

## Introduction

Researchers and curators label their diverse collections in various ways. Depending on the type of specimen, natural history labels contain primary collection data as catalog number, collection date and location, and species identification. The high amount of information required for a labels means that there is little 'direct' labelling of specimens, and far more attached tags.

Ideally, labels should last as long as the specimens do. Ensuring the archival properties for each element of the label such as the paper, plastic, inks and adhesives used is best practice.

Adapting standards and best practices from the library, archives and photo-archival disciplines is best practice for labelling since they deal with parallel issues affecting the longevity of similar materials such as paper, plastic, inks and adhesives. These standards are useful to help select and specify materials and also provide testing methods to verify quality control, some which can be done in-house.

When choosing labelling materials and labels it is important to be able to specify the correct materials needed by using these archival standards and terminology. Suitability and quality control can be determined by conducting simple standardized tests.

## Standards

ISO 11108:1996, Information and documentation -- Archival paper -- Requirements for permanence and durability

- Specifics on archival paper.

ISO 9706:1994, Information and documentation — Paper for documents — Requirements for permanence

- Specifics on permanent paper, which includes some buffered wood pulp papers.

ISO 18902:2013, Imaging materials - Processed imaging materials - Albums, framing and storage materials.

- Specifics on paper, plastics, inks, and adhesives to be used in photo-archival storage.

ISO 11798:1999, Information and documentation — Permanence and durability of writing, printing and copying on paper — Requirements and test methods

- Specifics on inks and printing.

ISO 18916, Imaging materials – Processed Imaging materials – Photographic activity test for enclosure materials

- Specifics on the PAT test used in assessing the archival quality of materials.

ANSI/NISO Z38.48-1992 (R2009), Permanence of Paper for Publications and Documents in Libraries and Archives

- Specifics on archival and permanent papers.

ASTM F1571-95(2008), Standard Test Method for Determination of Abrasion and Smudge Resistance of Images Produced from Business Copy Products (Sutherland Method)

- Smudge and abrasion test for printed materials

ASTM F2252-03, Standard practice for Evaluating Ink or Coating Adhesion to Flexible Packaging Materials Using Tape.

- Very similar to the Peel Test below.

Testing Electrostatic Copy Quality: The Peel Test, National Archives, <http://www.archives.gov/preservation/technical/peel-test.html>

- Specifics on conducting the Peel Test.

## Labelling Resources

For unusual labelling situations and collections there are a few great resources with chapters on labelling artifacts and specimens.

Buck, Rebecca A., and Jean Allman Gilmore. 2010. *MRM5: Museum Registration Methods 5th Edition*. Washington, DC : AAM Press, American Association of Museums.

National Parks Service. 2012. Appendix J: Marking in *Museum Handbook Part II*. National Parks Service, Washington. <http://www.nps.gov/museum/publications/MHII/mh2appj.pdf>

Rose, Carolyn, Catharine A. Hawks, and Hugh Genoways (Eds). 1995. *Storage of Natural History Collections: A Preventive Conservation Approach*. York, PA: Society for the Preservation of Natural History Collections.  
(Forthcoming updated publication in 2016)

## Dry Labels



### Archival Paper

- Look for the infinity symbol above
- Ideally meet ISO standards 18902:2013, 11108:1996 and 9706:1994
- ANSI/NISO Z38.48-1992 (R2009)
- Must pass the PAT

### Plastic

See the decision tree for wet labels or very cold labels for more detail on plastic based labels.

### Rag Paper

- First choice
- Stable for centuries
- Acid-free
- Susceptible to pests, mould, fire, abrasion, tears

### Permanent Paper

- Wood paper, must have a buffer
- less than 1% lignin content is key
- pH 7.0-10.
- Susceptible to pests, mould, fire, abrasion, tears

### Inks and Printing

#### In-house

- Greater flexibility in formatting
- On demand printing
- Small batch printing

#### Out-of-house Printing

Here are some things to consider:

- If printing catalogue numbers, there is less risk of human error or duplication.
- Ensure the materials are archival safe. This includes adhesives, ink, and substrate. See other sections of the decision trees to see what standards the printers should be meeting.

### Printers

#### Inkjet

- Carbon black pigmented ink only. Requires careful selection during purchase, as well as installation with printer drivers. No colour inks.
- Ideally pass the PAT and meet ISO standard 18902:2013
- At CMN, collections with texts that are prone to abrasion or lifting (e.g. botany) tend to favour inkjet printing because of the penetration of the ink into the paper fibre (CMN in-house testing 2005)

#### Laser

- Carbon pigmented toner only.
- Known adhesion issues especially if wet/solvents (spills)
- National Archives has a Peel Test to test adhesion.
- Ideally pass the PAT and meet ISO standard 18902:2013

### Stamps

- Meet ISO standards 11798:1999 and 18902:2013
- Library of Congress recommends "**Actinic**" ink, which is carbon based, permanent, indelible, and neutral pH, resistant to water and solvents.
- Most other stamp inks are water based (e.g. Trodat)

### Pencil

- Graphite is carbon
- Match the hardness of the pencil to the task, e.g. soft pencils for archival paper so they don't emboss.

### Pens

- Meet ISO standards 18902:2013 and 11798:1999
- Make sure they are **carbon pigment** based if choosing black ink, or pigment based for red ink for marking type specimens. 'Permanent' does not mean 'Archival'.
- Acid-free
- Pass the PAT
- Recommended brands:
  - Micron Pigma Pens
  - Staedtler Pigment Liners
  - Faber-Castell PITT Artist pens

#### Avoid!

- Sharpies - they fade, are soluble in alcohol and are not archival.
- Ballpoint, gel-pens, coloured pens or other common writing implements. These are fine for short term, but they will fade, and their chemical make up may vary

## Dry Labels

Archival paper and carbon based inks have been the standard for all dry collections due to the known longevity of archival papers and stability of carbon pigments. It is important to understand how to maintain these standards as methods of producing paper and printing technologies change.

#### ISSUES:

##### Paper

- High quality paper is known to last for centuries, while the same certainty does not exist for plastic yet. Low quality paper will yellow and become brittle in decades.
- Physical damage can be avoided by carefully matching the properties of the paper to the labelling task.
- Secondary concern: organic materials (paper) are prone to pest damage (insect, mice and mould) but can survive water damage (e.g flood)

##### Ink

- Pigmented inks e.g. Carbon black is always superior to dye based inks.
- Abrasion and lifting pose the greatest concern, The relative risk depends on different printing/writing methods which result in different levels of adhesion or penetration of the ink. Problems can often be encountered with changing products or malfunctioning equipment, therefore overall quality control should be periodically assessed using the Peel Test developed by the US National Archives.
- Fading is not a concern with carbon pigmented inks, as compared to fugitive dyes
- Secondary concern: solubility in water e.g. floods or leaks - Carbon based inks tend not to bleed when immersed in water and can be tested is outlined in ISO

## What is the PAT?

The PAT test is the Photographic Activity Test. It is a standard test to determine the archival quality of a material. It was developed specifically for the suitability of materials which come in contact with photos, but there are many parallels which are applicable. It was developed by the Image Permanence Institute and the ISO. <https://www.imagepermanenceinstitute.org/testing/pat>

## Attachment of Labels

#### INDIRECT ATTACHMENT

- High quality entomology pins
- Uncoated cotton or linen threads/cords
- Archival quality polyethylene bags (not Ziplock)

#### DIRECT/ADHESIVE ATTACHEMENT

This could be glued on paper labels or a barrier layer beneath a handwritten mark.

- Use a stable acrylic resin (eg. Acryloid B-72) as an adhesive or barrier layer (meet ISO 18902:2013)
- Use pigmented inks (ISO 11798:1999)
- Apply a topcoat to avoid abrasion

**AVOID:** Nail polish - it was very popular in the past but is not a stable labelling material.

## Wet Labels

### Paper

#### Uncoated Papers

- 100% cotton or linen rag for stability and inert chemical qualities.
- Paper should meet ISO 11108:1996 and ISO 18902:2013

#### Coated Papers

- Byron Weston Resistall Paper - Very popular and frequently used in collections since the 1980's. Despite its proven durability, it is not recommended in collections due to the acidity of the paper (pH 4.5-5.2).

### Plastic

- Now considered to be the preferred substrate for labelling wet or fluid collections.
- Plastics must pass the PAT test.
- Chlorinated, nitrated, or acetate plastics must not be used because they have poor chemical stability.
- Polypropylene is not recommended as it was found to not hold up in alcohol long term.

### Polyester

- Chemically inert, very stable and very durable.
- Resistant to UV degradation.
- Ideally 'archival' polyester should be used - no additives, plasticizers, colourants or coatings.
- Very high melting point (250°C), so would survive some minor heat events.
- Can carry a static charge.
- Brand examples: DuraCopy (Rite in the Rain®), Mylar

### Polyethylene

- Known as a polyolefin plastic - chemically inert, very stable and very durable.
- Will yellow with prolonged exposure to direct UV (outdoors).
- Ideally 'archival' polyethylene should be used - no additives, plasticizers, colourants or coatings.
- Lower melting point than polyester (110°C, begins to warp at 80°C), so would survive some minor heat events.
- Can carry a static charge.
- Brand examples: Tyvek®

### Printing

- Using printing technologies improves readability of label, and the amount of information that can be placed on the label.
- Printing onto paper and coated papers are fairly straightforward so long as the toners meet archival best practices.
- Printing onto plastic bases is somewhat trickier, but there has been success with laser, inkjet and thermal transfer, depending on the labelling environment.
- Testing is required in nearly every situation to ensure proper compatibility.

### Pens

- Biggest issue is solubility.
- Meet ISO standard 18902:2013
- Make sure they are **carbon pigment** based. 'Permanent' does not mean 'Archival'.
- Acid-free
- Pass the PAT
- Recommended brands:
  - Micron Pigma Pens
  - Staedtler Pigment Liners
  - Faber-Castell PITT Artist pens

### Printers

#### Thermal Transfer

- The most stable, durable and resilient form of printing on plastic.
- Use **Resin** only ribbons which contain carbon pigmented ink (not to be confused with wax/resin or wax ribbons).
- No long term data on longevity of resin ribbons or synthetic substrates in fluid collections (best data is unpublished and around 15 years)

#### Avoid!

- Direct Thermal Transfer. This is a thermal transfer technology which prints onto treated paper (think receipts and faxes). The paper and inks are unstable and fade rapidly.

#### Inkjet/Laser

- Some labels can be printed on with inkjet or laser printers, however once exposed to preservation fluids there is poor letter adhesion.
- Industrial laser printing uses higher temperatures and is more durable.
- If the label is mostly dry, and only risks wet exposure occasionally, ensure that the toner/ink is carbon pigment(ed), and ideally should pass the PAT and meet ISO standard 18902:2013
- Perform your own tests to make sure it will meet your requirements.

## Wet Labels

These labels are predominantly used in fluid collections in natural history institutions, or in conditions where artifacts or specimens are wet (e.g. water-logged artifacts) or may sometimes come in contact with water or require some chemical resistance.

### ISSUES

- Labels for fluid collections must be able to withstand prolonged exposure to ethanol, isopropyl alcohol and formalin, as well as other solvents and preservatives used in the lab.
- Labels on the outside of fluid specimens must also be able to withstand the occasional exposure to preservation fluids (e.g. drips and splashes)
- There are no standards which are directly related to wet labels, therefore best practices have been developed by adapting archival standards and industry expertise about chemically resistant labelling.
- pH of preservation fluids is important for tissue preservation.

### Substrate

- Historically labels were a wide variety of materials (paper, parchment, tin, wood).
- Non-archival, wood pulp paper has not been suitable or reliable in the past (acidic and weak).
- Resistall, a melamine coated paper which contains formaldehyde, has been durable and was widely adopted 1979-2010, but is no longer recommended due to the observation that

### Ink

- Ink solubility is primary concern.
- Abrasion and text adhesion are the secondary concerns.
- India ink (carbon pigmented ink) has been very successful in the past, but in an effort to improve legibility a series of printing methods have been tried with varying degrees of success. Early impact printers (typewriters, dot matrix) were replaced with inkjet and laser, which are currently being replaced by thermal transfer printing.

## Attachment of Labels

### OUTSIDE OF JAR

- Pressure sensitive adhesive labels, must have acrylic resin (ISO 18902:2013).

### INSIDE OF JAR

- Placed in jar, against glass for easy readability.
- Sometimes attached directly to specimen using linen or cotton thread/cord.

Research at the Canadian Museum of Nature has found that **laser** printing does not meet requirements for the collections as the letters loose adhesion to the paper over time and becomes 'alphabet soup.'

**Inkjet printing using carbon pigment ink** was found to be more desirable as a printing medium however it must be 'baked' for minimum 1 hour to set the ink so that it will not feather or bleed once in contact with the preservation fluids.

## Very Cold Labels

### Paper

- Not recommended for use due to condensation, however some biological researchers have been using paper labels for their cryo collections for 25 years (ATCC).
- If you choose paper, make sure it meets the dry label paper standards

### Plastic

- Plastics must pass the PAT.
- Chlorinated, nitrated, or acetate plastics must not be used because they have poor chemical stability.
- Polyester and polyethylene are most common.

### Polyester

- Chemically inert, very stable and very durable.
- Resistant to UV degradation.
- Ideally 'archival' polyester should be used - no additives, plasticizers, colourants or coatings.
- Very high melting point (250°C), so would survive some minor heat events.
- Can carry a static charge.
- Brand examples: DuraCopy (Rite in the Rain®), Mylar

### Polyethylene

- Known as a polyolefin plastic - chemically inert, very stable and very durable.
- Will yellow with prolonged exposure to direct UV (outdoors).
- Ideally 'archival' polyethylene should be used - no additives, plasticizers, colourants or coatings.
- Lower melting point than polyester (110°C, begins to warp at 80°C), so would survive some minor heat events.
- Can carry a static charge.
- Brand examples: Tyvek®

### Adhesives

- **Acrylic polymer or copolymer** adhesives are recommended (identifiable by infra-red spectrum).
- Adhesives must pass the PAT.
- Acid-free
- No rubber-based products. They might contain harmful solvents or plasticizers, or compounded with damaging sulphur.
- Check with manufacturer to ensure it is suitable for ultra cold conditions.

### Printing

### Printers

### Thermal Transfer

- The most stable, durable and resilient form of printing on plastic.
- Use **Resin** only ribbons which contain carbon pigmented ink (avoid wax/resin or wax ribbons).
- Problem: No long term data on longevity of resin ribbons or synthetic substrates in ultra cold storage.

#### Avoid!

- Direct Thermal Transfer. This is a thermal transfer technology which prints onto treated paper (think receipts and faxes). The paper and inks are unstable and fade rapidly.

## Key Issues with Very Cold Labels

Labels which are required for storage environments below -40°C require special consideration, especially if that collection is cryogenically preserved (~ -190°C) such as DNA collections at natural history institutions. For labels used in cool or cold storage follow best practices labelling standards for dry labels, taking into consideration condensation during any type of defrosting.

- Dissociation is one of the biggest issues at sub zero temperatures. Adhesive failure can mean loss of very important information.
- Labels added to the sides of vials and tubes add bulk which sometimes means they won't fit properly in centrifuges or speciality storage.
- Condensation on vials, tubes or jars can cause adhesive failure or solubilize water soluble inks.
- Balancing practical needs and preservation needs can be tricky, be sure to test new materials if you cannot find any information on them.

There are very few standards for very cold labels, therefore best practice is to extrapolate from dry labelling and archival materials standards. Testing of materials becomes very critical to ensure longevity of materials chosen.