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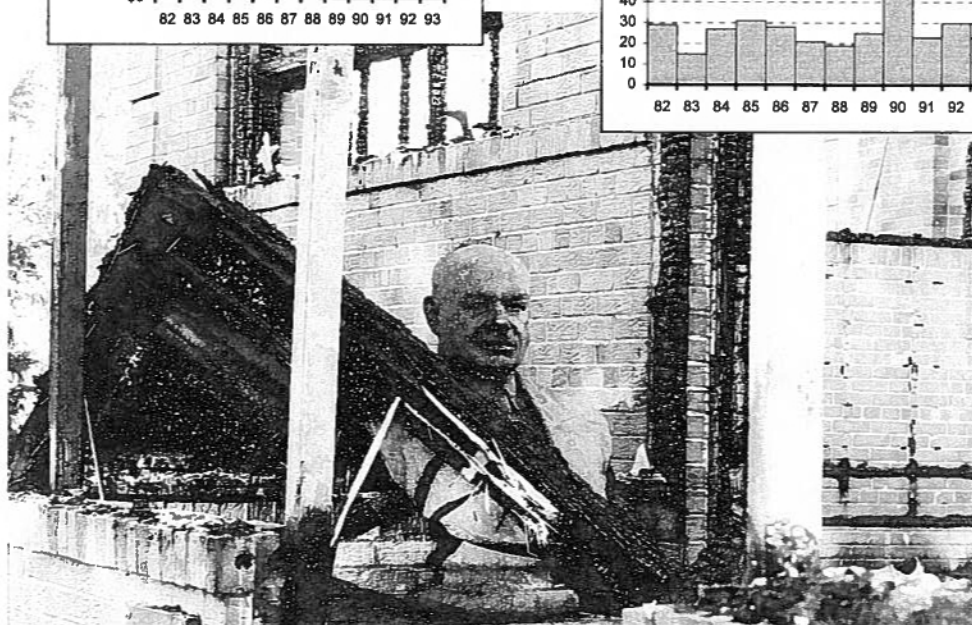
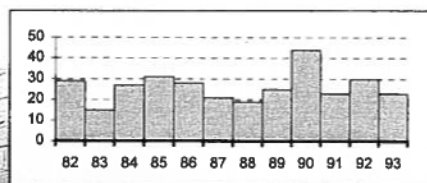
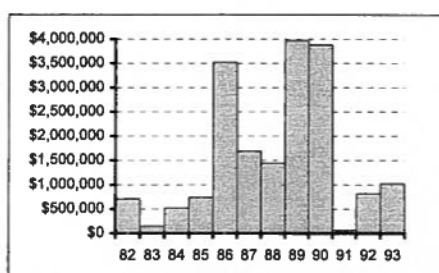
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Technical Bulletin

Fire Prevention Programs for Museums

18



Technical Bulletin No. 18

Fire Prevention Programs for Museums

by Paul Baril

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Abstract

Fire damages and destroys Canadian collections every year. This Technical Bulletin is intended to help museums develop and implement effective fire prevention programs. It describes the ways and means to develop and implement a successful, comprehensive, yet not overbearing program. Numerous examples are provided to help museum staff prepare documents and procedures.

Author

Paul Baril worked for the Canadian Printing Office Engineering Services from 1967 to 1984, where he trained and specialized in the administration of fire protection and occupational health and safety programs. Paul studied fire protection engineering at the University of Ottawa and at the University of Toronto. He joined the Department of Communications in 1984 as Chief of the Fire Protection and Safety Division, responsible for fire protection and occupational health and safety programs for the National Museums of Canada. Currently Paul works with the Conservation Processes and Materials Research Division of the Canadian Conservation Institute (CCI). He is an active member of the National Fire Protection Association's (NFPA) Technical Committee on the Protection of Cultural Resources. He is the recipient of the Regional Fire Commissioner's Award and of three Fire Commissioner of Canada, Fire Prevention Program Awards.

Cover

Illustrations by Paul Baril. Statistical data compiled from information provided by the Office of the Fire Commissioner of Canada.

Photo: Taras H. Shevchenko Museum

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1. Introduction

Museum¹ fires have taken their toll in Canada in recent years. Some museums have been entirely destroyed, and others have suffered extensive losses. This is unfortunate because most fires can be prevented. Fire prevention programs play an important role in protecting collections against fire, especially in museums with inadequate fire protection systems. This Technical Bulletin provides advice on such programs and is intended for museums, art galleries, historic sites, archives, and other facilities entrusted with irreplaceable collections.

Effective programs can prevent many fires and can help keep damage to a minimum. Of course, fire prevention programs cannot replace fire fighting systems, but they can supplement them by ensuring good performance. A balance between prevention and protection is the key to a sound defence against fire. The information provided in this bulletin is applicable to museums run by professional staff, as well as those run by volunteers.

1.1 Fire Has No Mercy

It is a dreadful experience to witness the aftermath of a museum fire. What once were prized collections have been quickly reduced to rubble by flames and heat (see Figure 1). Insurance policies may cover some or all reconstruction costs and may provide funds to replace lost collections. However, this is not much consolation when damaged objects are originals and when historic structures are destroyed.

Often the only positive aspect that can be salvaged from a fire is the invaluable knowledge and data it provides, which may be of assistance to others. Unfortunately, information on museum fires is hard to obtain, except from museums that have burned to the ground. These museums rarely hesitate to make their plight public. Otherwise, most museums have a tendency to keep their misfortunes quiet for a variety of reasons. Some are simply embarrassed, and others fear that

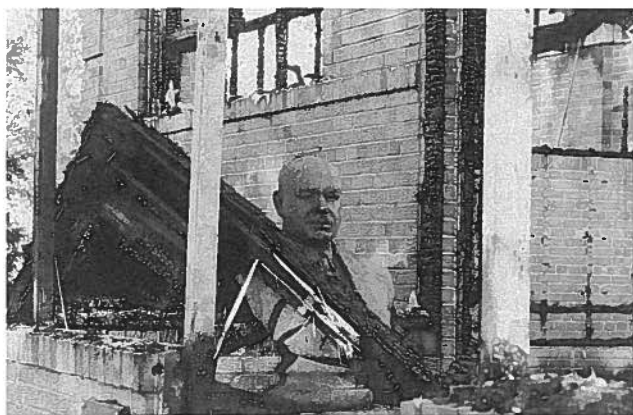


Photo: Taras H. Shevchenko Museum

Figure 1. Taras H. Shevchenko Museum fire, 1988.

discussing these events will jeopardize future opportunities to borrow collections. Some are simply unaware of the importance of this data, and others are too preoccupied with the disaster and day-to-day activities. Nevertheless, museums must be made aware of the importance of this data, and should be convinced to share it so that everyone can learn from it.

1.2 Fire Statistics

The Office of the Fire Commissioner of Canada publishes an annual report, *Fire Losses in Canada*, using information provided by the Association of Canadian Fire Marshals and Fire Commissioners, and by Statistics Canada. Museum, art gallery, and library fires are classified in one group. The data shown in Figures 2 and 3 were taken from the Fire Commissioner's annual reports. Dollar loss is expressed in real dollars, is not adjusted to any base year, and does not include collection losses. Some museums represented in these data were completely destroyed, while others suffered extensive damage. In some instances, losses were estimated to be over \$3,000,000.

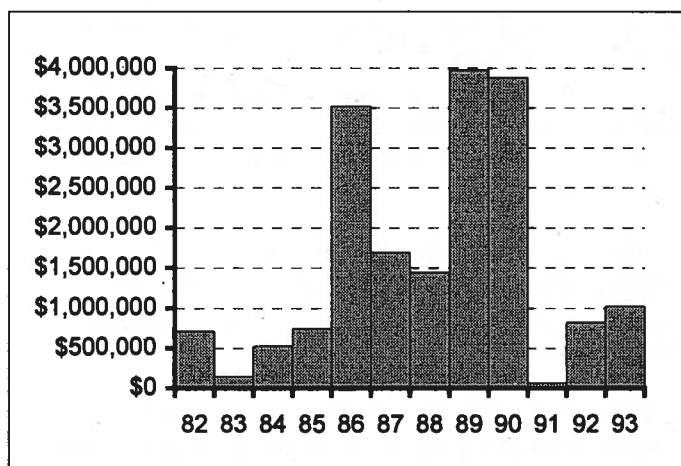


Figure 2. Museum, art gallery and library fire losses.

2. Basic Elements of a Fire Prevention Program

Most people believe that tragic events only happen to others. It is a built-in defence mechanism that is both curious and dangerous because it allows us to believe in something that is patently untrue. Such a belief poses a central problem in fire prevention.

A fire prevention program involves much more than conducting inspections, preparing reports, and providing safety equipment. Effective fire prevention requires motivation and a genuine belief that fire can happen anytime to anyone. Management must be convinced that the risk is serious enough to take appropriate measures. This is the most important step toward a successful program.

Admittedly, a fire prevention program is hard to promote in a museum that has not experienced loss through fire. Unlike

¹ According to the International Council of Museums definition.

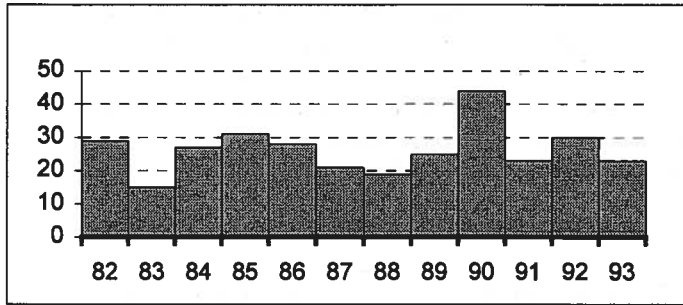


Figure 3. Number of museum, art gallery and library fires.

some museum programs, it does not bring much pleasure. It is mostly a chore, and is at times difficult to justify. The mere fact that fire does not occur is not always rewarding enough. Unfortunately, it often takes a fire to understand the importance of fire prevention.

Most agree that preventing a fire is better than fighting one, but not everyone is ready to commit their time and effort into getting a program up and running. For a fire prevention program to be successful, it should be comprehensive, but not overbearing. Such a program can be successful only when six basic elements are met (see Figure 4). Lower level elements must be satisfied, at least partially, before those at the next level can be met. The elements are explained as follows:

1. **Believed important and required:** Museum staff must believe that fires can happen to anyone. If staff and management do not believe the program is important and necessary, it will not survive very long.
2. **Supported by management:** The program must be supported by all levels of management. Neither the program administrator nor the employees can be motivated if management support is lacking.
3. **Funded adequately:** Funds are often required to buy safety equipment, to provide training, and to make minor upgrades. Fire hazards that go uncorrected because of a lack of funds can discourage the best intentions. Such inaction can compromise the program and can create a negative atmosphere. A museum must be prepared to allocate funds when necessary. Staff time should also be set aside for training, conducting inspections, preparing reports, keeping records, running meetings, and correcting hazards. Fire prevention should never be the last item in the budget. It should be as important as any other museum-related activity.
4. **Trained staff:** Adequate training and education play a key role in the administration of a fire prevention program. A little knowledge is often more harmful than no knowledge. Poorly trained staff may see a hazard where there is none, or may fail to discover more serious situations. Staff should be knowledgeable enough to recommend solutions to correct hazards. They should also be trained to use portable fire extinguishers, to handle dangerous products, and to

execute safety procedures. Fire prevention and fire fighting training are offered by some municipal fire departments and by some community colleges.

5. **Tested:** Program activities should be evaluated to see if they meet the intended objectives. For example, the time it takes to correct hazards or to evacuate occupants during an emergency drill should be evaluated.
6. **Updated:** The program should be reviewed annually, and updated when weaknesses are found.

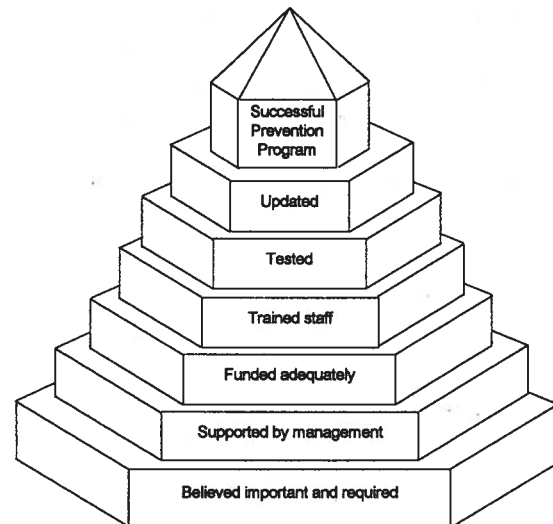


Figure 4. Basic elements of a successful fire prevention program.

3. Administration

A fire prevention program does not need to be overwhelming. On the contrary, it must be manageable, simple, and easy to administer. The following aspects should be considered when developing a program.

3.1 Objectives

The primary objective is to prevent fires from happening. The secondary objective is to minimize the impact of fire.

3.2 Responsibilities

Fire prevention responsibilities may be delegated to any employee. However, accountability and liability must remain with the most senior manager, usually the museum director. Most importantly, it is everyone's responsibility, and success depends on the satisfactory performance of all involved. Specific program responsibilities should be added to position descriptions and should be evaluated like any other duty.

3.3 Policy

Details of a fire prevention program should be documented in a museum policy and endorsed by the director of the museum.

This policy should carry as much importance as other museum policies. Once the policy is established, a date for its review should be decided on and complied with.

3.4 Committees

Because fire prevention is everyone's business, program activities can be carried out by a committee composed of staff and management. The committee can have other responsibilities such as occupational health and safety, fire emergency measures, and collection salvage. The point to remember is that these additional responsibilities should not interfere with the committee's ability to effectively carry out the program functions. Committee members should be few in number — otherwise too large a group will be difficult to manage. Membership should include staff from most areas. The committee chairperson should start meetings on time. This shows leadership, provides an element of importance to the meeting, and encourages everyone to be on time.

3.5 Meeting Minutes

Minutes should be prepared for every meeting. A simple format can make this unpopular task easy. It can also serve to monitor committee activities. Meetings and items requiring action can be assigned specific numbers for follow up. For example, the format illustrated in Appendix 1 (page 6) shows at meeting number 6, that item 10 originally discussed at meeting number 1 is still outstanding. If meetings are held every month, this item is already six months old. Background information on this item can be easily traced by simply looking for item 10, meeting 1 in previous minutes. This format is brief, precise and easy to complete. Minutes should be posted in a conspicuous area, such as the lunch room, so that all staff can be kept informed.

3.6 Chairperson

The committee chairperson should be from management simply because a certain level of financial authority is needed to resolve most issues. However, other employees can be successful at chairing the committee if management offers them full support. Rotating this task among managers every year is recommended, even if it means the museum director must take a term. There are two main advantages for doing this. One, the chairperson does not feel trapped under a never-ending burden, and two, it creates competitiveness between chairpersons. At the end of a term, an annual report highlighting major committee achievements should be prepared. From this, senior staff can recognize high performers.

3.7 Building Inspections

Hazards can be detected early by conducting regular building inspections. Staff should inspect work areas other than their own. Because we tend to adjust to the environment we work in, we do not always notice hazards in our own work area. For example, fumes leaking from a poorly sealed container may not be noticeable after a few hours. Sometimes we do not

bother to take corrective action, for example in order to avoid the reporting process and subsequent follow up.

Custom inspection checklists remind us to look for typical hazards usually found in our workplace. Hazards found can then be recorded on a hazard reporting form. A sample inspection checklist is shown in Appendix 2 (page 7).

3.8 Procedures

Procedures are a means to meet program objectives. For example, an inspection procedure can define who will conduct inspections, how often inspections will occur, what areas will be inspected, how findings will be reported and recorded, and how progress will be followed up. Certain procedures, such as a hazard reporting procedure, should be accessible to all employees, and not just to the people directly involved. Procedures should be clear and easy to understand. Hazard reporting forms (see Appendix 3, page 8) should be simple to complete, but, at the same time, effective. In recording and reporting a hazard, an employee describes the hazard, explains the consequences, and suggests a possible solution. In some instances, having to describe the potential consequences demonstrates that what was perceived to be a fire hazard is, in fact, not. This reduces further documentation and follow up.

4. Comprehensive Program

The program should be designed to protect collections from fire damage, not only by preventing fire, but by managing the impact during and after a fire. Program activities should also consider safety measures to help prevent injuries.

4.1 Preventing Fire Ignition

Preventing fire by limiting or reducing the risk of fire ignition is by far the most desirable method. To do this, the museum must be aware of potential ignition sources. Although ignition sources vary from one museum to another, site reviews conducted in small and large museums during the past ten years revealed the following to be very common:

- Improper wiring of temporary lighting fixtures;
- Excessive use of extension cords;
- Heating appliances such as portable heaters, clothing irons, and heat guns;
- Evidence of smoking, even if not permitted; and
- Use of open flames such as fireplaces, wood stoves, candles, and kerosene lamps (mostly in historic house museums).

While it is important to know how museum fires start, it is equally important to know when fire strikes. Figure 5 illustrates some of the most common causes of fire recorded by the Canadian Conservation Institute (CCI). The high number of arson-related fires should not be taken as an indication that museums are being singled out. In fact, the reasons for arson vary from fires set to cover thefts, to fires aimed at other tenants in shared occupancies.

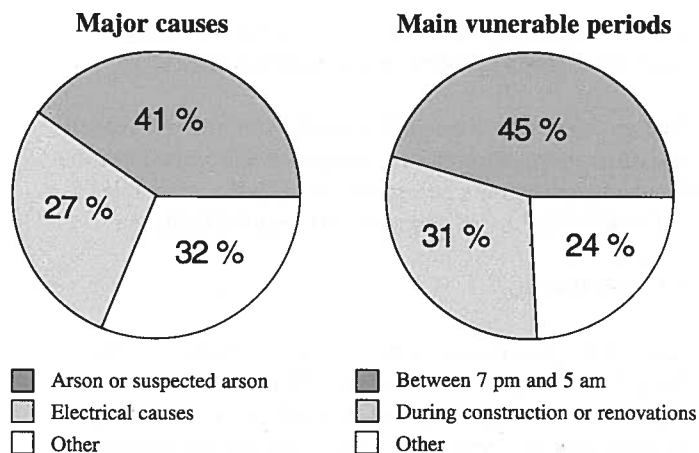


Figure 5. Causes and trends of museum fires.

Electrical faults are still a major cause of fire. Wiring should be checked periodically, and more so in older buildings. A complete electrical inspection should be conducted every ten years, especially in buildings over 40 years old. Electrical apparatus should be certified by the Canadian Standards Association (CSA), and listed by the Underwriters' Laboratory of Canada (ULC). Building wiring should be installed according to applicable electrical codes, by a journeyman electrician, and not by a handyman. Welding and soldering operations and the heat created by paint-removing heat guns are important ignition sources that require special precautions.

4.2 Managing the Impact of Fire

Limiting Fire Spread

Not all fire ignition sources can be controlled. Arson, hidden electrical faults, and ignition sources from natural disasters such as lightning and earthquakes are controllable only to a point. Because fire cannot be prevented every time, a museum should be prepared to manage its impact. Fire damage can be minimized by limiting its spread. Post-building reviews indicate that the risk of fire spread increases substantially after a museum has acquired a building. Controls that were put in place during construction by architects, engineers, and building inspectors are no longer being monitored. The quantity of combustible materials introduced by the new occupants often becomes a major problem — for example, wood partitions protected on one side only, and untreated wood boards installed on walls and ceilings. This increases the museum's fire load and greatly contributes to the rate of fire spread. It is important that program procedures and activities ensure that the following are complied with:

- Keep a tight control over post-construction projects, including temporary exhibit construction;
- Do not cause undue fire loading through museum storage. Do not use hallways, electrical and mechanical rooms, attics, and crawlspaces for storage;

- Use approved noncombustible products wherever possible;
- Treat combustible interior finishes, curtains, drapes, and temporary exhibit structures with fire retardants; and
- Keep flammable and combustible liquids in approved safety containers, and store them in approved safety cabinets.

Containing Fire

When radiant heat from a fire is intense, it can ignite everything in the room where the fire originated. This is known as flashover. At this point, a fire prevention program can still make a difference. Even though collections in the room on fire may be completely destroyed, collections in other rooms can still be saved. To do this, the fire must be effectively contained within the room of origin. Fires can be contained effectively if the room is compartmentalized, or protected by an automatic sprinkler system, or both. Compartmentalization, for example, involves building a room using fire-resistive floors, walls and ceilings, installing fire-rated doors, and fire dampers in duct openings. This construction method can prevent fires from spreading between rooms for a predetermined period, and hopefully until the firefighters arrive.

Alastair J.M. Aikman and John F. Berndt have noted that: "Seldom does fire spread through fire-rated floors or walls. Fire, however, can spread by means of open doors (because of faulty closers or homemade wedges), inadequate or missing fire stopping around building services or at the edges of floors, improperly sealed vertical shafts, and exterior windows." In the example shown in Figure 6, the collection storage room is located beside a workshop. Flames, heat and smoke from a fire in the workshop could spread to the collection storage room through wall openings, even in this fire-rated room.

Improperly sealed openings around pipes, cables, and ducts running through fire-rated rooms have been noted in most museum site reviews done by CCI. Such defects are usually caused by poor workmanship, improper renovations, and inadequate maintenance. Fire-rated rooms often fail to contain a fire when the following conditions exist:

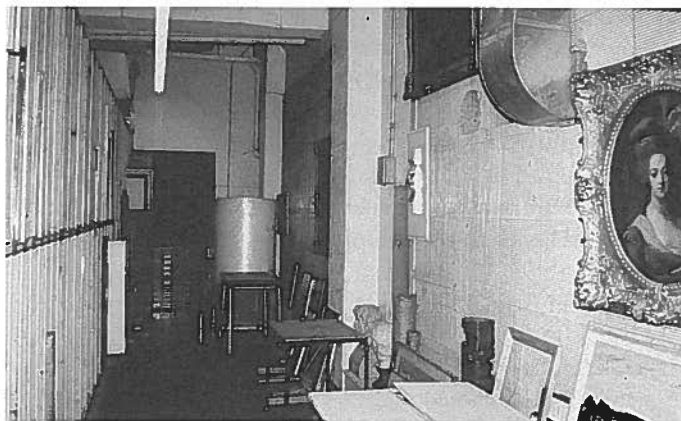


Figure 6. Hazardous openings in a fire-rated wall.

- Fire doors are wedged open;
- Openings in fire-rated enclosures are improperly sealed; and
- Heating, ventilation and air-conditioning (HVAC) systems do not shut down automatically when a fire is detected.

The first two conditions are the most common. For example, fire doors wedged open with wooden wedges, rocks, hangers, boards, and rope are often seen during site reviews. Approximately 98% of museums reviewed have kept one or more fire-rated doors open. Building renovations, changes in staff location, and lack of foresight during planning are some reasons given for this practice. If fire doors must be kept open for operational reasons, they should be held open with an approved device that closes the door automatically when smoke is detected. Improperly sealed openings should be sealed with ULC-listed, fire-rated materials.

Fire Fighting Equipment

If ignition occurs, it must be detected and extinguished very early to prevent fire from spreading. Portable fire extinguishers, standpipe systems, and automatic fire detection and suppression systems require regular maintenance and testing to be reliable. This responsibility lies with building owners or public works departments. However, a fire prevention program should ensure that maintenance is actually being done. Copies of maintenance contracts, work orders, and inspection reports should be filed with the program for auditing. For example, the program should ensure that the systems are maintained and tested by competent personnel according to acceptable standards. Such standards include NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems. Program activities and procedures can ensure that fire department access is provided at all times, and that fire routes are not blocked by parked vehicles or snow.

4.3 Reducing Post-fire Damage

The fire prevention program should have a plan in place to effectively salvage collections following a disaster. This is a subject that requires further discussion under separate cover. Advice and information on this can be obtained by contacting CCI.

4.4 Providing Safe Emergency Evacuation

A fire prevention program can play an important role to ensure visitors and staff can be evacuated safely during emergencies. Fire prevention activities should ensure that exit doors are kept unlocked when the building is open, that exit routes are kept clear, and that exit signs and emergency lighting are maintained.

Fire Emergency Organization (FEO)

This is especially important if building occupancy exceeds 100 persons at any given time, if visitors are elderly or have impaired mobility, if the building has exhibit spaces below

ground level, if the building is multi-levelled, and if an automatic fire detection system is not in place. Specific responsibilities should be assigned to staff, and effective procedures developed to ensure that occupants safely evacuate the building during emergencies. An emergency evacuation plan should be in place. It should be approved by management, by the local fire department, and in some cases by the employees' representative. Several examples are provided in Appendices 4 to 7 (pages 9 to 12).

Summary

Museum fire losses clearly demonstrate a need to better protect collections. To be effective, fire prevention programs must be fully supported by all levels of management, adequately funded, and run by knowledgeable staff. Fire prevention programs can reduce the risks and consequences of fire. Fire prevention activities are not restricted to preventing fire. Through effective procedures they can prevent fire from spreading, and can ensure that fire protection systems will function as intended when needed. Fire prevention procedures such as inspection checklists and hazard reporting systems can make program administration easier. The most important single element for a successful program is believing that fires can happen to anyone.

Suggested Reading

The following documents or portions thereof may provide additional information on fire prevention programs, and on fire protection systems.

National Fire Protection Association Publications *

- NFPA 909 *Standard for the Protection of Cultural Resources* [expected in 1997]
- NFPA 914 *Recommended Practice for Fire Protection in Historic Structures*
- NFPA 550 *Guide to the Fire Safety Concepts Tree*

Other Publications

Alastair J.M. Aikman, and John F. Berndt. *Committee Paper on Automatic Sprinkler Protection in Buildings Regulated by the National Building Code of Canada*. NBC3-46. February 1987, p. 25.

Art Gallery Handbook Volume II. Toronto: Ontario Association of Art Galleries, 1991.

Statutes. Paris: International Council of Museums, 1990.

* NFPA publications can be purchased by calling the Canadian Association of Fire Chiefs at (613) 736-0576. They are also available by calling the NFPA at (800) 344-3355.

Appendix 1

Format For Recording Committee Meeting Minutes

[illegible]

M = Meeting number

I = Item number

Appendix 2
Fire Prevention Inspection Checklist

Fire Prevention Inspection Checklist

The following checklist should be used as a reminder during inspections. Items requiring corrective action should be reported on a *Notice of Fire Hazard* form.

☒ Satisfactory ☒ Correction required ☐ Not applicable

Exits

- ☐ All exit doors are unlocked when the museum is occupied.
- ☐ Fire doors not equipped with automatic door holders are kept closed.
- ☐ Evacuation routes are free and clear of obstructions and of combustible storage.
- ☐ Exterior emergency exit routes are clear and free of snow and ice.
- ☐ Exit signs are illuminated.

Fire protection equipment

- ☐ Emergency lighting units operate for at least 30 minutes when tested.
- ☐ Portable fire extinguishers are properly hung in place and are fully charged.
- ☐ A space of at least 45 cm (18 in.) is kept between sprinklers and materials.
- ☐ Fire hose cabinets are in good order, easily visible, and accessible.
- ☐ Fire detectors are free of obstructions and are not painted.
- ☐ Sprinkler valves are easily accessible.

Hazardous liquids

- ☐ Emergency measures are posted in case of accidental spills.
- ☐ Flammable/combustible liquids are kept in approved safety containers.
- ☐ Containers are stored in an approved cabinet.
- ☐ Safety storage cabinet vents are clear of obstructions.
- ☐ Soiled rags are kept in approved waste containers.
- ☐ Portable fire extinguishers are appropriate and in place.

Exhibits / Collections

- ☐ Exhibits and collections areas are not overcrowded.
- ☐ Exhibit case lights do not show signs of overheating.
- ☐ Exhibits are not blocking exit routes and/or access to fire protection equipment.
- ☐ Extension cords are grounded, are in good condition, and do not cause tripping hazards.

Housekeeping and storage

- ☐ Rubbish is not accumulated in excessive quantities.
- ☐ Storage areas are kept clean and orderly.
- ☐ Unprotected areas such as crawlspaces and attics are not used for storage.

Building changes since last inspection

- ☐ These changes do not interfere with emergency evacuation, fire detection and/or fire suppression equipment, nor do they constitute any particular fire risks.

Areas inspected:	
Inspected by:	
Date of inspection:	

- ☐ Items requiring action were recorded on a Notice of Fire Hazard form.

Appendix 3
Format For Recording and Reporting Hazards

Notice of Fire Hazard

Date reported :	File no.:
The following hazard was noticed:	
Area where hazard was noticed:	
Describe the fire potential:	
The following action is recommended:	
Reported to: (print name) _____	
Reported by: (print name) _____	

Appendix 4
Title Page of a Fire Safety Plan

Fire Safety Plan

Name and Address of Institution

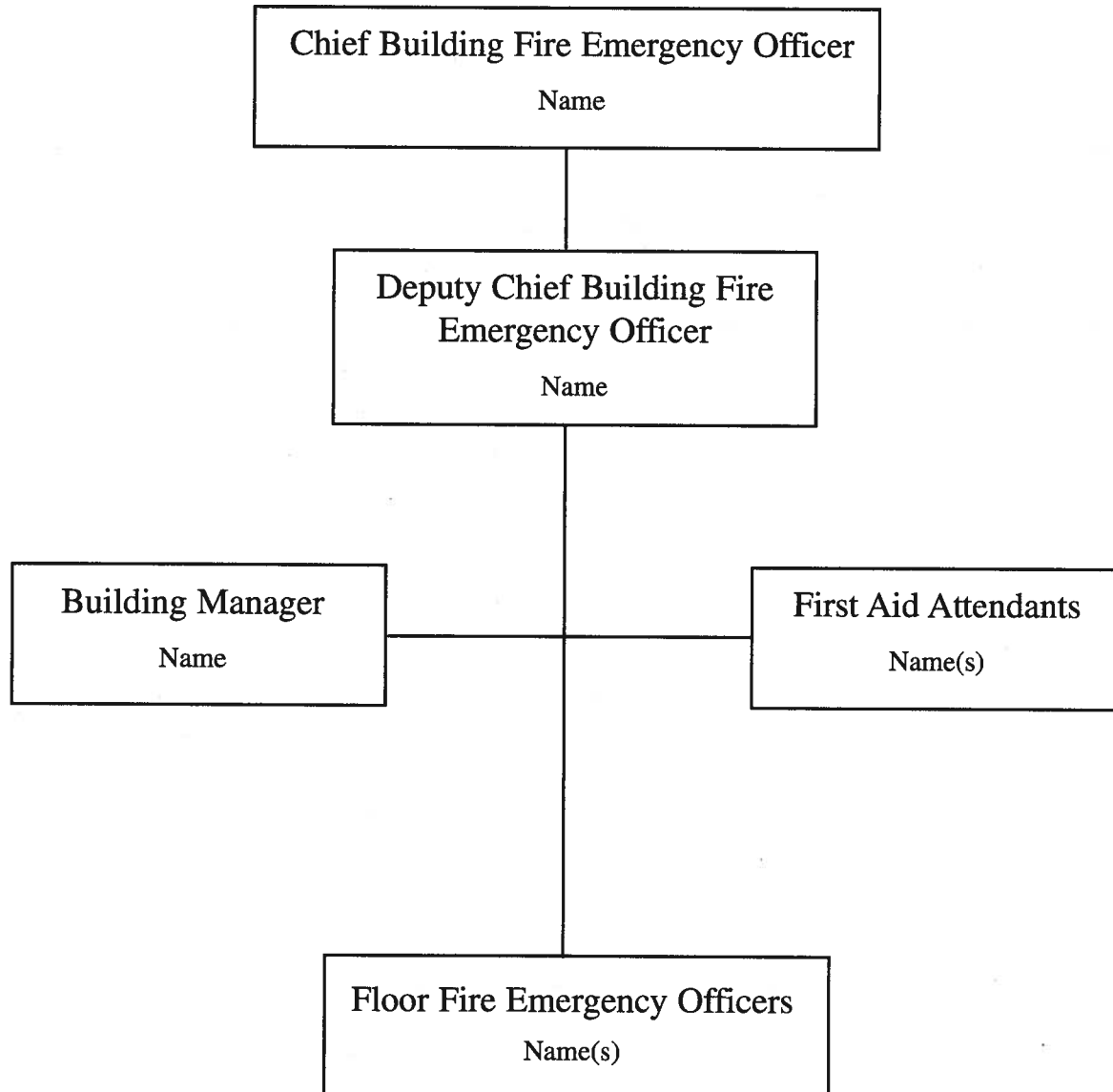
Approved by :

Employer representative	Employee representative	Fire department representative
name (print)	name (print)	name (print)
title	title	title
signature	signature	signature
date	date	date

Effective date:	
Next update:	

Appendix 5
Fire Emergency Organization Chart

Fire Emergency Organization



Appendix 6
Roles and Responsibilities of a Fire Emergency Organization

Fire Emergency Organization

Roles / Responsibilities

Chief building fire emergency officer (CBFEO)

Is in complete charge of the Fire Safety Plan and the specific responsibilities of the members of the Fire Emergency Organization.

Designates assistants to act in this position during any absence from the site.

Ensures that staff receive adequate training for using existing fire safety equipment, and for taking appropriate actions during emergency situations.

Ensures emergency response information sheets are made available at all times to fire fighters. Information sheets should show the following information on a floor plan: fire alarm zones, location of the fire alarm control panel, sprinkler control valves, main gas and main water valves, rooms holding hazardous materials, electrical room, and furnace room(s).

Ensures a fire inspection is conducted on a regular basis.

Deputy chief building fire emergency officer (DCBFEO)

Replaces the chief building fire emergency officer during any absence.

Floor fire emergency officers (FFEO)

Are responsible for life safety in their respective areas.

Ensure their area of responsibility is safely evacuated.

Take adequate training in the safe use of fire extinguishers.

Conduct fire protection inspections.

Report fire hazards immediately to the DCBFEO.

Building manager

Arranges regular fire alarm tests.

Ensures adequate servicing of all fire protection systems.

Checks portable radios and flashlights for serviceability once a month.

First aid attendants

Report to a pre-determined area outside the building.

Provide emergency care as required.

Employees, volunteers, visitors (all building occupants)

Follow direction from FFEOs.

Evacuate the building safely as directed.

Report to a pre-determined area outside the building.

Do not re-enter the building until authorized by FFEOs.

Report fire hazards to FFEOs.

Appendix 7
Format for Emergency Evacuation Procedures

Emergency Evacuation Procedures

When fire, smoke, or gas is discovered

Staff and volunteers

sound the fire alarm;
warn persons nearby;
call the Fire Department at _____ or 911;
close fire doors;
fight the fire only if safe to do so;
evacuate the building via a safe exit route and do not use elevators;
proceed to (predetermined area 30 m from the building) _____;
await re-entry until authorized.

The chief building fire emergency officer (CBFEO)

picks up a flashlight and portable radio;
turns the radio to channel _____;
checks each floor to ensure that evacuation of the museum is complete;
reports to the Building Control Centre;
controls the building emergency evacuation;
provides the status of evacuation to the fire fighter in charge;
reports problems to the fire fighter in charge.

The deputy building fire emergency officer (DCBFEO)

replaces the CBFEO if absent.

The floor fire emergency officers (FFEO)

pick up a yellow hard hat, flashlight, and portable radio;
turn portable radio to channel _____;
direct occupants to the nearest safe exit;
report to the CBFEO when respective areas are clear.

The fire department

responds to (predetermined area) _____;
receives vital information from the CBFEO;
assists with the evacuation of mobility-impaired persons (if time permits);
reports the situation to CBFEO;
authorizes occupants via the CBFEO to re-enter the building.

