

# Caring for Slides, Negatives and Digital Media

## *Preserve Your Story* Workshop Series

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Women's Art Register

### Presented by

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In today's webinar, we will discuss caring for digital and electronic media, as well as photographic slides and negatives. We have chosen to cover these topics as they have some commonalities in the complexity and types of materials that comprise their physical media.

# Aims of the workshop

*Increasingly, museums, galleries and libraries are digitising older media - such as photographic slides and negatives - or incorporating electronic media into their collections. As the interest in electronic media increases, people are becoming more concerned about preserving these formats.*

- 1 What are slides, negatives and electronic media?
- 2 What are the common types of degradation?
- 3 How should I store these objects?
- 4 What are the key preservation approaches?
- 5 What resources are available to me?
- 6 Q&A session

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Increasingly, museums, galleries and libraries are digitising older media or incorporating electronic media into their collections. As the interest in electronic media increases, people are becoming more concerned about preserving these formats. Equipment to access older media are harder to find. In response, these objects are increasingly being digitised so that they can be more viewed with modern equipment and to prevent deterioration of the fragile original media.

In this workshop, we will try to give you an overview of:

1. What are slides and electronic media?
2. What are the common types of degradation that you see?
3. How should I store these objects?
4. What are some simple preservation approaches that you can do
5. Go over some useful resources
6. And then we will end with a Q&A session.

The focus of today's webinar is on photographic slides and negatives, as well as digital media as they share some challenges in their preservation approaches:

- 1) They all require both the original media as well as the equipment to access it to be preserved;
- 2) They all use modern materials such as plastics, whose degradation is only being understood by conservation, and;
- 3) They use technologies that can become obsolescent and inaccessible very much quicker than traditional cultural materials.

This workshop aims to only provide a brief overview as each object can have very complex needs. The technology involved is technically complex and conservators in museums often collaborate with

technicians and engineers to come up with conservation solutions.

# 1 What are slides and negatives made of?

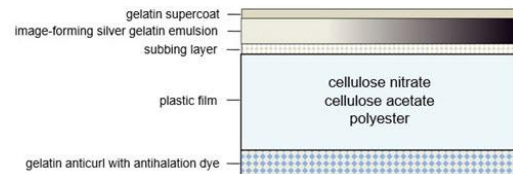
Slides and negatives are made up of many layers:

- Flexible plastic base material
- Image forming emulsion layer:
  - Single layer (B+W)
  - Three layer (colour)
- Other clear coatings and protective layers



Base materials and stability:

- **Cellulose nitrate - very unstable**
- **Cellulose acetate - less stable**
- **Polyester - very stable**



Cross-section of a black and white plastic-based film

Image:

<https://www.canada.ca/en/conservation-institute/services/preventive-conservation/guidelines-collections/photographic-materials.html#42>

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This presentation will be covering plastic-based slides and negatives today; glass-plate negatives and slides have their own histories but are less commonly found so will not be covering them.

The basic structure of film negatives and individual slides begins with a flexible plastic base material, which is coated on one or both sides, with an emulsion layer containing the semi-transparent image. Slides have a positive image, to be used for projection, whilst negatives have a negative image, and are used to make photographic prints. Colour emulsions consist of generally three distinct dye layers, while black and white prints consist of one layer. A protective topcoat of clear gelatin is then applied over the emulsion, and layer of gelatin is also applied to the back to prevent curling.

The composition of the plastic substrate has changed over time, from cellulose nitrate and cellulose acetate in the late 19thC, to polyester today. The different types of plastic base are where major degradation issues often arise.

Prior to the 1920s, slides were likely to be cellulose nitrate based. This type of plastic is the most unstable. In the 1920s and 30s, cellulose acetate was introduced and overtook cellulose nitrate as the primary material support for negatives. While it was more stable than CN, CA also has stability issues. In the 1960s polyester film was introduced, which is the only stable plastic film base and is often referred to as safety film. However cellulose acetate is still used for motion picture film to this day.

# 1 What is electronic media?

The main carriers, or media, for digital information are generally characterised into three categories:

1. **Magnetic media**
2. **Optical media**
3. **Flash media**



# 1 What is magnetic media made of?

Magnetic media is when audio, video or data is stored on magnetised tape or disks.

Magnetic tapes include:

- Compact cassettes
- VHS tapes
- Reel-to-reel tapes

They generally fall into two categories:

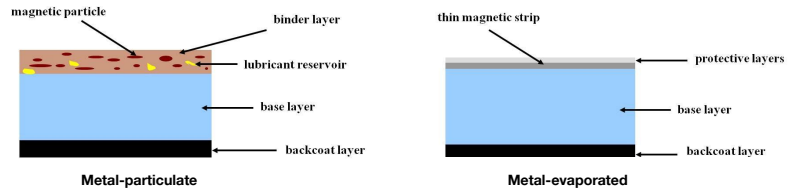
- Metal-particulate
- Metal-evaporated

Magnetic disks include:

- Floppy disks
- Hard disks/drives.

They have similar layer construction to tapes except on a rigid base.

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Cross section structure of magnetic tapes

Images: <https://www.canada.ca/en/conservation-institute/services/preventive-conservation/guidelines-collections/caring-audio-video-data-recording-media.html#a1>



Images of the internal components in various magnetic disks: 1. Hard drive; 2. Floppy disk; 3. Floppy diskette

Images: <https://www.canada.ca/en/conservation-institute/services/preventive-conservation/guidelines-collections/caring-audio-video-data-recording-media.html#a1>

## Magnetic media:

Magnetic media is when audio, video or data is stored on a magnetised tape or disk. The media is then accessed or read by devices with magnetic heads.

Recordable magnetic tapes were first introduced in 1935 when sound was recorded on cellulose acetate tape. Since then, more modern tapes have been produced using different magnetic metal coatings and polyester carriers. They are commonly found in home collections in the form of VHS tapes or cassettes.

The structure of magnetic tapes generally falls into two categories:

- Metal-particulate tapes  
Magnetic particles are suspended in a binder, commonly polyester urethane, which is on a tape carrier.
- Metal-evaporated tapes  
A thin magnetic layer is applied to the tape carrier with a protective layer over the top.

Magnetic disks include floppy disks or hard disks and have a similar construction to magnetic tapes but instead of a flexible tape, the magnetic material is on a rigid circular disk made of plastic, aluminium or other materials. This disk is then housed in a case of plastic or metal.

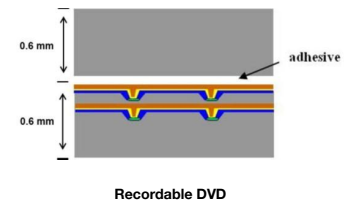
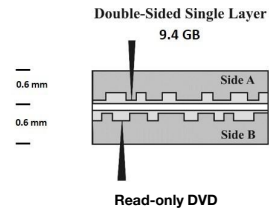
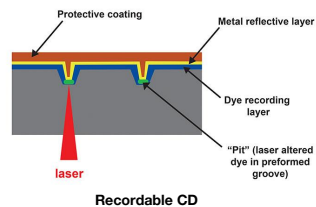
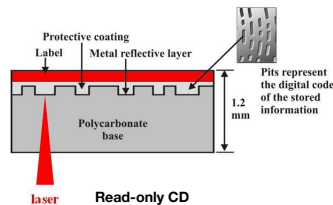
# 1 What is optical media made of?

Optical discs refer to media that is played by laser light and include:

- CDs
- DVDs
- Laserdiscs
- Minidiscs

Disks are generally composed of:

- a clear polycarbonate plastic substrate
- a reflective metallic layer, and
- a clear protective coating



Cross sections of read-only and recordable CDs and DVDs

Images: <https://www.canada.ca/en/conservation-institute/services/preventive-conservation/guidelines-collections/canino-audio-video-data-recording-media.html#a1>

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## Optical media:

Optical discs refer to media that is played by laser light. The first optical disc introduced commercially was the Laserdisc in 1978. Soon afterwards, a variety of other optical discs appeared, starting with the CD for music in 1982.

CDs and DVDs consist of the same basic materials and layers but are manufactured differently. A DVD is actually like two thin CDs glued together. A CD is read by the laser on one side only; a DVD can be read from on one or both sides.

Disks are generally composed of:

- a clear polycarbonate plastic disc
- a reflective metallic layer, and
- a clear protective coating

Like a vinyl record, the disk has a series of pits or grooves of different sizes that contain the binary code. These pits are located on the plastic substrate and are then coated with the reflective metallic layer, which is needed for the lasers to scan these 'pits'.

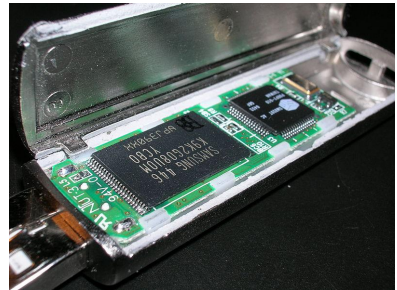
Advances in technology have produced three categories of optical discs: read-only, recordable and erasable.

# 1 What is flash media made of?

Flash media refers to objects like:

- SD cards
- USB flash drives
- Solid state hard drives

Flash memory is composed of a memory chip that can be electrically erased and reprogrammed.



Disassembled USB flash drives showing the flash memory chip inside

Images: <https://www.canada.ca/en/conservation-institute/services/preventive-conservation/guidelines-collections/caring-audio-video-data-recording-media.html#a1>

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## Flash media:

Flash media refers to objects like:

- SD cards - which you find in digital cameras
- USB flash drives or sticks
- Solid state hard drives, which are beginning to replace magnetic hard drives in computers.

Flash memory is composed of a memory chip that can be electrically erased and reprogrammed.



# 1 What are digital files?

Digital files are encoded to represent text, images, audio, video and more.

The data is often the main significance of the object and access requires:

1. **Digital file**
2. **Storage media to store files**
3. **Equipment to access media**

Therefore, it is important to keep files but also the **means to access them**.



Photos



Videos



Audio Files



Powerpoint



Graphics



3D Files



PDF Files



Excel



Word Documents



Illustrator Files

Digital materials in collections can include images, sound, text and data. These can either be digital materials that have been reproduced as a representation of a physical object - like a digital scan of a photo or newspaper - to works that are created and interacted with solely within the digital realm - such as software, websites and video games.

The data contained on electronic media is often the primary significance of the object rather than the physical media itself. Therefore, it requires that the carrier and the machine needed to play the media are in good condition so that the digital information can be accessed in the future.

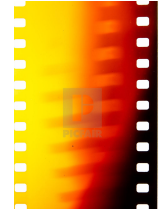
## 2

## Common types of degradation | Slides and negatives

Examples of degradation in negatives and slides:

(from top-left; clockwise)

1. **Acid deterioration**
2. **Blistering and creasing - "vinegar syndrome"**
3. **Base curling**
4. **Base discolouration**
5. **Silver mirroring (B+W)**
6. **Dye fading (colour)**
7. **Emulsion breakdown**
8. **Discolouration and loss of image**



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As mentioned, cellulose-based plastic negatives and slides can be chemically unstable, particularly cellulose nitrate. In high temperatures and humidity, cellulose nitrate can decompose rapidly, emitting harmful vapours, known as Volatile Organic Compounds, or VOCs, that can damage other materials nearby by forming acidic compounds. Cellulose nitrate can also pose a fire hazard. The more degraded it is, the lower the temperature at which it will combust. There are many examples of collections spontaneously combusting under inappropriate storage conditions. As a by-product of combustion, cellulose nitrate releases oxygen, allowing it to sustain a fire in the absence of outside air, making it virtually impossible to extinguish. Regardless of their initial stability, once they start to deteriorate, the process is rapid.

Cellulose acetate films generally deteriorate by shrinking, blistering and creasing of the emulsion layers due to the degradation of this type of plastic. The smell of acetic acid, commonly known as vinegar, in slide and negative collections is a sure sign of decomposition of the acetate compounds. This is known as "vinegar syndrome." Just like cellulose nitrate film, decomposition is autocatalytic i.e. once it starts, it quickly spreads to nearby objects of the same material.

You can check what type of plastic your slides and negatives are made from by looking up the brand and product name on google. If you do have cellulose acetate in your collection, make sure to use your nose and if you smell vinegar, remove the degraded materials from the collection immediately to protect the surrounding media.

The dyes used in colour negatives and slides are also susceptible to degradation. Fading can occur from exposure to light. However it can also happen in the dark if the temperature and relative humidity are too high. Dyes can fade differentially also, depending on what they are composed of, which can leave colour images tending towards magenta, cyan or yellow. Whilst in black and white slides, the image silver can

oxidise and discolour.

As well as these inherent vulnerabilities of the plastic base and coloured dyes, negatives and slides are also susceptible to embrittlement of and scratches to the emulsion layer.

All processed photographic materials are sensitive to high and fluctuation in relative humidity (RH). Typically, film negatives curl up in a dry environment and flatten again in an high humidity environment. Properly processed negatives on safety film are essentially stable in dry heat, however if black and white, the image silver can degrade in the ways previously mentioned.

## 2

## Common types of degradation | Electronic media

Examples of paper degradation:  
(from top-left; clockwise)

1. **Scratches**
2. **Breakages**
3. **Adhesive labels removing layers**
4. **Delamination of layers**
5. **Flaking of layers - “sticky shed syndrome” in magnetic tape**
6. **Corrosion - “laser rot”**
7. **Tape wrinkles and stretching**
8. **Mould**



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Even though technologies like magnetic tapes and optical media are more modern, these types of objects can present many material vulnerabilities that can affect how you access the information.

Physical forces can detrimentally affect electronic media. For most media, the greatest source of physical damage is dirty or unmaintained equipment, as well as poor handling and cleaning techniques.

Common physical deterioration that you see in electronic media are:

- Scratches, which can affect playability.
- Breaks to cases, making the tape or disk contained exposed
- Delamination and flaking of layers - especially optical disks that have fragile reflective layers
- Tears, stretching, folds and wrinkles

High temperature and relative humidity, as well as exposure to pollutants, can materials and cause them to chemically degrade and lose their cohesiveness. Chemical changes can also make the media more vulnerable to physical stresses.

Some common chemical degradation that you see are:

- Degradation of plastic components in the data layers or carriers e.g. “sticky shed syndrome” in magnetic tapes, causing the tape to become sticky and to shed from the tape base.
- Corrosion and loss of metal components e.g. the reflective layer in CDs and DVDs, known as “laser rot”, and the loss of the magnetic layer on tapes
- Heat can warp CDs or change the tension of tapes
- Moisture can result in “print-through” or transfer of tape layers to adjacent tape layers
- And also mould can form in the presence of moisture

## 2

## Common types of degradation | Digital files

**Technological obsolescence** can result in digital files to not be accessible. This can arise due to:

1. **Lack of functioning equipment**
2. **Missing hardware connections**
3. **Missing device drivers**
4. **Discontinued or missing proprietary software**



Images: ACMI

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Electronic media and digital files are completely dependent on software and machines to make them accessible. Technology changes very rapidly and storage media can become obsolete in only a few years. We call this phenomenon technological obsolescence. Technological changes occur much faster than in physical materials, and therefore, digital files and media are often considered more at-risk than traditional objects.

Future equipment and computers may not be able to access historical digital files due to:

- Non-functioning equipment that can receive older media
- Missing hardware connections that can attach to older media
- Outdated device drivers that can recognise older hardware
- Discontinued or missing proprietary software such as applications, operating systems, plugins and codecs

Museums with significant time-based media collections often stockpile old computers and playback equipment, as well as spare parts and software, so that original electronic media and digital files can still be accessed.

### 3 Ideal physical storage conditions

Ideal museum conditions are difficult to achieve at home, so choose a space to store your objects that is:

**cool - dark - dry - stable**

	SLIDES & NEGATIVES (B+W)	SLIDES & NEGATIVES (COLOUR)	MAGNETIC MEDIA	OPTICAL MEDIA	FLASH MEDIA	EQUIPMENT / OBJECTS
<b>Temperature</b>	<18°C ± 2°C - cellulose nitrate 0°C - cellulose acetate 2-7°C - polyester 18-20°C	<5°C ± 2°C - cellulose acetate -10°C - polyester -10°C - 5°C	18°C ± 2°C	18°C ± 2°C	20°C ± 2°C	20°C ± 2°C
<b>Relative Humidity</b>	35% ± 5% - cellulose nitrate 20-30% - cellulose acetate 20-40% - polyester 20-50%	35% ± 5% - cellulose acetate 20-40% - polyester 20-50%	35% ± 5%	35% ± 5%	50% ± 5%	50% ± 5%

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Source: National Archive of Australia standards  
Refer for updated guidance: AICCM Environmental Guidelines, <https://aiccm.org.au/conservation/environmental-guidelines/>

The best way to care for any of these materials you may have in your home collections is by keeping them in appropriate storage conditions and making regular checks on potentially vulnerable materials.

The ideal environmental conditions to store slides and negatives are listed in this slide, however these museum conditions can be difficult to reproduce in the home environment.

In general, cold storage, like a freezer, is the ideal for cellulose nitrate and cellulose acetate, and can slow and sometimes stop degradation processes in these materials. Cool, dry environments are recommended for plastics that appear to be stable.

Heat and high humidity are the two greatest enemies of audio and video tapes in storage, and this can be said for most materials.

When thinking about preserving electronic media, the aim is to be able to use the items and access the information contained on them for as long as possible. There are three main issues to consider:

- the preservation of the actual item, that is, the CD-ROM or the audio tape;
- Preservation of the equipment so that you can access the media, and;
- Preservation of the information itself

Once you have determined an appropriate storage solution for the actual items, it is worth prioritising them based on the information they contain, and digitising the most important. Do not place any magnets near any magnetic media as this will erase their contents. Making a digital copy of electronic or magnetic media is the best way to preserve the information, especially as the physical object ages. The lifespan of these materials are quite short, usually between 5-10 years only. Even if the physical object is in quite

good condition, playback equipment can be hard to come by, and will only get harder as they stop being produced and serviced. Therefore, digitisation is your best option for long-term preservation.

For negatives and slides, acid-free enclosures or folders are strongly advised.

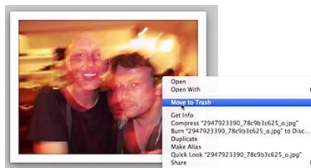
The degradation mechanisms we have discussed already today are due to the inherent acidity of the plastic carriers, therefore for cellulose nitrate and cellulose acetate-based materials, you should store these materials in buffered, alkaline enclosures. Degrading cellulose acetate negatives should be separated from the rest of your collection to prevent degradation of nearby materials. Cellulose nitrate collections, if you have any, should be stored away from other collections due to their potential for combustion. Keep them in a freezer if you can.

Objects should be housed in archival quality enclosures such as boxes, folders, envelopes, wrappers and sleeves. You should use paper or cardboard that is acid free, for slides and negatives, has passed the Photographic Activity Test. You should also use only polyester, polyethylene or polypropylene plastic storage enclosures. Avoid PVC plastics. Look for products online from suppliers like Archival Survival, and photography stores, such as Vanbar Imaging.

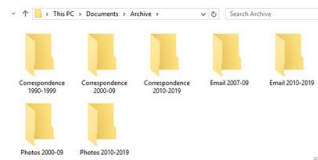
### 3 Digital storage management

The best method to maintain your digital archives is to:

1. **Identify what you want to save**
2. **Determine what is important**
3. **Organise your content**
4. **Make multiple copies and store them in different places**
5. **Manage your archive over time**



Determine what is important - delete unwanted files



Organise content logically



Make multiple copies using different media types

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Older media is increasingly being digitised, which poses additional challenges of storing the digital files. You can preserve digital possessions with good management approaches, but it requires you to actively manage and archive them.

The best method to maintain your digital archives is to:

- **Identify what you want to save** - gather your files together so you can assess what you have
- **Determine what is important** - save the highest quality version you can, use file formats recommended for long-term preservation, and delete duplicate files. You can look up the Library of Congress's recommendations on file formats.
- **Organise your content** - use a consistent file naming system, fill in the metadata in the file properties, create a catalogue, label your media storage
- **Make copies and manage them in different places** - store using diverse media types (thumb drives, CDs and cloud storage), store in different physical locations
- **Manage your archive over time** - Check your files once a year, migrate files to new archival copies using the updated media and files formats at least every 2-5 years to avoid data loss.

Following these guidelines will help you protect your personal digital files for years to come.



## 4

## Preservation approaches

The best way to preserve your objects:

1. **Store in archival quality enclosures**  
Use only acid-free paper and chemically inert plastics, avoid PVC!
2. **Regularly monitor condition**
3. **Housekeeping & pest control**
4. **Make copies using different storage media and digitise important objects**
5. **Contact a conservator**  
AICCM 'Find a Conservator'



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Simple preservation techniques:

- Regularly monitor condition - check on your objects and files once a year to see if they are degrading. If you notice anything problematic in your electronic or magnetic material, get in touch with a digitisation professional before attempting to playback
- Housekeeping and pest control - keep storage areas dry, clean and with as stable environmental conditions as possible.
- Store in archival quality enclosures - invest in archival grade storage enclosures, and label them with good descriptions of their contents
- Make multiple copies and digitise important objects - this will decrease the amount of times you have to physically handle objects in order to access the information
- Contact a conservator - You can look up the AICCM directory to find a conservator. If you do identify an degrading object, quarantine it away from the rest of your collection and contact a conservator for advice.

## 5

## Useful resources

**Collections care advice**

- State Library of QLD:  
<https://www.slq.qld.gov.au/how-do-i/preserve-your-collections>
- Western Australian Museum 'Collections Care Manual'  
<http://manual.museum.wa.gov.au/>
- National Archives of Australia:  
<https://www.naa.gov.au/information-management/storing-and-preserving-information/preserving-information>
- National & State Libraries Australia, Digital Archive Toolkit:  
<https://www.nsla.org.au/publication/digital-archive-toolkit>
- reCollections:  
<http://culturalmaterials.net/wp/>
- Australian Institute for the Conservation of Cultural Materials (AICCM):  
<https://aiccm.org.au/conservation/collection-care/>
- National Film and Sound Archive of Australia, 'Preservation at Home':  
<https://www.nfsa.gov.au/preservation/guide/home>
- Canadian Conservation Institute:  
<http://www.canada.ca/en/conservation-institute/services/care-objects.html>
- US National Parks Service, Conserve-O-Grams:  
[https://www.nps.gov/museum/publications/conservoogram/cons\\_toc.html](https://www.nps.gov/museum/publications/conservoogram/cons_toc.html)
- Library of Congress, 'Personal Archiving' resources:  
<http://www.digitalpreservation.gov/personalarchiving/index.html>
- Int'l Assoc of Sound & Audiovisual Archives:  
<https://www.iasa-web.org/tc04/audio-preservation>
- Smithsonian Institution Archives, Digital Curation:  
<https://siarchives.si.edu/what-we-do/digital-curation>
- Northeast Document Conservation Centre:  
<https://www.nedcc.org/preservation101/welcome>
- American Library Association, 'Preservation Week' resources:  
<http://www.ala.org/alcts/preservationweek/howto/>

## 5

## Useful resources

## Preservation techniques videos

- State Library of QLD 'Caring for Collections' Series:  
<https://www.slq.qld.gov.au/how-do-i/preserve-my-collection/caring-collections>
- Brush vacuum cleaning:  
<https://youtu.be/nBTUkKSPG0s>
- Making boxes to store objects:  
<https://youtu.be/DUZLvHRN0y4>
- Digitising your collections:  
<https://vimeo.com/262919728>
- Preserving digital collections at home:  
<https://vimeo.com/showcase/4108340/video/62131787>
- Making a four- and three-flap wrapper for VHS tapes:  
<https://youtu.be/c0nsSWZXkKo>
- Conservation Centre for Art & Historic Artifacts 'Digitization 101' webinar series:  
[https://www.youtube.com/watch?v=tl\\_eBR5puPCo&list=PLUwal4tAEZjSaTQjTE1JvofToG6pnN7XH](https://www.youtube.com/watch?v=tl_eBR5puPCo&list=PLUwal4tAEZjSaTQjTE1JvofToG6pnN7XH)
- Conservation Centre for Art & Historic Artifacts 'A Race Against time: Preserving AV Media' webinar series:  
<https://www.youtube.com/playlist?list=PLUwal4tAEZjSCODaEx53v7i1T90in-4az>

## Conservation supplies

- Archival Survival:  
<https://archivalsurvival.com.au/>
- Larson Juhl:  
<http://www.larsonjuhl.com.au/>
- Conservation Supplies Australia:  
<https://conservationsuppliesaus.com.au/>
- Good quality art stores e.g. Melbourne Etching Supplies, Zetta Florence
- Good quality photographic stores e.g. Michaels, Vanbar Imaging

## Find a Conservator

- AICCM directory:  
<https://aiccm.org.au/find-a-conservator/>

# Thank you

## Contact Us

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[careofstudios@gmail.com](mailto:careofstudios@gmail.com)  
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