light source, using a large soft box, an umbrella, or large lit reflector cards or flats. *Tip*: A light source with a small reflector bowl may be more effective for small paintings.
- Method 1: Place the light source directly in line with the axis of the camera and the object, taking care not to cast a shadow on the surface of the object.
- Method 2: Place the camera slightly off axis in one direction and the light source off axis in the opposite direction (the resulting image will be slightly skewed but this can be minimized by using a lens with a long focal length or a PC lens).
- View the illumination from the camera's perspective, and observe the effect of varying the position of the light source.

Exposure determination

- Take an incident light reading at the centre of the object and at all four corners.
- Check that the exposure reading is approximately even across the surface. If it isn't, reposition the light(s) so that there is no more than 1/3 f-stop differential between the exposure readings.
- Set the camera exposure to the measured exposure.
- Depending on the surface reflection and desired effect, it may be necessary to underexpose by up to 2 f-stops.
- Bracketed exposures are recommended.

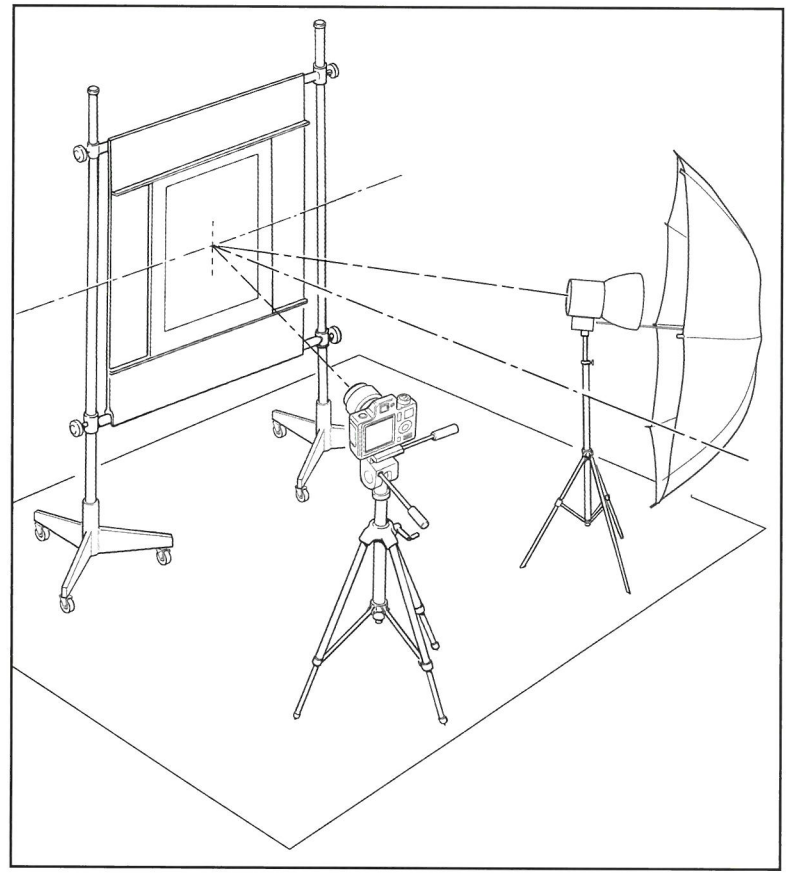


Figure 46. Specular light photography setup.

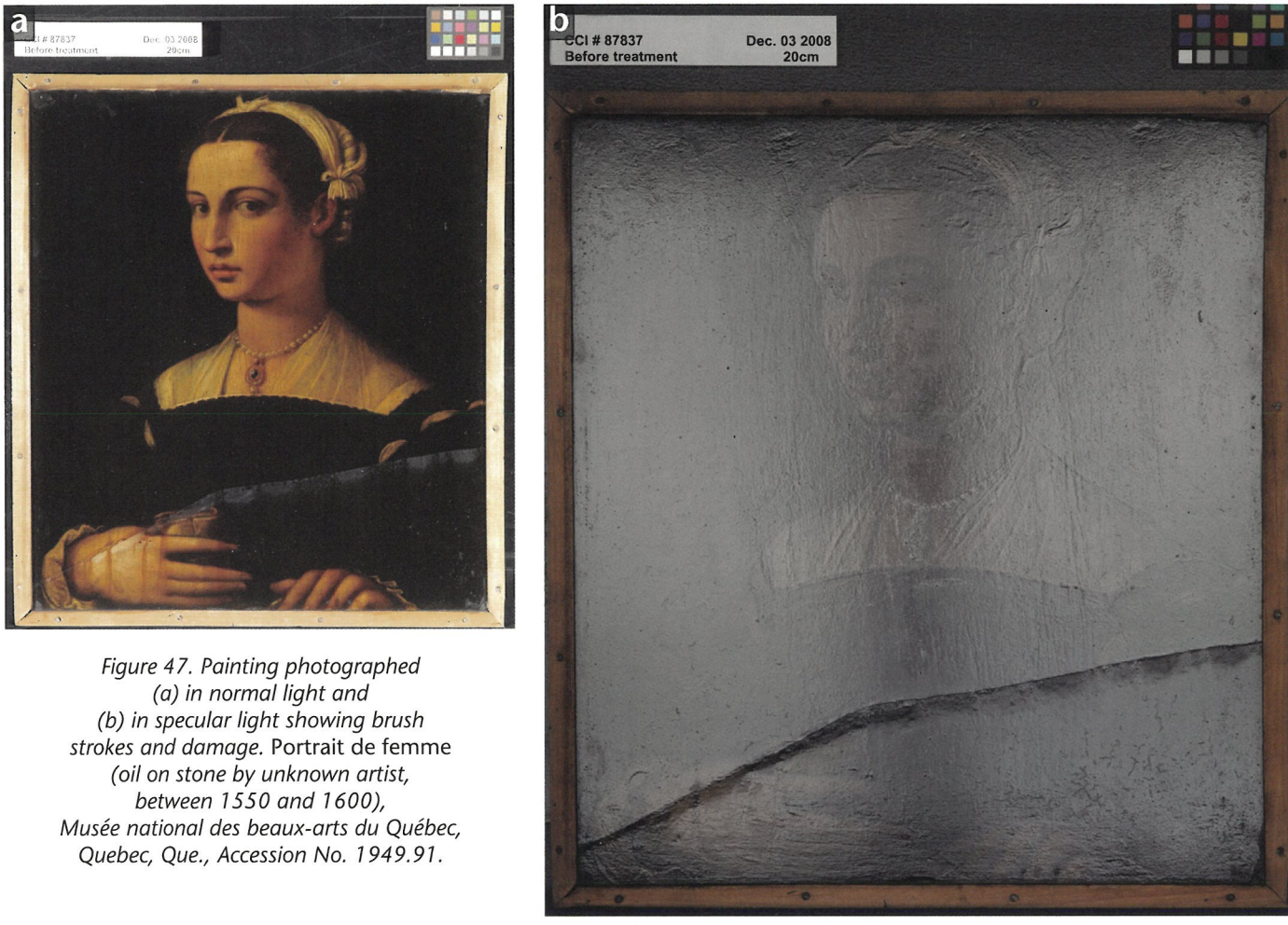


Figure 47. Painting photographed (a) in normal light and (b) in specular light showing brush strokes and damage. Portrait de femme *(oil on stone by unknown artist, between 1550 and 1600), Musée national des beaux-arts du Québec, Quebec, Que., Accession No. 1949.91.*

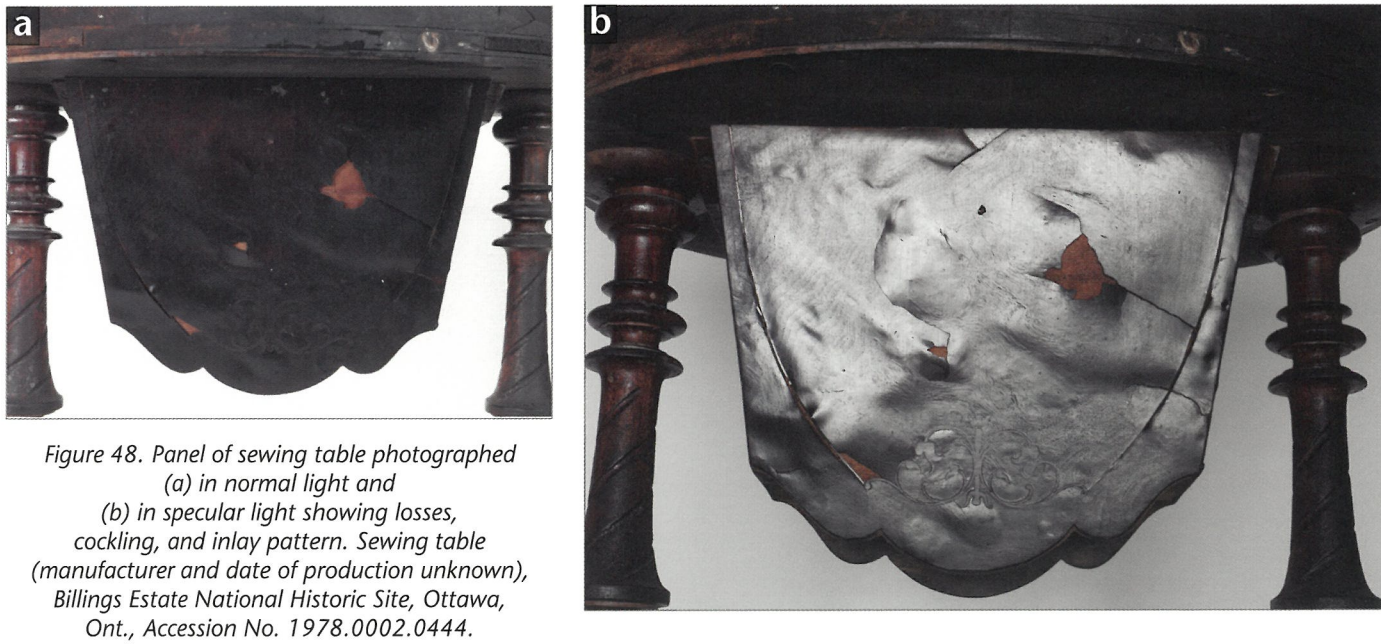
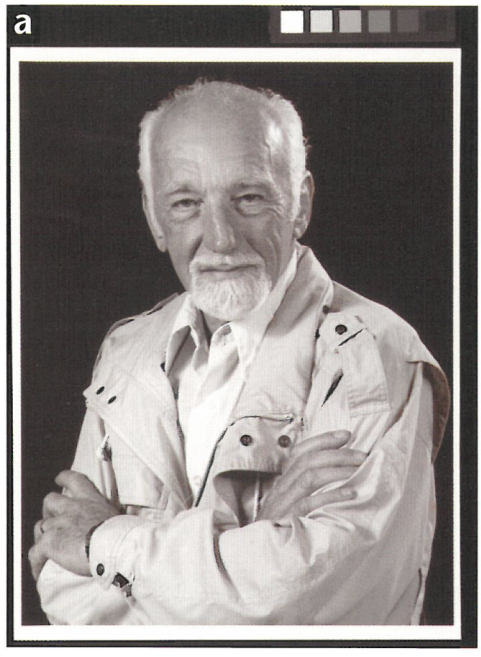


Figure 48. Panel of sewing table photographed (a) in normal light and (b) in specular light showing losses, cockling, and inlay pattern. Sewing table (manufacturer and date of production unknown), Billings Estate National Historic Site, Ottawa, Ont., Accession No. 1978.0002.0444.



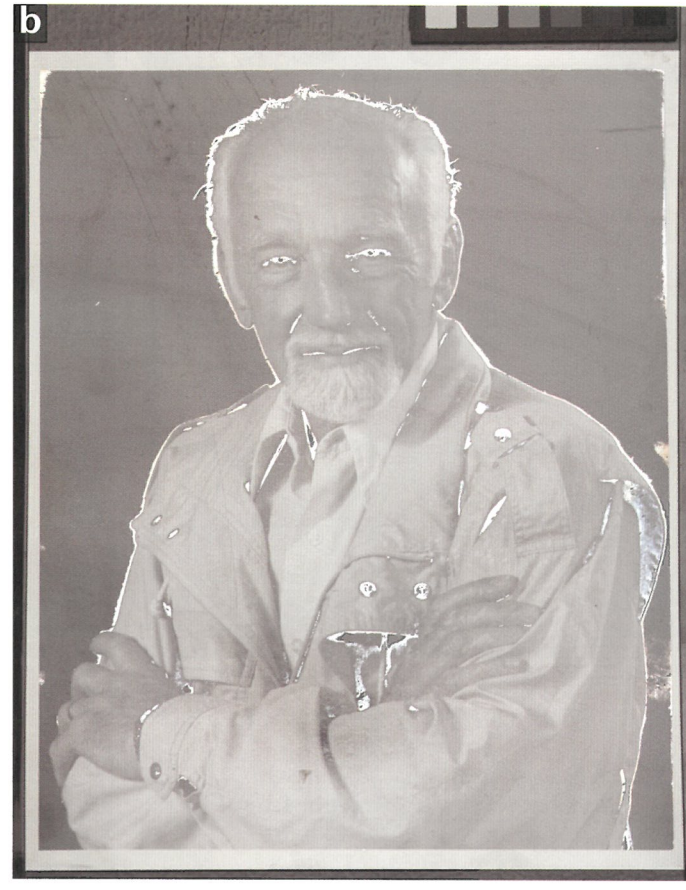


Figure 49. Silver gelatine print photographed (a) in normal light and (b) in specular light, revealing silver mirroring resulting from oxidation of image silver. Silver gelatine print from the CCI Training Collection.

Figure 50. Detail of an illuminated manuscript photographed (a) in normal light and (b) in specular light, revealing gilded areas. Salzinnes Antiphonal from Belgium (1554–1555), Rare Book Collection of the Patrick Power Library at Saint Mary's University, Halifax, N.S., Accession No. TL2000.32.

9. Transmitted (direct) light

Introduction

Transmitted (direct) light is used when photographing a painting to record its condition: cracks, tears, paint losses, thinly painted areas, and stretcher garlands (uneven tension produced by nails used to attach the canvas to the stretcher). With the addition of a diffusing screen, it can be used to photograph stained glass and glass plate negatives. Watermarks in paper can also be recorded.

Procedure

Position the light source on the same axis as the camera lens but on the opposite side of the object. Use black masking material (such as black matt board) to block light that spills off the edges of the object. Small- to medium-sized paintings can be photographed in one shot, but larger paintings should be photographed in sections (overlapping quadrants) to ensure full coverage.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects"] to set up the shot.
- Place one light source at least 2 m behind the painting, on the same axis as the camera lens (see Figure 51).
- Use barn doors to reduce light spillage around the edges of the painting.
- Cut black matt board to shape to mask the object and prevent light spillage around its edges.
- Choose a lens with a longer than normal focal length; wide-angle lenses are unsuitable for accurately recording craquelure towards the edges of a painting.
- If it is necessary to record a point of reference and/or some features of the object, partially light the front of the object by allowing some ambient light to bounce off a white ceiling or reflector, or by using a controlled low intensity soft light set to one side as described in normal light photography (see p. 22).
- If it is necessary to soften the light source (e.g. for thinly painted works of art, watermarks, and glass objects), place a white diffusing screen about 30 cm from the back of the object or use a light box. If a quartz-halogen lamp is being used as the lighting source, a diffusing screen also serves to protect the object from the heat generated by the lamp.
- Photograph a colour reference target from the back of the object (using the same camera and same lighting technique), and use it as a point of reference to set the white balance for all subsequent photographs (from the front) within the same session.

Exposure determination

- Check that the object is evenly illuminated by:
  - taking light readings from the back of the painting at the centre and at each corner, with the light meter aimed at the light source
  - comparing the light readings and adjusting the light position to obtain as even illumination as possible
- To determine the camera exposure, use the light reading from the back of the object's centre, with the meter aimed towards the back. *Tip*: Because the thickness of objects is not likely to be uniform, bracketing exposures is necessary to achieve the best image quality.
- For thinly painted works of art, watermarks, and glass objects (where a diffusing screen or light box is placed behind the object), set the camera exposure very close to the measured exposure. Bracket $^1/_2$ f-stop over and $^1/_2$ f-stop under.
- For opaque paintings (where a light source with standard reflector bowl is used), it may be necessary to set the camera exposure up to 10 f-stops higher than the measured exposure, depending on the thickness of the painting.

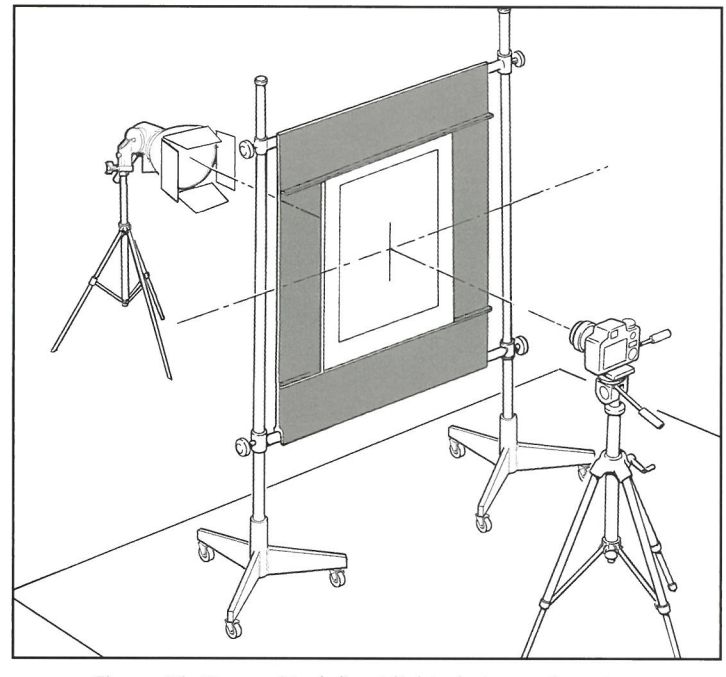


Figure 51. Transmitted direct light photography setup.

Figure 52. Painting photographed (a) in normal light and (b) in transmitted direct light, revealing losses and craquelures. Colour in Space *(oil on canvas by Hortense Gordon, 1958), Chatham Cultural Centre, Chatham, Ont., unaccessioned.*

Figure 53. Stained glass photographed (a) in transmitted direct light (can also be photographed in transmitted indirect light) and (b) in transmitted direct light with reflectors (positioned on each side of the camera) bouncing light to show surface details. Stained glass from a private collection.

10. Transmitted (indirect) light

Introduction

Transmitted (indirect) light is similar to transmitted (direct) light (see p. 44). It is used to light large objects where space is too limited to set up a transmitted direct light system, and is also suitable for smaller objects such as stained glass with clear glass, watermarks in paper, thin paintings, and perforated metal artifacts.

Procedure

This technique is based on producing a diffused light source by converting a background into a large uniformly lit surface. It requires a minimum of two lights (with optional umbrella or soft box), positioned on each side of a white surface at about 45° (see Figure 54). The white surface can be a white wall or a custom-built background of white fabric or sheets of foam board. This technique saves studio space, which is advantageous when photographing large objects.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects"] to set up the shot.
- Place the supported object in front of the lit background assuring the complete surface is equally illuminated.
- Aim the lights towards the background and slightly behind the object, making sure the light does not fall in front of the object.
- Use a lens with a longer than normal focal length; wide-angle lenses are unsuitable for accurately recording craquelure towards the edges of a painting.
- Cut black matt board to shape to mask the object and prevent light spillage around its edges.
- Use barn doors and gobos to prevent direct light from flaring into the camera lens.
- If it is necessary to record a point of reference and/or some features of the object, partially light the front of the object by allowing some ambient light to bounce off a white ceiling or reflector, or by using a controlled low intensity soft light set to one side as described in normal light photography (see p. 22).
- Use umbrellas or light boxes to improve the evenness of the illumination or accommodate large objects.
- Photograph a colour reference target from the back of the object (using the same camera and same lighting technique), and use it as a point of reference to set the white balance for all subsequent photographs (from the front) within the same session.

Exposure determination

- Check that the object is evenly illuminated by:
  - taking light readings from the centre of the background with an incident light meter facing each light in turn
  - comparing the two readings and adjusting the light distances so that both readings are identical
  - taking a light reading from each corner of the background with the light meter facing the object
  - comparing the readings and feathering (swivelling) the light heads by a few degrees inwards or outwards until all readings are identical
- To determine the camera exposure, take a light meter reading from the back of the object's centre, with the meter aimed towards the lit background. *Tip*: The camera exposure setting should be very close to the measured exposure, but could be off depending on the thickness or density of the object. Bracketed exposures are recommended.

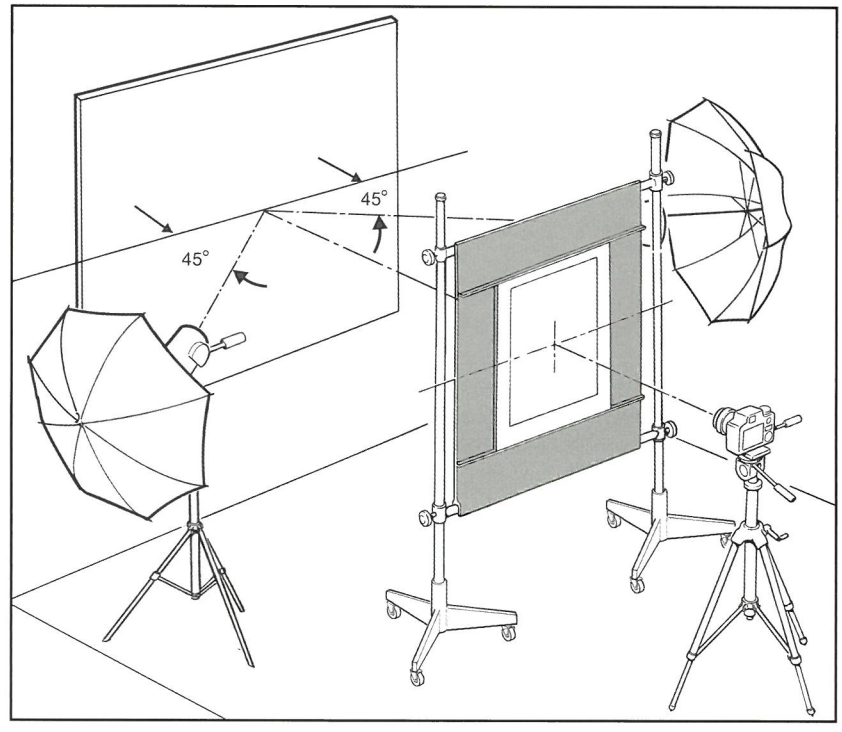


Figure 54. Transmitted indirect light photography setup.

Figure 55. Watermark photographed in transmitted indirect light. English handmade paper with watermark from the CCI Training Collection.

Figure 56. Ruby ambrotype portrait photographed (a) in transmitted indirect light and (b) in transmitted indirect light with secondary light sources (positioned on each side) to show frame. Ambrotype (portrait photographer and date unknown) from the CCI Training Collection.

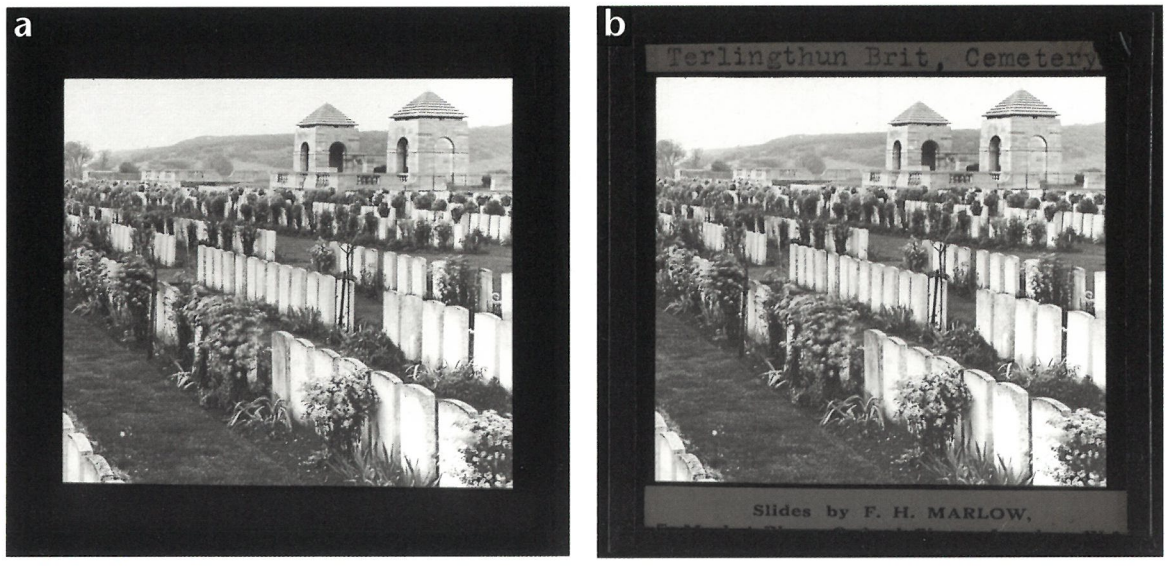


Figure 57. Lantern slide photographed (a) in transmitted indirect light and (b) in transmitted indirect light with reflectors (positioned on each side) to show labels. Lantern slide (Terlingthun Brit, Cemetery by F.H. Marlow, date unknown) from the CCI Training Collection.

11. Dark field illumination

Introduction

Dark field illumination is used when photographing transparent 2D objects to record surface features such as the formation of accretions on glass surfaces. It can also be used on etched and engraved flat glass and, in some cases, on transparent 3D objects.

Procedure

Two lights are positioned behind the object and are directed at a very shallow angle of incidence (about 10°) onto the back of it. The angle can be changed depending on the nature of the object. Barn doors can be used to reduce the amount of light illuminating the background and surrounding areas, and also to eliminate lens flare.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects"] to set up the shot.
- Place the object in front of a black background (otherwise the details on a glass surface will be difficult to record).
- Position two lights behind the object, directed at a very shallow angle of incidence (about 10°) onto the back of it.
- Use barn doors to ensure that no illumination falls on the black background.
- Choose a lens with a longer than normal focal length to make sure the background exceeds the lens coverage.
- Photograph a colour reference target from the back of the object (using the same camera and same lighting technique), and use it as a point of reference to set the white balance for all subsequent photographs (from the front) within the same session.

Exposure determination

- Check that the object is evenly illuminated by:
  - taking a light reading from the centre of the object (on the back side) with an incident light meter facing each light in turn
  - comparing the two light readings and adjusting the light distances so that both readings are identical
  - taking light readings from the back of the object, one at the centre and one at each corners
  - comparing the readings and feathering (swivelling) the light heads by a few degrees inwards or outwards until all readings are identical
- To determine the camera exposure, take a light meter reading from the back of the object's centre, with the meter aimed towards the background.
- Depending on the density and transparency of the object, it may be necessary to either increase or decrease the camera exposure.

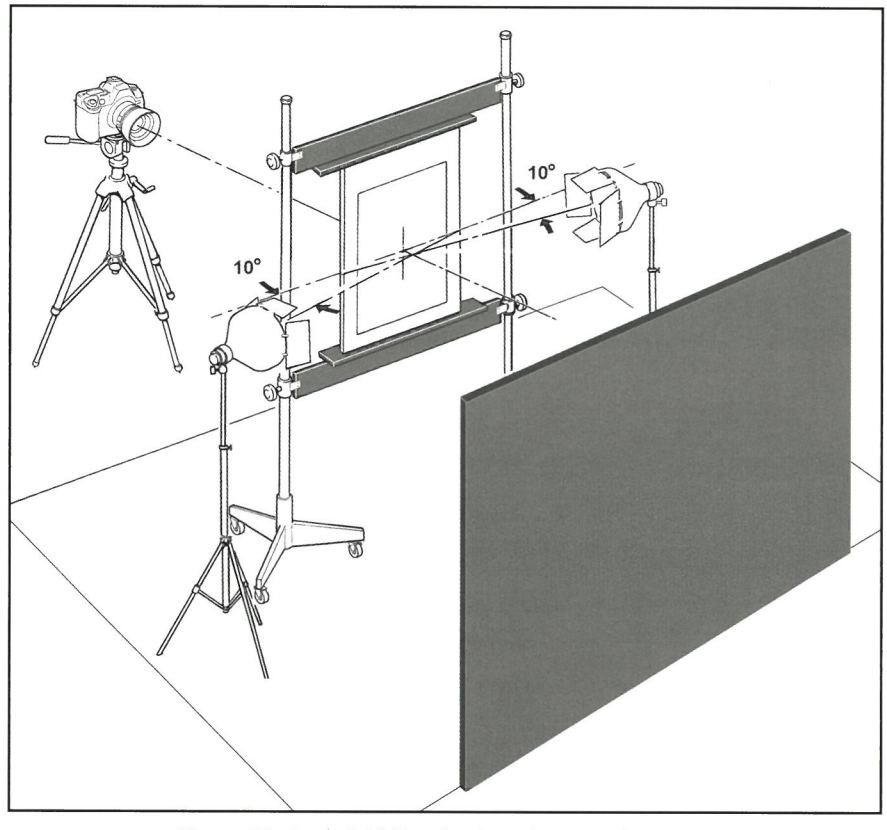


Figure 58. Dark field illumination photography setup.

Figure 59. Glass plate photographed in dark field illumination. Glass plate from a private collection.

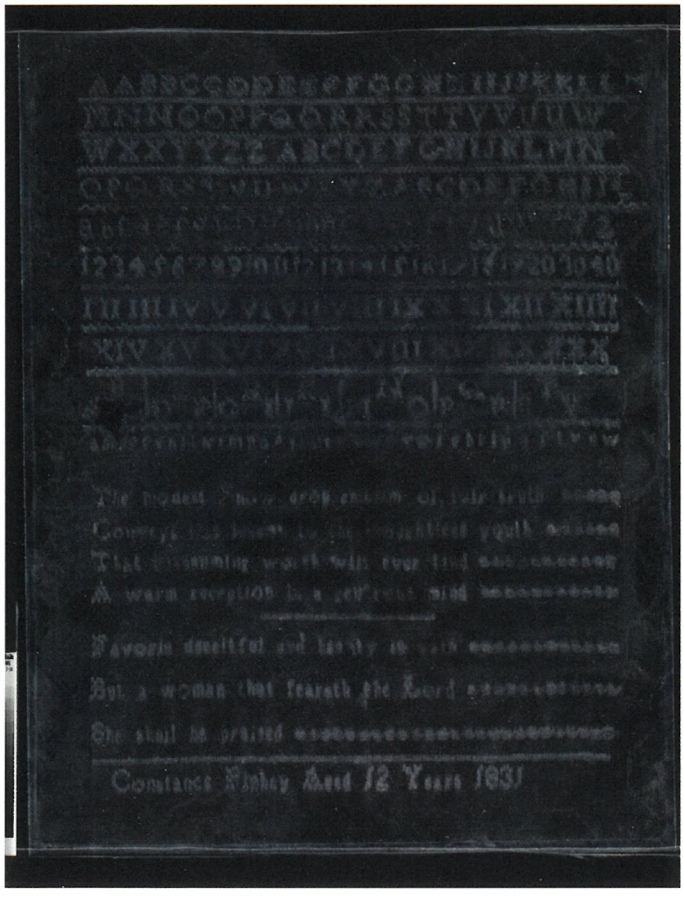


Figure 60. Ghostly image formed on the inside surface of glazing (glass) over a needlework sampler. Needlework sampler (Constance Pinhey, 1831), Pinhey's Point Foundation, Dunrobin, Ont., Accession No. 2000.15.

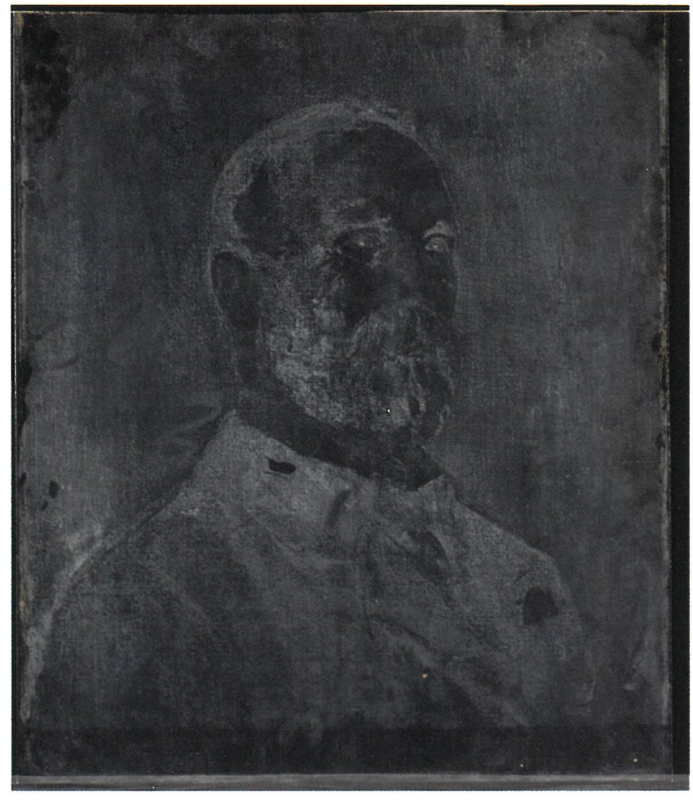


Figure 61. Ghostly image formed on the inside surface of glazing (glass) over a painting, photographed in dark field illumination. Portrait of Hugh Boyd *(oil on canvas attributed to T. Walker, 1911), City of Richmond Archives, Richmond, B.C., Accession No. 1979 707 1.*

12. Lighting with cone diffusers

Introduction

Cone diffusers are used primarily for photomacrography of small, reflective objects such as highly polished or newly minted coins, wet archaeological specimens, metal parts, some silverware, and gilded areas on illuminated manuscripts. They soften the light and change the characteristics of the light reflection off the surface of the object. However, because they can soften the light to the point where the surface texture becomes featureless, they should be used only when umbrellas or soft boxes are not effective on their own. Combining a cone diffuser with an umbrella or soft box creates an even softer, more diffused light.

Procedure

A cone diffuser can be made in-house with a white translucent 4-litre bottle, a lampshade, or translucent Mylar, or can be custom-made at a plastics fabrication shop. Always verify the cone diffuser is free of any colour cast by inspecting it in front of a light source. For best results, photograph a colour reference card inside the diffuser and adjust the white balance later with photo editing software. Unlike soft box or umbrella techniques, cone diffusers are placed directly over the object and just below the camera. Either one or two light sources can be used, positioned on either side of a copy stand at an incident angle of 10–35° to its surface (if two lights are used, one should be positioned on each side). If the plastic of the cone diffuser is thin, umbrellas can be added to further soften the light. One light source is often adequate to create diffuse light inside a cone diffuser; the light is bounced internally resulting in a reasonable lighting ratio.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"] to set up the shot.
- Use a macro lens on the camera.
- Light the object with a regular light source (with or without an umbrella or softbox, depending on how soft the light needs to be).
- Adjust the camera so that it is positioned directly above the object, facing down.
- Place the cone diffuser over the object and underneath the camera lens.
- Looking through the camera viewfinder, observe the effect. Make sure the cone diffuser does not cause vignetting (if vignetting is observed, lower the camera height or increase the focal length of the lens).
- Add a colour reference target and/or grey scale inside the cone diffuser to increase the accuracy of colour rendition and exposure. If space is limited, take one image with the colour reference target and/or grey scale only and a second with just the object.

Exposure determination

- To determine the camera exposure, take an incident light reading from the inside of the cone with the light meter facing the camera.
- For photomacrography, adjust the exposure based on the exposure compensations in Table 1 (p. 3).
- More or less exposure may be required due to the reflection and absorption characteristics of the object.
- The lighting ratio will change depending on the internal reflective properties of the cone.
- To determine the ratio when one light is used, take one light meter reading inside the cone diffuser with the meter facing the light source, and a second reading with the meter facing the opposite side. If the difference is 1 f-stop, then the lighting ratio is 2:1.

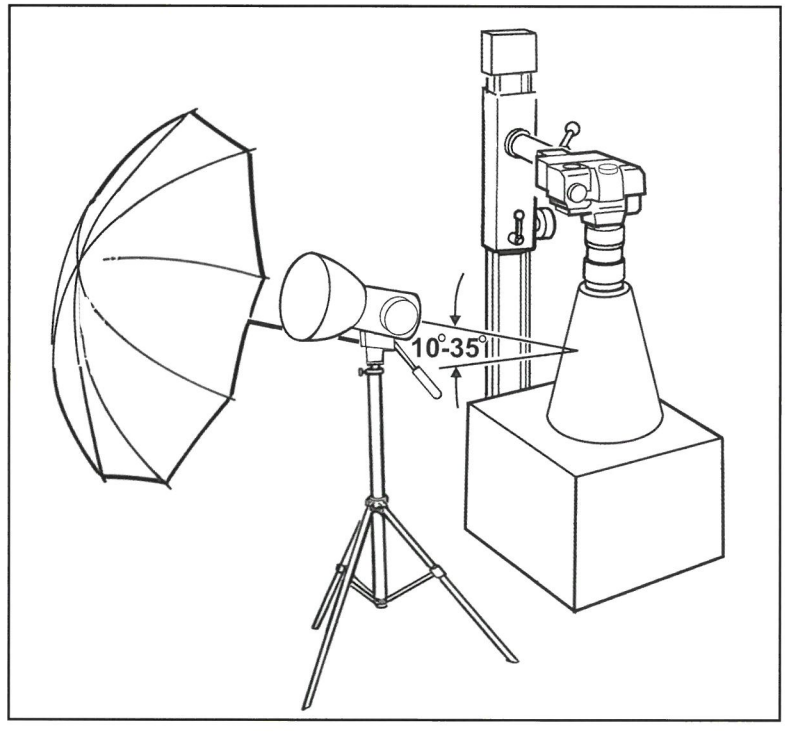


Figure 62. Lighting with a cone diffuser photography setup.

Figure 63. Doll head with reflective surface photographed (a) without a cone diffuser and (b) with a cone diffuser. Doll (manufacturer unknown, 20th century), Agassiz-Harrison Historical Society, Agassiz, B.C., Accession No. 987-69-667.

Figure 65. United States "Morgan Dollar" showing normal wear, photographed using two light sources pointed at the diffuser (bottle) with a 10° incident angle. Coin from a private collection.

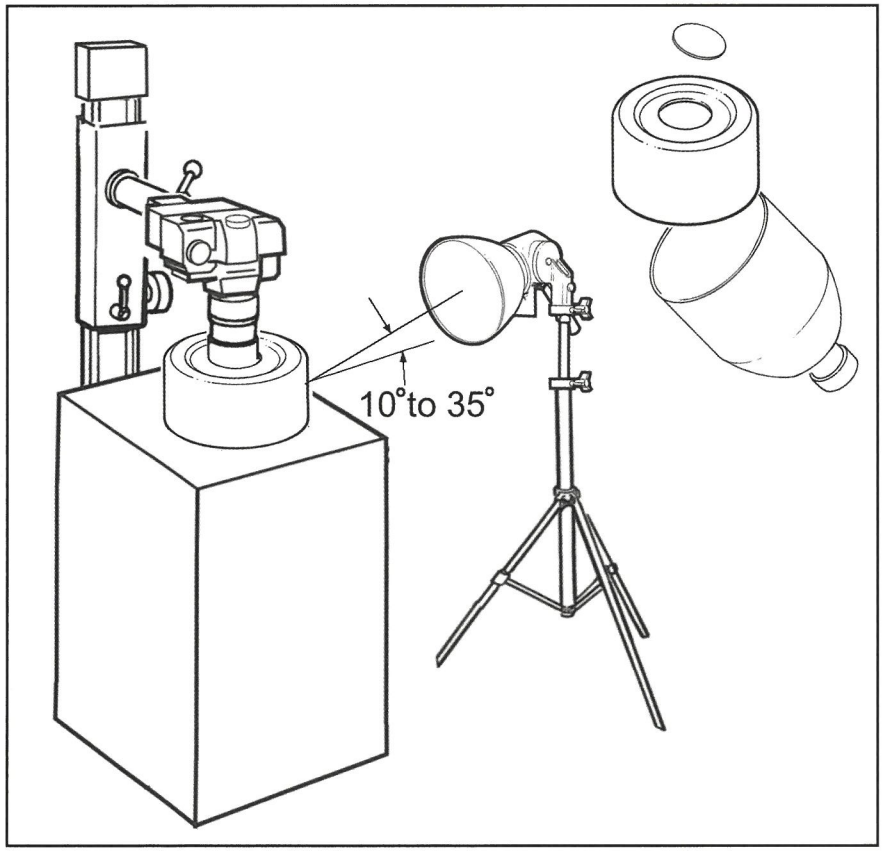


Figure 64. Lighting with a cone diffuser for photomacrography. A cone diffuser can be made simply from a white translucent 4-litre bottle.

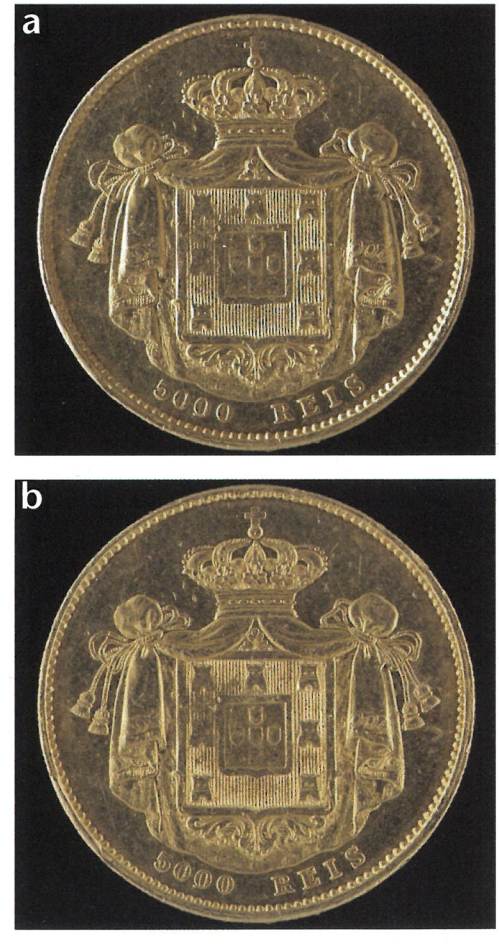


Figure 66. Portuguese 5000 Reis coin photographed with a diffuser using (a) a single light source positioned to the left of the diffuser and (b) two light sources of equal power. Coin from a private collection.

13. Tent lighting

Introduction

Tent lighting is used for photographing highly reflective 3D objects such as jewellery, glassware, and silverware. It consists of light transmitted through fabric to produce soft even illumination. The technique is similar to lighting with a cone diffuser, and has the advantage of reducing specular reflection and softening highlights and shadows. Tent lighting is not suitable for matt objects because details of the surface texture are lost and the object appears featureless.

Procedure

Tents can be purchased or custom-made with white fabric (cotton or polyester) according to the size of the object. Once obtained, the tent must be set up carefully (as certain objects will reflect all of the folds, openings, and defects in the fabric as well as anything else within the workspace area) and a small hole cut for the lens. Either one or two light sources can be used, positioned on either side of the tent at a safe distance from the fabric. Placement of the light sources varies depending on the shape of the object in combination with the opacity and reflective properties of the tent material. Umbrellas can also be used to further soften the light. One light source is often adequate to create diffuse light inside the tent; the light is bounced internally resulting in a reasonable lighting ratio.

Setup

- Set up the tent and position the object within it, following the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"]. Be sure to include a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- Set the camera through the tent opening.
- Position a single light source on one side of the tent slightly above the height of the object.
- Looking through the camera viewfinder, observe the highlights, reflections, and shadows on the object.
- If the desired effect cannot be achieved with a single light, add a second light on the opposite side.
- Check again to observe the highlights, reflections, and shadows on the object, and adjust the lights until the desired effect is achieved.
- If it is necessary to further diffuse the light, add a white translucent umbrella to the light source(s).
- If the colour reference target and/or grey scale reflect on the object, take one image with them and a second without them.

Exposure determination

- To determine the camera exposure, take an incident light reading from the inside of the tent with the light meter facing the camera.
- More or less exposure may be required due to the reflection and absorption characteristics of the object.
- The lighting ratio will change depending on the internal reflective properties of the tent.
- To determine the ratio when one light is used, take one light meter reading with the meter facing the light source, and a second reading with the meter facing the opposite side of the tent. If the difference is 1 f-stop then the lighting ratio is 2:1.

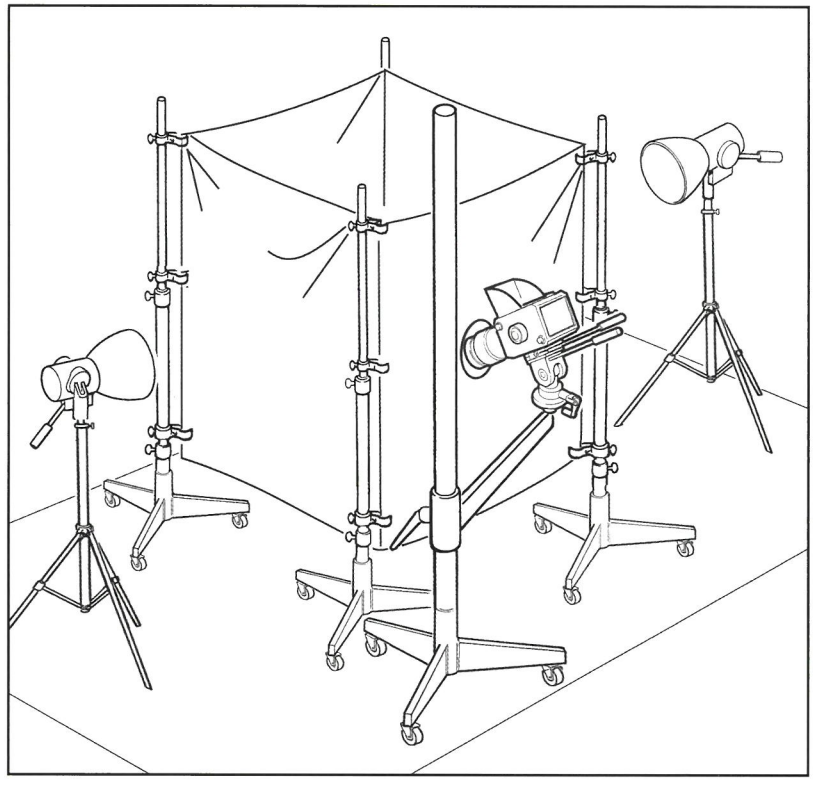


Figure 67. Tent lighting photography setup with two lights.

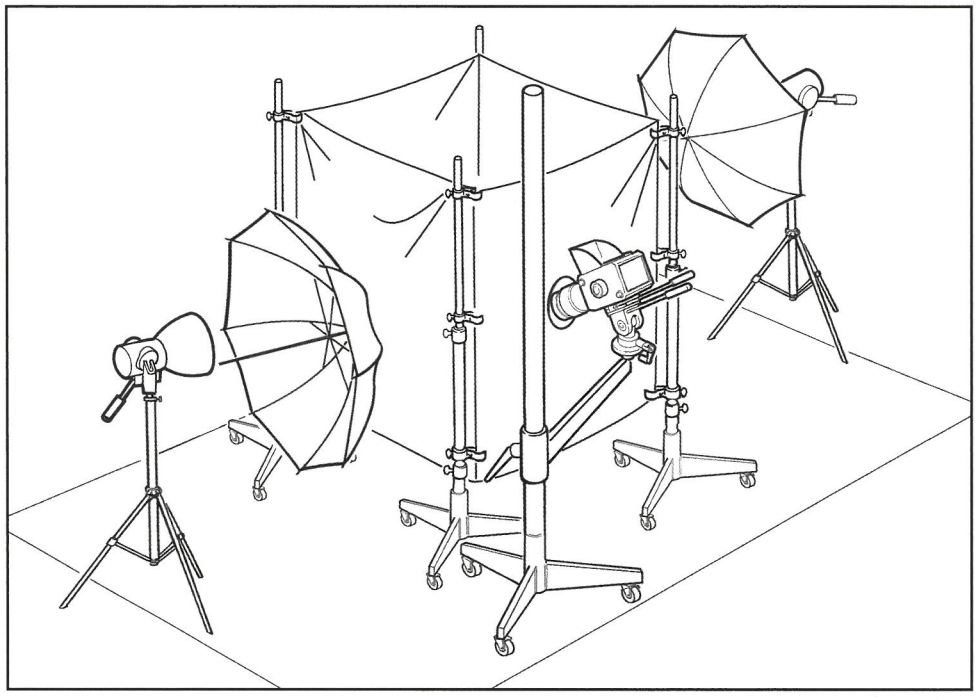


Figure 68. Tent lighting photography setup with two lights and two white translucent umbrellas to further diffuse the light.

Figure 69. Tent lighting is effective for highly reflective objects such as glass and silverware, as shadows and reflections can be controlled. Objects from a private collection.

14. Axial lighting

Introduction

Axial lighting is used for photographing objects with flat, metallic surfaces such as engraved coins and medals. There are two methods to create axial lighting, and each produces different results.

Procedure

Method 1 uses an umbrella adapted to the light source and positioned above the camera. The light is diffused by the umbrella, but the camera prevents the light from hitting the surface of the coin directly. This setup produces shadows in all the contours of an engraved coin or medal, and produces a higher contrast image than Method 2.

In Method 2, the light source is directed onto a sheet of optical glass placed under the lens at an angle of 45°. This divides the path of the light source in two, with half of it being transmitted straight through the glass and the other half being reflected downward from the glass at 90° and illuminating the coin. This method shows the engraved details on a coin or medal.

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects" or "Photographing 3D objects"] to set up the shot.
- Mount the camera on a copystand and make sure the lens axis is perpendicular to the surface of the table.
- Use a macro lens with at least twice the focal length of a normal lens.
- Method 1 (see Figure 70).
  - Adapt a large umbrella to the light source and place it above the camera, in the same axis as the lens. Note that the diameter of the umbrella must be large enough to diffuse light onto the coin.
  - Add a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure.
- Method 2 (see Figure 71).
  - Insert a clear glass sheet at a 45° angle between the object and the lens.
  - Place the light source at 90° to the axis of the lens facing the lower surface of the glass which will reflect a portion of the light onto the object.
  - Add black fabric on the opposite side of the glass, facing the light source, to absorb the remaining light passing through the glass.
  - *Optional*: Position a small black card between the coin and the light source to eliminate specular reflections on the edge of the coin.
  - If it is necessary to soften the contrast, place a diffuser between the glass and the light source.
  - If the object reflects on the glass, add a polarizing filter to the camera lens and adjust the exposure (see photography with polarizing filters on p. 26).
  - Add a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure. If space is limited or the colour reference target and/or grey scale reflect on the object, take one image with them only and a second with just the object.

Exposure determination

- To determine the camera exposure, take an incident light reading from the centre of the object with the light meter facing the lens.
- For photomacrography, adjust the exposure based on the exposure compensations in Table 1 (p. 3).
- More or less exposure may be required due to the reflective and non-reflective characteristics of the object.

Tip: Coins should be photographed on a black background. For best results, soften the background imperfections by raising the coin on a short (2.5 cm) dowel and decrease the depth of field by using a smaller f-stop number (e.g. f5.6 instead of f8).

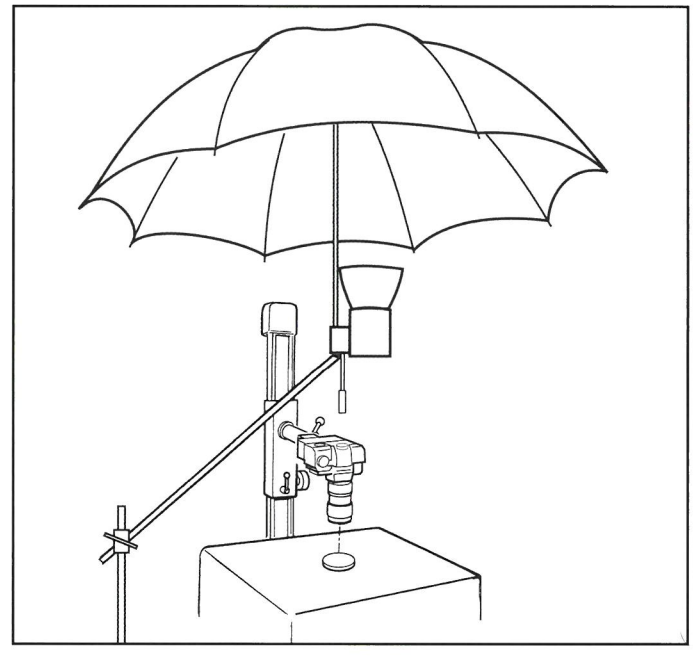


Figure 70. Axial lighting photography setup for Method 1.

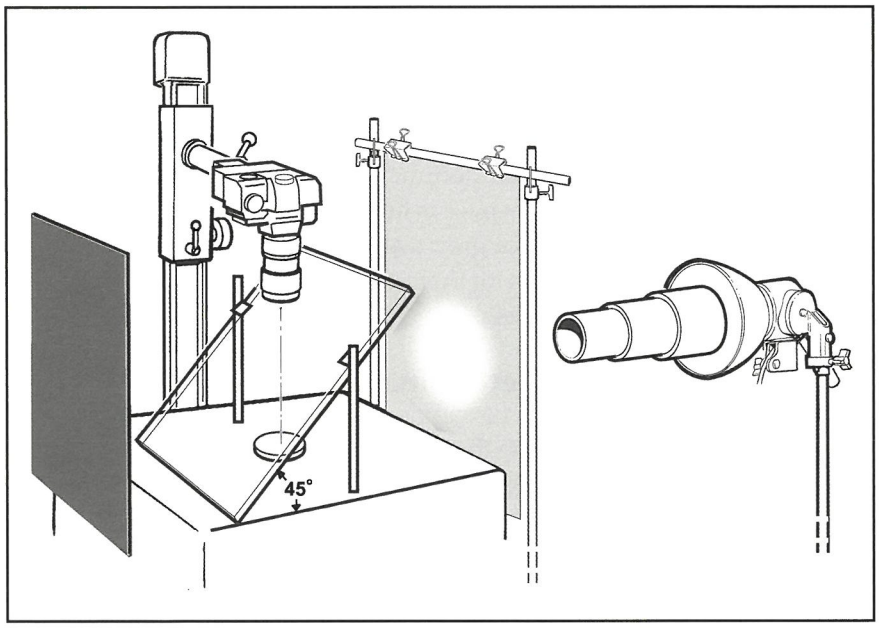


Figure 71. Axial lighting photography setup for Method 2.

Figure 72. Ferdinand IV Naples & Sicily 6 Ducati coin photographed with an umbrella over the camera and coin (Method 1). Coin from a private collection.

Figure 73. United States five dollar Indian Head incuse coin photographed (a) with an umbrella over the camera and coin (Method 1) resulting in soft details and low contrast, and (b) with the light source reflected on a glass surface at 45° over the coin (Method 2) showing higher contrast and greater detail on the surface of the coin. Coin from a private collection.

15. Customized lighting for mirror-like surfaces

Introduction

Customized lighting is necessary for coins with a mirror-like surface to prevent unsuitable reflections. This technique is also suitable for etched and engraved metal.

Procedure

A coin with a mirror-like surface is tilted approximately 5° forward to reflect, onto its surface, light from a white card placed above it. A white or grey matt board is positioned beside the camera, and is reflected on the mirror-like surfaces instead of surrounding areas (which could create unwanted reflections).

Setup

- Follow the general guidelines on p. 18 ["Photographing 2D ("flat") objects"] to set up the shot.
- Mount the camera on a copystand and make sure the lens axis is perpendicular to the surface of the table.
- Set the coin at a 5° angle on black velvet fabric.
- Use a macro lens with a long focal length and a single light source at a 10° incident angle.
- Place a white reflector card near the camera lens using a stand and clamp (see Figure 75).
- Angle the white reflector card to direct light toward the coin (changing either the angle or the height of the card will vary the amount of light reflected on the surface of the coin).
- Place a smaller black card below the white reflector card and adjust it to produce a small partial reflection onto the coin (this will improve the definition of features on the mirror surface of the coin).
- To produce a softer transition between the two reflectors, use a larger camera aperture to produce a shallower depth of field.
- Add a colour reference target and/or grey scale to increase the accuracy of colour rendition and exposure. If space is limited or the colour reference target and/or grey scale reflect on the object, take one image with them only and a second with just with the object.

Exposure determination

- To determine the camera exposure, take an incident light reading from the centre of the object with the light meter facing the light source.
- For photomacrography, adjust the exposure based on the exposure compensations in Table 1 (p. 3).
- More or less exposure may be required due to the reflective and non-reflective characteristics of the object.

Tip: To soften background imperfections, raise the coin from its background and decrease the depth of field by using a smaller f-stop number (e.g. f5.6 instead of f11).

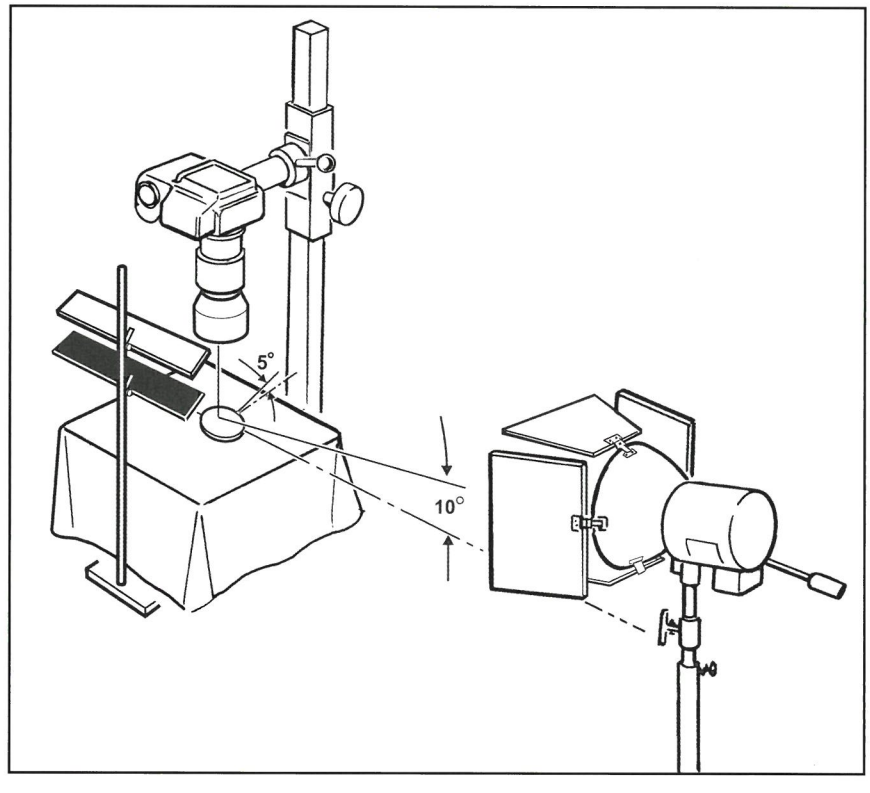
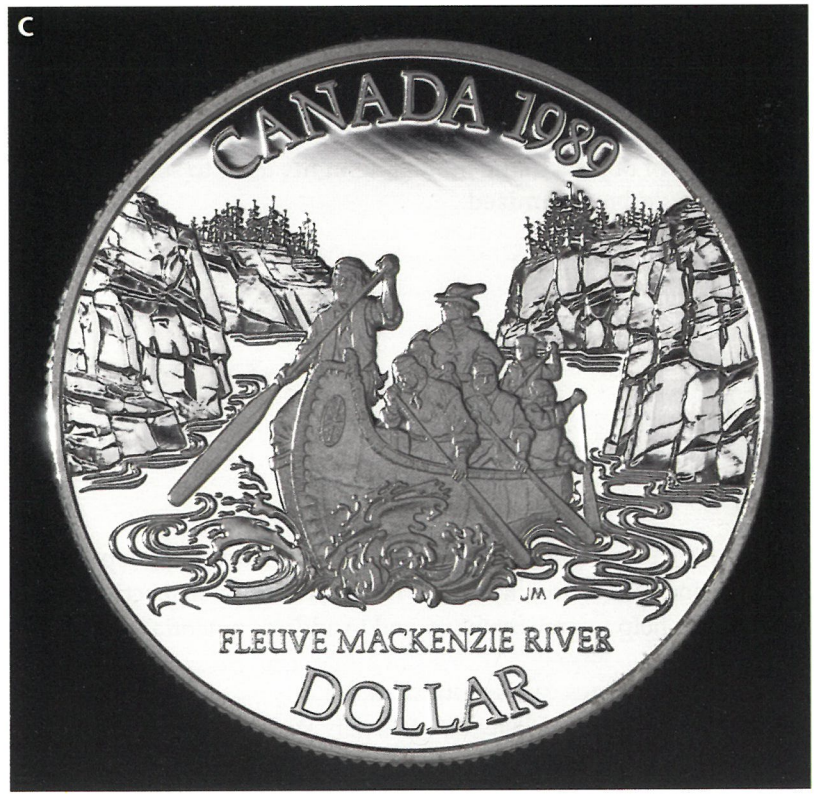


Figure 74. Customized lighting for mirror-like surfaces photography setup.

Figure 75. Sample layout for positioning reflectors above a coin.

Figure 76. (a) This photograph of a Canadian one dollar coin with a mirror-like surface shows inappropriate reflection of fingers. (b) When photographed with only a white reflector, the image has a flat appearance and does not reveal the mirror-like surface of the coin. (c) When photographed with custom lighting, the image reveals the design and mirror-like finish of the coin while giving a sense of depth.



Object moving, handling, and preparation

Museum objects must always be moved and handled carefully. When working in a museum, photographers should seek the advice of a preparator, curator, or conservator for fragile, very large, or complex objects. When in doubt about the best way to handle or support an object, always obtain assistance.

The following manuals provide guidelines for safe handling of objects:

- *Basic Handling of Paintings* (CCI Notes 10/13)
  www.cci-icc.gc.ca/crc/notes/html/10-13-eng.aspx
- *The Care of Musical Instruments in Canadian Collections* (CCI Technical Bulletin No. 4)

Lighting precautions

Some light sources have the potential to damage objects.

Incandescent lamps, such as halogen lamps (also called tungsten, tungsten-halogen, quartz-halogen, quartz-iodine lamps), radiate heat that can damage objects. To prevent objects from overheating:

- monitor the temperature of the object to ensure that heating does not occur
- keep halogen lamps, including modelling lights, as far away from the object as possible and turned off when not in use
- use diffuse illumination whenever possible
- add scrims (a scrim is a small metal screen shaped and adapted to the front of a light source; scrims protect objects by reducing the intensity of the light thereby reducing the amount of heat produced)
- ensure that all accessories, such as umbrellas, are compatible with the light source

There is no scientific evidence that museum objects suffer discoloration, fading, or other light damage from the electronic flash used during photography. However, exposure of objects to the modelling lights used to set up the electronic flash should be minimized.

Health and Safety Guidelines for the Photographer

Health and safety are important considerations in every workplace. A periodic review of work practices and procedures, as well as health and safety inspections of the photography studio, help to prevent injury and to address potential health concerns.

Health and safety guidelines can be found on the Canadian Centre for Occupational Health and Safety Web site:
www.cchst-ccohs.gc.ca

Bibliography

Barclay, R.L. *The Care of Musical Instruments in Canadian Collections*. CCI Technical Bulletin, No. 4. Ottawa: Canadian Conservation Institute, 1982.

Brosseau, K., M. Choquette, and L. Renaud. *Digitization Standards for the Canadian Museum of Civilization Corporation*. 2006. http://cyberboutique.civilization.ca

Cambridge in Colour. *Digital Photography Tutorials*. www.cambridgeincolour.com/tutorials.htm

Canadian Association for Conservation of Cultural Property and Canadian Association of Professional Conservators. *Code of Ethics and Guidance for Practice*, 3rd edition. Ottawa: Canadian Association for Conservation of Cultural Property and Canadian Association of Professional Conservators, 2000. www.cac-accr.ca/pdf/ecode.pdf

Canadian Centre for Occupational Health and Safety (CCOHS). www.ccohs.ca/resources/

Canadian Conservation Institute. *Basic Handling of Paintings*. CCI Notes 10/13. Ottawa: Canadian Conservation Institute, 1993. www.cci-icc.gc.ca/crc/notes/html/10-13-eng.aspx)

Canadian Heritage Information Network. www.pro.rcip-chin.gc.ca

Chéné, A., P. Foliot, and G. Réveillac. *La pratique de la photographie en archéologie*. Aix-en-Provence: Édisud, 1999.

Collins, S. *How to Photograph Works of Art*. Nashville, Tenn.: AASLA Press, 1986.

Digital Photography Review. www.dpreview.com/

Dorrell, P.G. *Photography in Art and Conservation*. Cambridge University Press, 1989.

Eastman Kodak Company. *Close-up Photography and Photomacrography*. Publication N-12. Rochester, N.Y.: Eastman Kodak Co., 1977.

Evans, J. *Photographic Lighting in Practice*. London: David and Charles Publishers, 1984.

Frey, F., D. Heller, D. Kushel, T. Vitale, J. Warda, and G. Weaver. *The AIC Guide to Digital Photography and Conservation Documentation*, 1st edition. Washington, D.C.: American Institute for Conservation, 2008. http://aic.stanford.edu/sg/emg/dtf/DTF_Online_Weblinks.pdf

George, C. *Flash et photo numérique — Matériel, techniques et post-traitement*. Paris: Éditions Eyrolles, 2009.

Gilbert, V. *Développer ses fichiers RAW*. Paris: Éditions Eyrolles, 2009.

Hanlan, J.F. "The Effect of Electronic Photographic Lamps on the Materials of Works of Art." *Museum News* 48, 1 (June 1970), pp. 33–41.

Harnischmacher, C., and V. Gilbert. *Fabriquer ses accessoires d'éclairage photo*. Paris: Éditions VM, 2007.

Hart, R. *Photographing Your Artwork*, 2nd edition. Buffalo, N.Y.: Amherst Media, 2000.

Hedgecoe, J. *The Photographer's Handbook*. New York: Alfred A. Knopf, 1977.

Hoberman, G. *The Art of Coins and Their Photography*. London: Lund Humphries Publishers Limited, 1981.

Hunter, F., S. Biver, and P. Fuqua. *Light Science & Magic. An Introduction to Photographic Lighting*, 3rd edition. Boston, Mass.: Focal Press, 2007.

Hunter, F., S. Biver, and P. Fuqua. *Manuel d'éclairage photo*. Paris: Éditions VM, 2009.

Kushel, D. *Photodocumentation for Conservation: Procedural Guidelines and Photographic Concepts and Techniques*. Washington, D.C.: American Institute for Conservation of Historic and Artistic Works, May 1980.

Kushel, D. "Digital Documentation: We Are There But Enter With Care." *AIC News* 27, 6 (November 2002), pp. 1, 3–5, 7, 9–10.

Kushel, D.A. "Basic Guide to the Photography of Gilded Artifacts." pp. 249–262 in *Gilded Wood, Conservation and History* (edited by D. Bigelow and C.E. Hutchins). Madison, Conn.: Sound View Press, 1991.

Lewis, J., and E. Smith. *The Graphic Reproduction and Photography of Works of Art*. London: W.S. Cowell Ltd., 1969.

MacDonald, L.W. *Digital Heritage: Applying Digital Imaging to Cultural Heritage*. Oxford and Burlington: Butterworth-Heinemann, 2006.

Mates, R.E. *Photographing Art*. New York: Amphoto, 1966.

Neevel, J.G. "Exposure of Objects of Art and Science to Light from Electronic Flashguns or Photocopiers." pp. 77–87 in *Contributions of the Central Research Laboratory to the Field of Conservation and Restoration* (edited by H. Verschoor and J.A. Mosk). Amsterdam: Centraal Laboratorium voor Onderzoek van Voorwerpen van Kunst en Wetenschap, 1994.

Novak, A. *Resources for Conservators: Documentation Images Captured with a Digital Camera*. Winterthur, Del.: Winterthur Museum, Garden and Library. Pamphlet, 2007.

Peres, M.R. *The Focal Encyclopedia of Photography*, 4th edition. London: Focal Press (Elsevier), 2007.

Pozeilov, Y.A. *Digital Photography for Art Conservation*, 2nd edition. Yosie A. R-Pozeilov (self-published), 2008.

Puglia, S., J. Reed, and E. Rhodes. *Technical Guidelines for Digitizing Archival Materials for Electronic Access: Creation of Production Master Files—Raster Images*. U.S. National Archives and Records Administration (NARA), June 2004. www.archives.gov/preservation/technical/guidelines.pdf

Reichmann, M. *Making the Transition from Film to Digital*. Technical Paper. Adobe Systems Inc., 2006. www.adobe.com/digitalimag/pdfs/phscs2ip_filmtodig.pdf

Sancho-Arroyo, M., and J.-P. Rioux. "L'utilisation au musée des équipements à éclairs électroniques. " *Technè: la science au service de l'histoire de l'art et des civilisations* 4 (1996), pp. 128–136.

Swan, C.M. "Documentary Imaging: Some Applications for Furniture." pp. 59–69 in *Postprints of the Wooden Artifacts Group*. St. Paul, Minn.: American Institute for Conservation of Historic and Artistic Works, 1995.

The Luminous Landscape. www.luminous-landscape.com/

Thornes, R., P. Dorrell, and H. Lie. *Introduction to Object ID; Guidelines for Making Records that Describe Art, Antiques, and Antiquities*. Los Angeles, Calif.: The J. Paul Getty Trust, 1999. http://icom.museum/object-id/guide/ guide_index.html

Titus, W. *Photographing Works of Art*. New York: Watson-Guptill, 1981.

UPDIG. *Universal Photographic Digital Imaging Guidelines (UPDIG) Version 4.0.* 2008. www.updig.org

U.S. National Park Service. *Museum Handbook*. www.nps.gov/history/museum/publications/handbook.html

Vitale, T. *Notes on Digital Documentation*. Electronic Media Group, American Institute for Conservation, July 2005. http://aic.stanford.edu/sg/emg/library/pdf/vitale/2005-06-21_digital_documentation_001.pdf

Vitale, T. *Digital Imaging in Conservation: Cameras.* Electronic Media Group, American Institute for Conservation, July 2005. http://aic.stanford.edu/sg/emg/library/pdf/vitale/2005-07-vitale-digital-imaging.pdf

CCI #92907
During Treatment
Feb.3 /2010
30CM

ISBN 978-0-660-19995-5
9 780660 199955