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Burning down the house

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Abstract

On 7 August 2012 the National Archives of Australia held a fire exercise in association with ACT Emergency Services Agency (ESA). The purpose of the exercise was to examine questions relating to the fire protection provided by of storage materials and furniture. A range of box types, furniture types and surrogate materials were included in the exercise including documents, artworks, photographs, film, magnetic tape and discs.

Among the questions being looked at were:

- What box making material is best?
- What style of box is best?
- Is metal or wooden shelving preferable?
- What type of enclosure is best for motion picture film?
- What fire protection is afforded by plan drawers?
- What protection is afforded by filing cabinets?
- What is the best framing method?

Also examined was the effect of fire on various vulnerable materials, for example thermal papers and CDROM. The exercise resulted in a set of useful conclusions which could be used to help develop a set of guidelines for best practice storage for fire protection.

Background

Canberra is home to a wide range of important heritage collections.

The threat of fire to these collections is of significant concern to the conservators, curators, librarians and archivists entrusted with their care.

This is not an idle concern; the National Library of Australia (NLA) caught fire in 1985 and in 2003 fires threatened the Tuggeranong building of the National Archives of Australia (NAA). More recently there have been high profile fires in ACT heritage buildings - the Hotel Diamant and the Canberra Serviceman's Club. More recently still, there was a major chemical fire in the suburb of Mitchell in September 2011. As many people would know Mitchell holds

large parts of the collections of the National Museum of Australia (NMA), National Film and Sound Archives (NFSA) , NAA and Australian War Memorial (AWM).

All of this has led to a heightened awareness of the danger of fire affecting our collections.

The exercises

In response to this, in August 2012 and June 2013 I organised two exercises where, in association with local emergency services, we examined the issues related to the effects of fire on our collections and storage systems, and looked for ideas on how to minimise fire damage.

Some of the questions we examined were:

- What boxmaking material offers the best fire protection: corrugated paperboard or polypropylene?
- Is metal or wooden shelving is preferable?
- What type of enclosure is best for motion picture film – plastic, metal or cardboard?
- What fire protection is afforded by plan drawers?
- What protection is afforded by filing cabinets?
- What is the best glazing for framed items – perspex or glass?
- What is the best framing material – wood or metal?
- Is tightly packed better than loosely packed?
- What is the fire protection provided by exhibition transport cases?
- Are solander boxes good protection?
- Does compactus assist in fire protection?
- What is the effect of fire on photographs and audio visual material?
- How best do we recover material after a fire?

The first exercise involved only NAA staff, the second was open to anyone from the local DisACT group and was treated as a training exercise in fire preparedness and recovery. DisACT is a local disaster co-operation group with membership from cultural agencies, libraries and archives.

Both exercises took place at the local Emergency Services Agency (ESA) compound at Hume. Set up there are two shipping containers which are used for fire simulations and training exercises.

1: The ESA facility at Hume. The containers are in the top right corner.

What was tested

For the exercises a range of storage furniture and surrogate objects were set up in a container and a fire was lit. When it had been judged to have done significant damage, the fire was extinguished. Participants then moved in and cleared out the damaged material. All material and furniture was carefully recorded photographically before the exercise and again afterwards. Various moving images were also captured, including thermal imaging in the first exercise.

Furniture used in the exercises included:

- Metal shelving
- A 'compactus' comprising two bays of metal shelving face-to-face
- Wooden shelving
- Plan cabinet
- Filing cabinet
- Wooden desk drawers
- Exhibition transport crates

Surrogate objects included:

- Files, including thermal copies
- Maps and plans
- Books
- A variety of boxes – archival corrugated paperboard, brown corrugated paperboard, Marbig 'Archive Boxes', polypropylene boxes, fluted plastic boxes and solander boxes
- Motion picture films in various 'film cans' – metal, plastic, both vented and unvented
- Photographs, photograph albums, negatives and slides
- Audio cassettes and video cassettes

- Gramophone records
- Framed artworks, including works in wooden frames, metal frames, glazed with glass and glazed with Perspex
- Textile items, both hanging loose and in boxes

This material was sourced in a variety of ways, for example cast-off furniture and de-accessioned material from various collections. Another useful source for material was a local refuse recycler trading as Tiny's Green Shed.

On the day before each exercise we moved everything to the ESA facility and set it up.

On the day of each exercise a press call was put out and press turned out for both exercises. This included the Canberra Times, ABC TV, WIN TV and the Canberra Chronicle. Everybody loves to watch things burn!

2: Ian talks with the local ABC.

Lighting the fire

The initial fuel for the fire consisted of sheets of chip board. Some of these were cut into sticks and stacked in a 'crib' whilst others were attached to the walls and ceiling.

3: The ‘crib’

4: Applying the torch

Once things were set up a fireman applied a gas torch to the crib to begin the fire. Once the fire was self-supporting the fireman moved away and let it develop. From here things moved quickly, for example, with the second exercise it took 8 minutes for the fire to reach a stage where significant damage had been done. At this point the decision was made to allow the fire fighters to move in and put the fire out.

5: The fire well alight

6: Extinguishing begins

In both cases the fire fighters used a misting hose attachment which minimised the amount of water needed. In the first exercise, shelving was arranged so that everything was open to the room, in this case it took only 5 or 6 litres of water to extinguish the fire. For the second exercise, a mock ‘compactus’ was arranged comprising two bays of metal shelving placed face-to-face. It was hoped to show that a compactus protected the contents from the worst of the fire. The truth was quite opposite, the fire easily transferred to the inside of the compactus, presumably from heat transference through the metal, and the fire took a strong hold inside. When it came to extinguishing the fire the structure of the compactus hindered the extinguishing of the fire inside – water simply did not penetrate. As a result much more water had to be applied and the contents of the unit were very wet and stained. Even worse, the fire inside the compactus kept reigniting long after the rest of the fire was out. Ultimately the two units had to be moved apart and the contents thoroughly soaked. In a real fire, this would present a significant issue for fire fighting – in a real fire it may not be possible to move compactus apart either for access reasons, or because the fire has warped the mechanism. Furthermore a sprinkler system, if triggered would have the same issue – compactus shelving usually has a largely solid top.


7 & 8: The ‘compactus’ before


9 & 10: The ‘compactus’ after

Specific observations

Plan drawers

A set of metal plan drawers was included in the first exercise. It was on the floor of the container so only rose about 600 mm, thus avoiding the worst of the heat. Nevertheless the contents of the top two drawers sustained major damage. These comprised modern drawings on plastic film stored in cardboard folders, the folders charred and burnt whilst the drawings melted and burnt.

11: Polyester architectural drawings in a plan cabinet

Film cans

Various film cans, containing films, were included in both exercises, these included cans of polypropylene and metal as well as cardboard boxes. In the fire the plastic cans melted, exposing the contents, the cardboard boxes charred and burnt whilst the metal cans appeared to act as an oven. Based on these observations it is difficult to decide which is the best storage option for film.


12 & 13: Pile of metal and plastic film cans – before and after


14 & 15: Polypropylene and metal film cans – before and after

Boxes

In both exercises a range of box types were included. These included boxes of corrugated cardboard (both archival and non-archival), polypropylene and fluted plastic. Packing of the boxes played a significant part in their behaviour; boxes sitting out in the air fared the worst whilst boxes packed tightly on shelving sustained less damage – due to the lack of oxygen. Corrugated cardboard boxes charred on the exposed side but in doing so offered some protection to their contents. The polypropylene boxes melted quite readily, exposing the contents, whilst the molten plastic ran over the contents and anything stored below.


16 & 17: Corrugated cardboard box – before and after


18 & 19: Polypropylene box – before and after

In the second exercise some cardboard boxes, stored high on metal shelving, burnt badly on the unexposed side, i.e. the side against the metal back of the shelf. This would be due to heat transference through the metal.

Solander boxes were also included in both exercises. As with corrugated board boxes, these charred and burnt on the outside but in doing so appeared to protect their contents.


20 & 21: Badly charred solander box with slightly damaged contents

Framed items

In both exercises a range of framed items were tested. These included items in wooden frames and metal frames and items glazed with both Perspex and glass. Also included were a number of items in 'Fini' frames which are used almost exclusively by cultural institutions in Canberra for temporary display. These frames are of wood with Perspex glazing and a system of metal braces at the back. In the fires wooden frames charred but in doing so appeared to offer some protection to the material in the frame, metal frame on the other hand appeared to transfer the heat to the framed item, usually in a fairly localised fashion based on the source of the heat. As for glazing, glass was found to shatter whilst Perspex melts and distorts; it is difficult to decide which of these options is the best.


22 & 23: Wooden frame with glass that fell face-up – before and after


24 & 25: Wooden frame with glass that fell face-down – before and after


26 & 27: Metal frame that fell face-down – before and after



28, 29 & 30: Fini frame that fell face-down – before and after

In the second exercise the framed items were placed on display screens, early in the progress of the fire all items fell from the screens, possibly due to the failure of the cord or wire used for hanging. Those items that fell face-down survived better than those that fell face-up.


31 & 32: The art screens – before and after

Books, ring binders, storage pages and photo albums
Damage to these items was directly related to the level of protection they had (e.g. box, slip cover) and the proximity to the heat source. In general plastic elements were prone to melting and metal elements (e.g. ring binder mechanism) assisted in heat transfer. Burning occurred where there was sufficient heat and oxygen.


33 & 34: Ring binder and plastic slide storage - after

AV material: video tapes, audio tapes, CDs and vinyl records
These items are generally made up of a range of plastic elements. Therefore, depending on their proximity to the heat source they exhibited melting, distortion and charring to various extents. For each material, there would be a level of damage, after which the data on the medium would be un-recoverable.

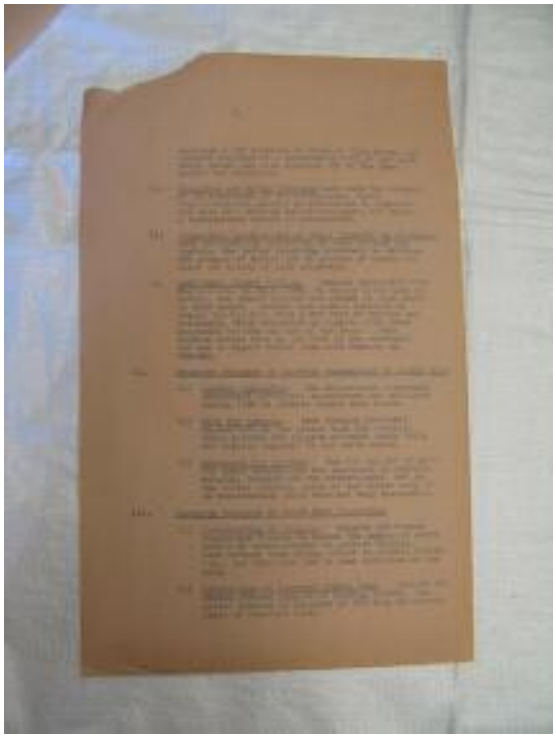
35 & 36: Polypropylene gramophone disc storage – before and after

37: Gramophone disc - after

38 & 39: Videotape storage – before and after

Thermal papers

Thermal papers, thermo-fax and thermal faxes were included, placed on files, in various locations in both fires. Papers only discoloured on the edges and only when close to actual burning, there was no tendency to overall darkening.



40 & 41: Thermal paper – before and after

Nitrate film

Small pieces of nitrate film were included in the second fire, in small paper envelopes attached to files. When retrieved there was no evidence they added to the fire damage, where the file burnt the film burnt and vice versa.


42 & 43: Nitrate film on a file – before and after

Exhibition transport crates

Small exhibition transport crates were included in each exercise. In both cases the crate was very close to the fire source. Both crates were made of thick MDF and were lined with foam rubber. Both crates survived the fire very well, the outsides charred but the inside appeared unscathed.

44: Exhibition transport crate - before


45 & 46: Exhibition transport crate - after

Plastics and fire retardants

After both fires there was a brown oily deposit in many of the boxes and drawers holding AV material. This is most likely plastic additives such as plasticisers and fire retardants. Fire retardants suppress fire by interfering with the chemical reactions that produce flame and heat and can include elements such as chlorine, silicone, magnesium as well as heavy metals such as antimony, molybdenum and lead. The health issues of all of these materials should be of concern to anyone working with these materials, particularly in the aftermath of a fire.

47: Film can showing brown deposit – likely fire retardent

Conclusions

Best storage practice for fire safety

The two exercises carried out have revealed a lot about the best way of storing and packaging materials for fire protection. The following recommendations are made:

- Always tightly pack materials and minimise air gaps, whether in boxes or on shelves
- Avoid plastics where possible, use plastic boxes and enclosures only where there is no alternative
- When crating items use the heaviest wood possible
- In framing, where possible use wooden frames, the heavier the better

- In framing, where possible use Glass not Perspex (this should be weighed against the fragility of glass)
- Compactus makes fire fighting very difficult as water can't penetrate; examine options such as the use of open walls or mesh instead of solid steel shelving.

Fire recovery recommendations

The two exercises carried out have also revealed a lot about the best way of retrieving fire damaged materials. The following recommendations are made:

- Safety first – be aware of materials that may fall and the some things may be still smouldering
- Wear full respirator and gloves– fires produce nasty gases and deposits
- Find a suitable safe place to transport the material to. The area will need to be secure, weather tight, have a lot of floor or table space and should be well ventilated and well lit. The material will be smelly and messy so this needs to be considered – e.g. consider people working nearby.
- Use trays or crates to move items – they will be fragile and need support
- Remove material fallen on floor first. In this way people will not walk on it when retrieving the remaining material.
- Throw away damaged unimportant things, for example boxes and shelves.
- Don't write anything off. Immediately after a fire the temptation may be to simply throw things away. However, some things that look lost may be able to be retrieved to some extent once they are separated, cleaned and dried.
- Get things out of boxes and frames to stop water damage and assist with the drying process.
- As soon as possible remove excess water using cloth, sponge or blotting paper.
- Where items are still strong rinse them with clear water to remove soot and stains.
- Proceed from here as with flood recovery.

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Biography

Ian Batterham was among the first intake of students for the original materials conservation course at the CCAE. He graduated in 1980 and took up a position at the National Archives of Australia, where he remains to this day. Over the years Ian has carried out a range of significant treatment projects including work on the Walter Burley Griffin Canberra designs.

He is author of the book ‘The Office Copying Revolution’ published by the NAA. He has completed a Masters Degree in Materials Conservation at the University of Canberra and has often filled in as lecturer in Paper Conservation there. He is currently Assistant Director, Preservation at the NAA where he carries out a range of research work, currently including modification of storage standards, storage for fire protection and paper quality in the 20th century.