Print ISSN No 1175-5288
Online ISSN No 1179-711

CANTERBURY DISASTER
SALVAGE TEAM

Number 51 **March 2015**

National Archives of Australia/ACT Fire & Rescue. Part 1
Fire simulations 2012 and 2013 – Ian Batterham.
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Fire dangers to heritage collections

Fire is always a danger with any stored collection which contains flammable material. Cultural materials themselves, the storage containers and furniture which house them and the buildings they are stored and displayed in are all flammable and could in the right situation catch fire.

Fire at National Library

Government 'should resis

1. Canberra Times, march 1985

There have been many reminders of this danger over the years: in 1985 when the National Library of Australia caught fire (Fig 1); in 2003 the National Archives of Australia (NAA) Tuggeranong Building was threatened by bushfire (Fig 2) ; more recently there have been high profile fires in ACT heritage buildings - the Hotel Diamant and the Canberra Serviceman's Club; and in 2011 there was a major chemical fire in Mitchell (Fig 3) a few blocks from a number of building storing historical collections - the NAA, the AWM, NFSA and the NMA.

2. Canberra fires 2003

3. Mitchell fire 2011

Fire protection

Of course institutions that hold cultural materials take proper precautions against fire – including alarm systems, sprinkler systems, extinguishers and emergency plans. However, there is another level of protection that can be offered – the very storage materials for the collection – boxes, frames, cabinets and shelves. If these are properly chosen and configured they can provide additional protection, conversely poorly chosen storage materials can actually increase the danger to a collection in the event of a fire.

The exercises

To specifically examine questions relating to the fire protection of storage materials the NAA arranged two fire exercise in association with ACT Emergency Services Agency (ESA). The exercises were held at the held at the ESA Training facility in Hume (Fig 4) on 7 August 2012 and 24 May 2013.

4. ESA TRAINING FACILITY AT HUME

First exercise: 7 August 2012

Introduction

Due to concerns with liability the first exercise was limited only to NAA staff. The exercise therefore focussed on questions of concern to the NAA. Issues to be examined were:

- What box making material is best? Corrugated paperboard, paperboard, polypropylene, fluted polypropylene?
- What style of box is best? NAA box, 'Archive Box' (with separate lid), Solander box?
- Is metal or wooden shelving preferable?
- What type of enclosure is best for motion picture film? – plastic, metal or paperboard?
- What is the effect of fire on thermal papers?
- What fire protection afforded by plan drawers?
- What protection is afforded by filing cabinets?
- What is the best framing method? Wooden frame? Metal frame? Unglazed? Glazed with glass? Glazed with Perspex?
- What is the fire protection provided by exhibition transport crates?
- What effect has fire on books and ring binders
- What effect has fire on photographs, negatives, slides and photo albums
- What effect does fire have on AV material such as microfilm, audio tape, video tape and floppy discs?

Preparation for the exercise included:

Collecting range of box and enclosure types. These included boxes of: archival corrugated paperboard (NAA boxes), non-archival corrugated paperboard (old NAA boxes and Marbig 'Archive Boxes'), polypropylene (Albox), fluted polypropylene (Staminex) and Solander boxes (from the NGA). There were also film cans of steel, polypropylene and corrugated cardboard.
Collecting a range of expendable materials including files, loose papers, plans, books, folders, ring binders, photographs, negatives, audio tapes, video tapes, computer discs and motion picture film.
Collecting framed items in metal/wooden frames and with glass/Perspex glazing.
Collecting a series of storage furniture including metal shelving, wooden shelving, and a filing cabinet, a set of wooden drawers, a plan cabinet and an exhibition transport case.
Material was sourced from local cultural institutions, from the NAA and from Tiny's Green Shed. Before the exercise all items to be used (Fig 5) were photographed.

5. Material for the exercise collected at the NAA Hume building

Preparing for the exercise

On the day of the exercise all materials were transported to the ESA facility at Hume. The actual 'Burn House' comprises a shipping container. The fire was prepared in the back of the container; fuel for the fire comprises particle board both as 'kindling' and full sheets (Figs 6 & 7). The fire is lit using a gas torch.


6 & 7. FUEL FOR THE FIRE. PHOTOGRAPHER JENNIFER EVERART

We arranged our material on the various shelving units and cabinets facing the fire. An attempt was made to ensure that material was placed such that there was as much variety as possible in both location and configuration (Figs 8, 9 & 10).



8, 9 & 10. MATERIAL IN PLACE -PHOTOGRAPHER JENNIFER EVERART

Publicity

On the day of the exercise the NAA put out a press call. There was great interest and press came from the Canberra Times, ABC TV, WIN TV and the Canberra Chronicle (Figs 11 & 12).

11 & 12. THE PRESS PHOTOGRAPHER JENNIFER EVERART

Lighting the fire

When it was time to light the fire all observers were moved well back. The ESA set up two cameras to film the exercise – a thermal camera (Fig 13) and an expendable mini camera (Fig 14).

13. THERMAL CAMERA 14. MINI CAMERA

PHOTOGRAPHER JENNIFER EVERART

Two fully suited firemen entered the container with a gas torch and played it on the pile of particle board kindling until this was well alight (Fig 15), they then stayed in the container until it was too hot for them (Fig 16).

15. Lighting the fire
Photographer Jennifer Everart

16. Stepping back as it develops
Photographer Jennifer Everart

The fire was allowed to progress until the head fireman felt it had caused significant damage. The time from ignition to extinguishing was only 6 ½ minutes, and only 3 ½ minutes from when the firemen moved back because it was too hot. Examination of the thermal camera footage after the exercise revealed that the heat in the space was most extreme towards the roof of the container where it reached as high as 1,000C. The temperature dropped significantly as you moved towards the floor.

17 & 18. Extinguishing the fire Photographer Jennifer Everart

The fire was extinguished with 'surgical' care by the firemen (Figs 17 & 18). They used minimal water and used a misting spray nozzle. The water was only directed at hotspots and irrigation was ceased when the fire appeared out. In this way the firemen only used 5-6 litres of water to put the fire out. Other benefits were minimal wetting of material and the lack of damage caused by water applied at high pressure (Fig 19).

19. CHECKING THE FIRE IS OUT PHOTOGRAPHER JENNIFER EVERART

The fire did reignite in one spot sometime after it seemed to be out, this was not unexpected and the firemen simply applied a small amount of water in a mist to the area and quickly extinguished it. Participants were not allowed into the container until the all clear was given, this was after about two hours.

The aftermath

20. THE SCENE WHEN WE WERE ALLOWED TO ENTER PHOTOGRAPHER JENNIFER EVERART

On entering the container after the fire it was clear there was a lot of damage (Figs 20 & 21). A large number of in situ photos were first taken and then items were carefully moved outside. The material and furniture were then packed up and moved to the NAA's Greenway building. The next day the material was carefully examined and each item was rephotographed.

21. VIEW OF THE METAL SHELVING AND FILING CABINET PHOTOGRAPHER JENNIFER EVERART

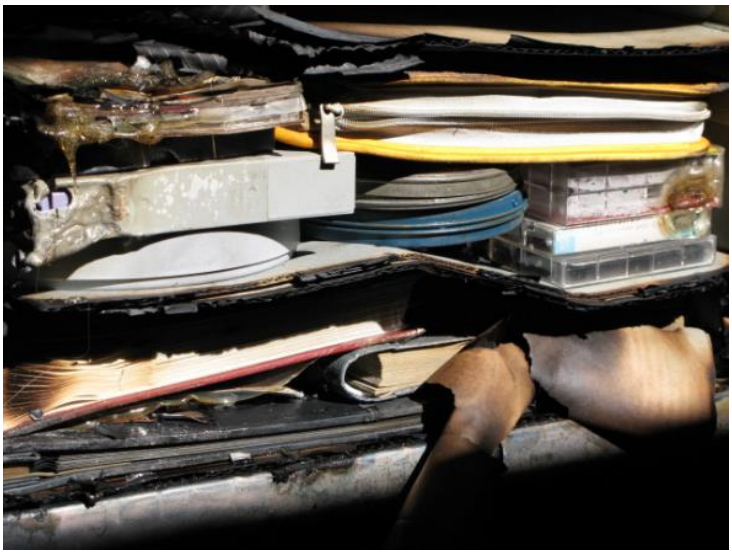
Conclusions

A few general conclusions can be made:

- A fire can progress very quickly and do a lot of damage in a short time
- Fire fighters with appropriate training and equipment can put out such a fire with minimal water and minimal water force. This minimises both water damage and physical damage.
- As regards the questions asked at the outset of the exercise, we are able to make a range of conclusions:

How flammable is stored cultural material?
Cultural material is definitely flammable – its flammability is mitigated by appropriate storage. Bearing in mind that fire needs oxygen to progress, any storage method that minimises oxygen around the material reduces fire damage.

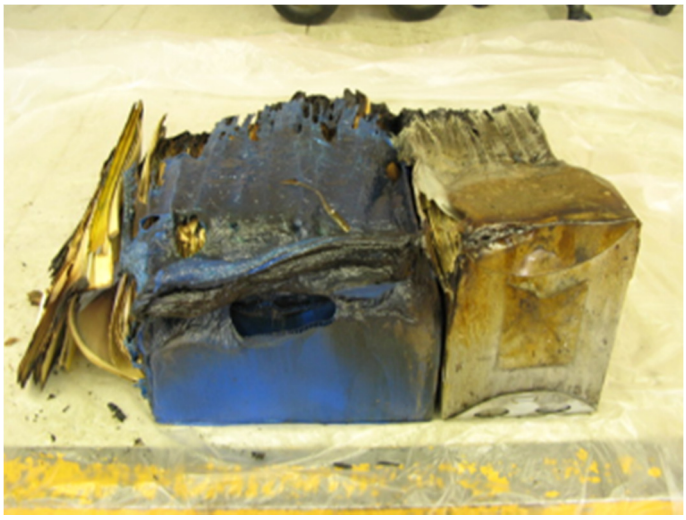
What are the vulnerable materials?
The exercise did not answer this directly. It can be assumed however that damage was more significant for materials where the medium is delicate and the information is packed densely. Thus AV materials would be considered most vulnerable (Fig 22).



22. CDS, FILM, AUDIO TAPE, VIDEO TAPE AND PHOTO ALBUMS AFTER THE FIRE

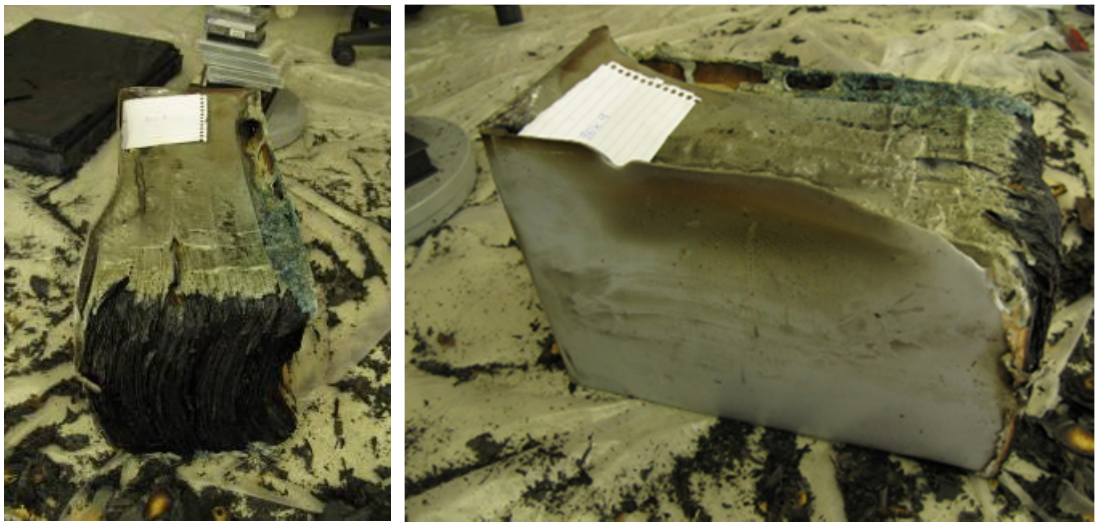
What box making material is best? Corrugated paperboard, polypropylene, fluted polypropylene?

There was a distinct difference between materials stored in corrugated paperboard, when compared to material stored in polypropylene (whether fluted or not). The corrugated paperboard burnt but in doing so appeared to protect the material stored within. The polypropylene boxes on the other hand melted and left the contents exposed to the fire. The lid of the box when melted ran into the box, covering the contents (Figs 23-29).



23 & 24. FLUTED POLYPROPYLENE BOX (STAMINEX) PACKED ON SHELVING - BEFORE AND AFTER (WITH POLYPROPYLENE ALBOX BESIDE)

25. POLYPROPYLENE BOX (ALBOX) PACKED ON SHELVING -BEFORE



26 & 27. Polypropylene box (Albox) packed on shelving - after

28 & 29. Archival corrugated paperboard box packed on shelving – before and after

What style of box is best? NAA box, 'Archive Box' (with separate lid), Solander box?

It was very difficult to compare box styles (as opposed to fabrication materials) and no style seemed to behave better than another. The Exception was the Solander box which appeared to offer significant protection (Figs 30 & 31).

30 & 31. The solander box was charred badly but the contents survived

Is metal or wooden shelving preferable?

This was hard to assess. Unfortunately the wooden shelving used was the type where each shelf is held up using plastic plugs. These apparently melted leading to the shelves falling on the floor (Fig 32). Having said this, as far as can be deduced there was little difference between the two shelving materials.

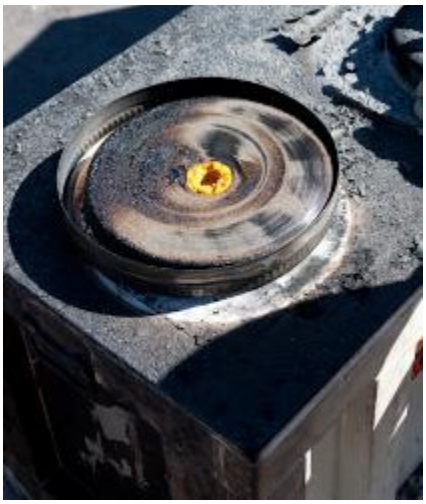
32. The collapsed wooden shelving Photographer Jennifer Everart

What type of enclosure is best for motion picture film? – plastic, metal or paperboard?

It is very difficult to make a conclusion about this question. Plastic containers tended to melt, metal containers appear to have acted like ovens and the paperboard container charred. In each case there was significant damage to the film inside and it was not possible to say which film received the worse damage (Figs 33-45).

33 & 34. Polypropylene and steel film cans in the open – before and after

35. Polypropylene film can - after



36. Metal film can – after, open

37 & 38. Stack of film cans – before and after

39 & 40. acetate film in polypropylene can - before and after

41 & 42. acetate film in steel can - before and after


43 & 44. Polyester film in steel can - before and after


45 & 46. Acetate film in corrugated paperboard box - before and after

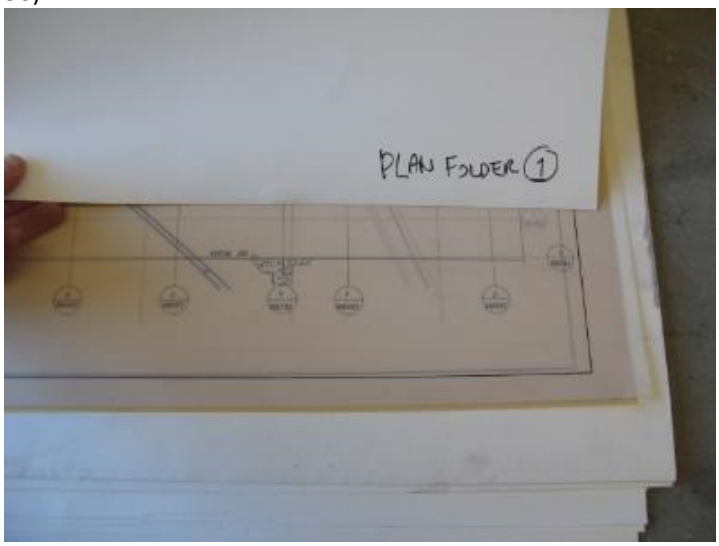
What is the effect of fire on thermal papers?

Thermal papers within file material did not totally blacken as expected. Blackening was restricted to the edges where the heat was most intense (Figs 47 & 48).


47 & 48. Thermofax papers before and after the fire

What fire protection afforded by plan drawers?

The plan cabinet was sitting on the floor and as such received less heat than materials sitting high up. The greatest damage was to material in the top two drawers. These drawers held plans on plastic drafting film within paperboard folders and were significantly damaged from both burning and melting (Figs 49 & 50).



THE TOP DRAWER OF THE PLAN CABINET

49. BEFORE

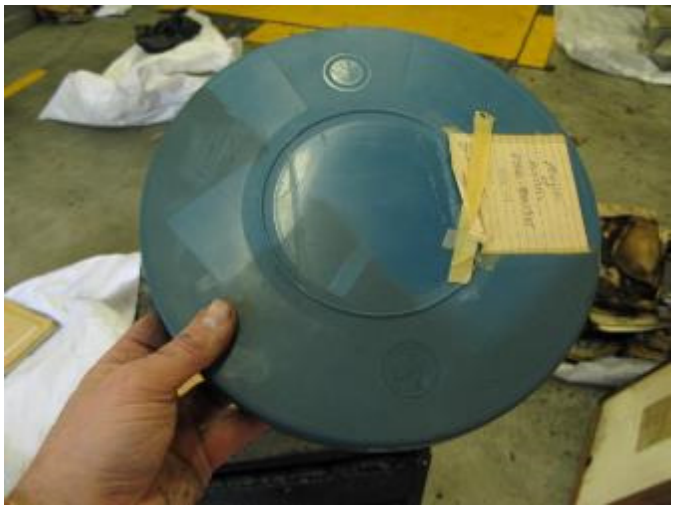
50. AFTER

What protection is afforded by filing cabinets and wooden drawer units? The contents of the top drawer of the metal filing cabinet were singed and somewhat brittle but had not burnt. There was minimal obvious damage in the lower drawers (Figs 51 & 52).

51 & 52. Top drawer of the metal filing cabinet – before and after

Within the small wooden drawer unit were stored various audio visual materials, these seem to have off gassed a brown oily material which deposited itself on the materials in the unit (Figs 53 & 54). We have done XRF analysis of this material and it has revealed that the material includes levels of chlorine, silicone, magnesium as well as possible slight traces of metals such as antimony, molybdenum and lead. All of these elements occur in various fire retardant materials, for example magnesium hydroxide, Dechlorane plus (Bis(hexachlorocyclopentadieno)cyclooctane) and molybdenum trioxide. Such chemicals are added to plastics and are designed to become volatile at high temperatures. They suppress fire by interfering with the chemical reactions that produce flame and heat. Of course some elements of the material could also be the result of the breakdown of plastics such as PVC. 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.

53. Wooden drawer unit with film and video

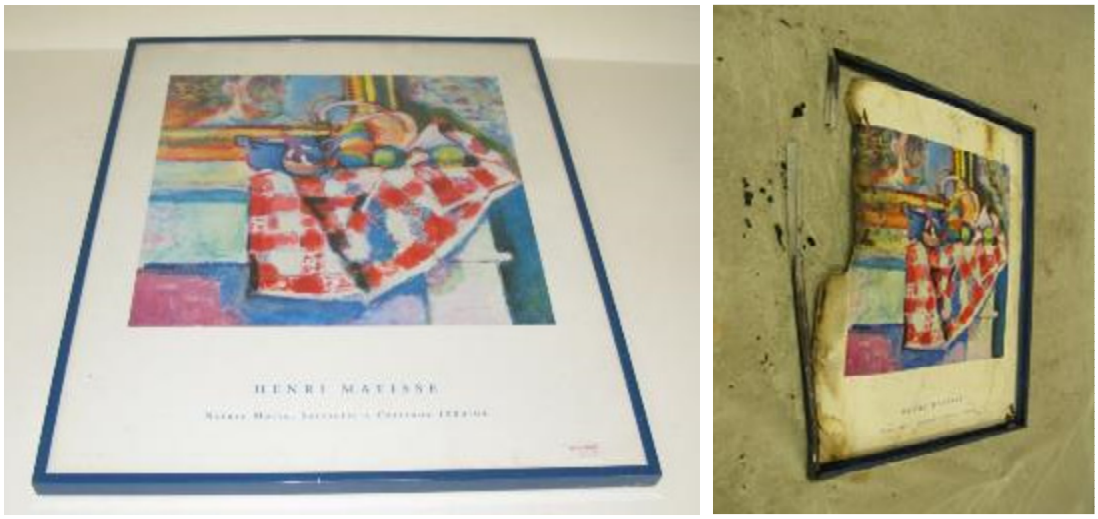


54. polypropylene film can – brown deposit, possibly fire retardent

The exercise did not answer this with any certainty. The Perspex glazing melted and slumped (Figs 55 & 56) whilst the glass shattered (Figs 57 & 58). We had both aluminium frames and wooden frames – the aluminium burnt where it got the hottest and the wooden frames also charred. The artworks within charred where the heat reached them (Figs 57-62).

55 & 56. Wooden frame and Perspex glazing (fini frame) – before and after

57 & 58. Wooden frame and glass glazing – before and after



59 & 60. metal frame and glass glazing – before and after

61 & 62. Unglazed photo in wooden frame stored in corrugated paperboard box - before and after

Is tightly packed better than loosely packed?

It was clear that damage was less for items packed on shelves rather than sitting out in the open. It was less clear whether loosely packed items within a box were more vulnerable than tightly packed ones (Figs 63-66).

63. Exposed corrugated paperboard boxes - before

64. Exposed corrugated paperboard boxes – after Photographer Jennifer Everart

65 & 66. Exposed fluted polypropylene box (staminex) - before and after

What is the fire protection provided by exhibition transport crates?

We had only one transport crate in the exercise. This came from the AWM and had very thick MDF walls. The fake object in was a small plastic vacuum cleaner. The crate was placed on the floor, very close to the fire. The lid of the crate charred significantly and the sides blackened but the contents had not sustained any obvious damage (Figs 67-69).

67 & 68. Exhibition transport crate - before

69. Exhibition transport crate - after

What effect has fire on books and ring binders

A small number of books and ring binders were included in the exercise. They were mostly placed in different boxes with a few items exposed. The PVC covers of exposed ring binders melted and burnt (Figs 70 & 71). Books stored in boxes were stained, singed and embrittled (Figs 72 & 73).

70 & 71. Exposed Ring binder - before and after

72 & 73. Various books stored in boxes - before and after

What effect has fire on photographs, negatives, slides and photo albums

A variety of photographic materials were included in the exercise. These were boxed in a number of configurations. Few of the materials received sufficient heat to develop visible problems. An exception was a group of modern colour photos that received enough heat to char at the edges. The un-charred portion of the image had developed a strong orange cast, most likely through loss of one or more of the colour dyes making up the image (Fig 74).

74. Fire affected colour photos

Photographer Jennifer Everart

What effect does fire have on AV material such as microfilm, audio tape, video tape and floppy discs?

A variety of AV materials were included in the exercise. These were boxed in a number of configurations or stored in drawers. Few of the materials received sufficient heat to develop visible problems. Where problems were obvious they comprised melting and/or burning of the housing where heat was the most intense (Figs 75 & 76). Unfortunately it was not possible to assess the play-ability of these formats before and after the exercise. Careful observation of a group of audio cassettes (Figs 77 & 78) suggests the cases have melted as a result of heat entering the box through a finger hole.

75 & 76. Roll of microfilm – before and after

77 & 78. Audio cassettes – before and after