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Using Shipping Containers for Record Storage Specification and Description

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1. INTRODUCTION

- 1.1 Building and maintaining a repository with environmental conditions appropriate for long-term record retention can be an expensive process, particularly in countries with tropical climates. Indeed, it can be a process that is beyond the financial means of some countries. This paper describes the process of using shipping containers as low-cost alternatives to more expensive permanent buildings. Shipping containers are readily available in most countries, and can be acquired, established and maintained relatively cheaply.
- 1.2 Regardless of the type of facility used, it must protect the records stored within it from dust and other contaminants. In addition, repositories in tropical environments must also protect the records from the effects of:
 - high temperature and relative humidity levels;
 - salty sea air;
 - high levels of rainfall;
 - cyclones (hurricanes or typhoons), storms and lightning strikes; and
 - pest infestations.
- 1.3 If properly treated and maintained, a shipping container can go some way towards protecting the records stored within it.
- 1.4 While this paper proposes the use of shipping containers as alternatives to purpose-built repositories, such containers should not be regarded as lesser facilities. When a shipping container is used to house records of archival value, it should be treated accordingly. If it looks the part – for example, is kept clear of vegetation or rubbish, and is fenced and signposted – it is likely that it will be respected as a bona fide repository by both staff and visitors. To illustrate this point, the photographs in Attachment 1 show a shipping container in Kiribati that has not been well protected and subsequently been subject to vandalism.

2. SHIPPING CONTAINERS

General description

2.1 Precise details concerning container dimensions and types can be found in the Australian and New Zealand Standard AS/NZS 3711.1-9 *Freight containers*.

Dimensions - External

2.2 Containers are generally made from mild steel. They are commonly identified by their length, which is usually given in feet rather than metres. Usually they are 8 ft (2.40 m) wide and the same height, although some containers are 8 ft 6 in (2.55 m) high. Container lengths vary - they can be 9 ft (2.7 m), 20 ft (6 m), 30 ft (9 m) or 40 ft (12 m) long. However, the most common length is 20 ft (6 m).

Dimensions - Internal

2.3 A standard 20-ft container has the following internal dimensions:

- Height 2,159 mm (if 8 ft high, or 2,309 mm if 8ft 6 in high)
- Width 2,330 mm
- Length 5,867 mm

Container types

2.4 There are different types of shipping containers. The major ones, identified by their Australian Standard code number, are as follows:

- **General purpose container** (code 00) - totally enclosed and weather-proof, having a rigid roof, side walls, end walls and a floor, with doors at one end.
- **Closed ventilated container** - similar to a general purpose container, but specifically designed for transporting cargo where ventilation, either natural or forced is necessary. There are two types - containers with natural ventilation (code 9) and containers with mechanical ventilation (code 15).
- **Thermal containers** - built with insulating walls, doors, floor and roof. There are different types:

- insulated containers that rely on built-in insulation and do not use mechanical devices for cooling or heating (code 20 or 21);
 - refrigerated containers that use an expendable refrigerant such as ice, dry ice or liquefied gas as the coolant rather than any external power source (code 30);
 - mechanically refrigerated containers that use a powered refrigeration unit (code 31); and
 - refrigerated and heated containers that use a combined refrigeration and heating unit (code 32).
- 2.5 An empty general-purpose container weighs about 2.3 tonnes (5,000 pounds) while an empty mechanically refrigerated container weighs about 2.7 tonnes (6,000 pounds).
- 2.6 A mechanically refrigerated model will, of course, make it easier to maintain desirable environmental conditions. However, these models are more expensive to purchase, operate and maintain, particularly in regions where power supplies are erratic. The buyer must also be sure the container is in good condition. It may be that the refrigeration unit has been poorly maintained in the past and will not last for long. If in doubt about the refrigeration unit, it is better to choose a non-refrigerated one.
- 2.7 This specification assumes that an insulated or a general-purpose container is being used, with some form of additional insulating material then being applied. This is a cheaper alternative than using a mechanically refrigerated model. It also recognises that some countries may not have reliable electricity supplies, and the use of containers to establish and maintain a passive internal environment is essential.
- 2.8 Purchasing a used and insulated, but not airconditioned, container in Australia costs about AUD\$3,800.

3. ACQUIRING THE CONTAINER

- 3.1 When a container is being assessed for purchase, it should be inspected thoroughly to ensure it is in good condition. There should be no rust, gaps or leaks. The doors should be checked to ensure they move freely and form a reasonably tight seal when

closed. The container must sustain a sealed internal environment to ensure stable conditions and to protect against the intrusion of rain, dirt and dust, insects and other pests.

- 3.2 It is easy to tell whether the container has any leaks by the amount of daylight entering the container when its doors are closed. Of course, it is preferable that the inspection be undertaken on a bright, sunny day.
- 3.3 Apart from the purchase cost, there will also be expenses associated with transporting the container to its new location and placing it in position.

4. PREPARING THE SITE

- 4.1 The site chosen for the container should be level with good drainage (eg, gutters or ditches) so that water flows away from it quickly. The container should not be located next to creeks or rivers that are likely to flood, nor should it be near exposed stormwater drains. If it is located on or near the coast, it should be sited well clear of the shoreline. This will ensure protection against a king tide or a storm surge in the aftermath of a cyclone.
- 4.2 The site should be thoroughly inspected for any evidence of pests (particularly termites) and should be treated before the container is placed in position. Any vegetation, including tree stumps, should be removed and the site kept free of vegetation at all times. Ideally, the surrounding area should be paved or concreted.
- 4.3 The site should be secured. A chainwire fence about 2 m (6 to 7 ft) high is ideal, along with a set of double gates for vehicle access. The container itself should be locked. Remember, the container is housing valuable records and should be secured accordingly.
- 4.4 The container should be located on piers or blocks (bricks or concrete) and not on the ground. Ant cappings should also be used on each pier. Elevating the container will enable greater air circulation underneath and will also reduce the possibility that rodents, snakes or other pests may nest there. The space between the container and the ground should be fenced with chicken wire. It should also be remembered that the total weight of a fully laden container could be in excess of seven or eight tonnes, and this needs to be taken into consideration when designing the piers.
- 4.5 The container's long axis should be oriented east to west to minimise the effects of the western afternoon sun. The entrance

should face away from the direction from which wind and storms normally come.

- 4.6 The entrance should be protected from the elements. A reasonably sized bullnose verandah would be very helpful in this respect, as would a decent external floor and a quality mat to help keep dirt and dust from being tracked into the container.
- 4.7 Containers generally do not have internal lighting and several light fittings may have to be installed. It is also possible to use emergency lights with in-built Ni-Cd (nickel-cadmium) batteries that charge when the power is available as normal lights in the building. An alternate solution is simply to use torches.
- 4.8 One problem is that every time a container is opened its environmental conditions are affected. The doors on a typical container are generally heavy and cumbersome, and opening and closing them takes time. Ideally it would be preferable to install an airlock inside the container or have a small sealed facility outside. This facility would need to be sealed or airconditioned and this would add to the installation and running costs. If these options are considered too expensive, at the very least access to the container should be kept to an absolute minimum. If possible, access should be restricted to set times during the day.
- 4.9 The container should be covered by a roof (eg, a carport-type structure) to protect it from the effects of the sun and the rain. The roof should be tilted (not flat) to ensure rapid rainwater runoff. The roof covering can be made from steel (such as *Colorbond*TM) or plastic. Examples of the latter include *Alsynite*TM (made from polyester) or *Laserlite*TM (made from polycarbonate). The photographs in Attachment 2 illustrate the type of roof structure that could be used.
- 4.10 The roof structure should extend past all sides of the container by at least 900 mm (3 ft) to provide further protection. The roof water and surface run-off should be directed away from the container, either by gutters or ditches.
- 4.11 There should be a gap of about 800 mm (2.5 ft) between the roof structure and the container to allow air to circulate between the two. In addition, 'whirlybird' ventilators can be installed on the top of the container. The Australian company Insulco produces inexpensive ventilators to meet the Australian cyclone code. If ventilators are installed, particular attention should be paid to sealing any gaps to prevent intrusion by water or dust.

- 4.12 A cheaper alternative for a roof structure is a tarpaulin. However, if a tarpaulin is used, it should be stretched above the container, not simply draped over it. It should be noted that a tarpaulin would probably be blown away in a cyclone.
- 4.13 If a general-purpose container is used rather than an insulated one, the exterior walls and roof should be coated with a highly insulating material.
- 4.14 It is, however, preferable to use both a canopy and an insulating coating.
- 4.15 When a mechanically refrigerated unit or powered lighting is to be used, it will be necessary to establish a connection to the local power supply.
- 4.16 Given the weight of a fully laden container, it is unlikely that it will move during a cyclone. It might, however, be pushed off its support blocks. Recently in Western Australia a number of people sheltered safely in an empty container during a category 5 cyclone (the strongest in terms of wind velocity). The container was unaffected by the cyclone.

5. STORAGE CAPACITY OF SHIPPING CONTAINERS

- 5.1 A standard 20-ft container has an internal storage capacity of 29.50 cubic metres. What will be achieved in terms of linear storage is dependent on how efficiently the boxes are arranged. A balance will need to be struck between maximum storage capacity, ease of access and retrieval, and good ventilation.
- 5.2 It is assumed that the boxes used will conform to the dimensions of a National Archives' standard type 1 box (ie, 390 mm x 260 mm x 180 mm).
- 5.3 Boxes should ideally be placed on shelving or racking and not simply stacked on top of each other. While it is possible to stack them seven or eight high, there is always the risk that the bottom layers will be crushed under the weight. If this method has to be adopted thick layers of cardboard across each level should be used in order to distribute the weight. The benefit from not using racking means that a larger number of boxes can be stored cheaply. The disadvantage is that should access be required to a particular box - for example, the box on the bottom level - the set up will have to be dismantled to gain access to that box.

- 5.4 Using standard racking, boxes can be stacked in the following manner:

Height (bottom to top)

- Stacking the boxes on individual shelves will give seven layers with a height of 260 mm for each layer. However, if a container 8 ft 6 in high is used, boxes could be stacked eight high. These heights allow sufficient space for the boxes, racking and ventilation.

Length (front to back)

- Stacking the boxes lengthwise from the front to the back of the container will allow the placement of 30 boxes side-by-side, as they are 180 mm wide. Again, this allows sufficient space for shelf supports and ventilation.

Width (left to right)

- If a 770 mm-wide aisle is included down the centre of the container, from the front to the back, there will be sufficient space to provide two rows of shelving – one on the left and one on the right. Given that individual boxes are 390 mm deep, each row would then be two boxes deep (with one being placed behind the other).

- 5.5 Using an 8 ft-high container, it is possible to achieve a storage capacity of 840 boxes or 151 shelf metres. Using an 8 ft 6 in-high container, it is possible to achieve a storage capacity of 960 boxes or 173 linear metres.

- 5.6 Once again, regardless of how the boxes are arranged, sufficient clearance between the boxes and the container walls must be provided for ventilation.

6. CONTROLLING PESTS

- 6.1 As boxes are brought into the container they should be inspected to ensure there is no evidence of damp, mould or pest infestations. Otherwise, a problem could easily be imported.
- 6.2 Once established, boxes of moisture-absorbing crystals such as *Damp Rid*[™] or *Closet Camel*[™] should be placed inside the container to help keep excess moisture under control. Baits and blunder traps should also be included for insects and other pests.

- 6.3 These items should be checked regularly and replaced when necessary.

7. CONTROLLING ENVIRONMENTAL CONDITIONS

- 7.1 The biggest environmental issue for record storage in the tropics is mould, whose growth is encouraged by the high levels of humidity. Reasonable temperatures can be maintained within a container if it is shielded from direct sunlight and there is good airflow around and through it using ventilators, as suggested in paragraph 4.11.
- 7.2 A mechanically refrigerated (airconditioned) container will keep the temperature lower and reduce humidity levels. Such a unit is, however, more expensive to purchase and operate than non-airconditioned ones. Another negative side effect is that condensation may occur when the warm moist air from outside the container comes into contact with the internal cooled metal surfaces.
- 7.3 Mechanical refrigeration draws significant levels of electricity. This can cause unacceptable voltage drops on electrical supply lines that are not adequately sized for it.
- 7.4 Portable dehumidifiers can help control humidity levels. They require less power to operate than mechanically refrigerated units but it is necessary to empty their condensate containers at regular intervals.

8. MONITORING ENVIRONMENTAL CONDITIONS

- 8.1 Environmental conditions within the container should be monitored regularly. This can be done in a number of ways.
- 8.2 Portable electronic data loggers can be used. Only one or two would be needed. They are powered by a lithium battery and can monitor conditions without interruption for over a year. The results can then be downloaded to a computer system.
- 8.3 Older style thermohygrographs can also be used but they need to be monitored more closely, with readings noted and the graph paper replaced.

9. FIRE PREVENTION

- 9.1 As previously stated, the site should be kept clear of vegetation and leaves (as stated previously), as should the roof structure.
- 9.2 If mains water supply is available, a hose point and a hose might be provided. Hand pressurised water type fire extinguishers should also be provided.

10. STEPS IN SETTING UP A SHIPPING CONTAINER FOR RECORDS STORAGE

1. Select the site ensure it is reasonably flat and safe from flooding (paragraph 4.1)
2. Secure the site install fencing and gates (paragraph 4.3)
3. Prepare the site clear away all vegetation, including tree stumps (paragraph 4.2); spray the site for pests (paragraph 4.2); install blocks or a concrete base (paragraph 4.4)
4. Select the container ensure it is in good condition, there are no rust or holes and the doors move freely (paragraphs 3.1–3.2)
5. Have the container delivered and placed in position paint the container, install ventilators; patch any holes (paragraph 4.11, 4.13)
6. Associated works install a canopy above the container (paragraph 4.9–4.12); install steps or verandah (paragraph 4.6); install shelving (paragraph 5.3); install lighting (paragraph 4.7)
7. Introduce records check for evidence of mould or insect pests first (paragraph 6.1)
8. Control pests provide baits and traps (paragraph 6.2)
9. Monitor environmental conditions install dataloggers or thermohygrographs, portable dehumidifiers and moisture absorbing crystals (paragraphs 6.2 and 7.4)

11. ATTACHMENTS

11.1 Attachment 1 shows a shipping container damaged by vandals.

11.2 Attachment 2 shows a roof structure that could be added when converting a shipping container into a record storage unit.

11.3 Attachment 3 is a set of three drawings that illustrate the way in which a shipping container should be established for record storage:

- Drawing 1 Site Plan
- Drawing 2 Side Elevation
- Drawing 3 Front View

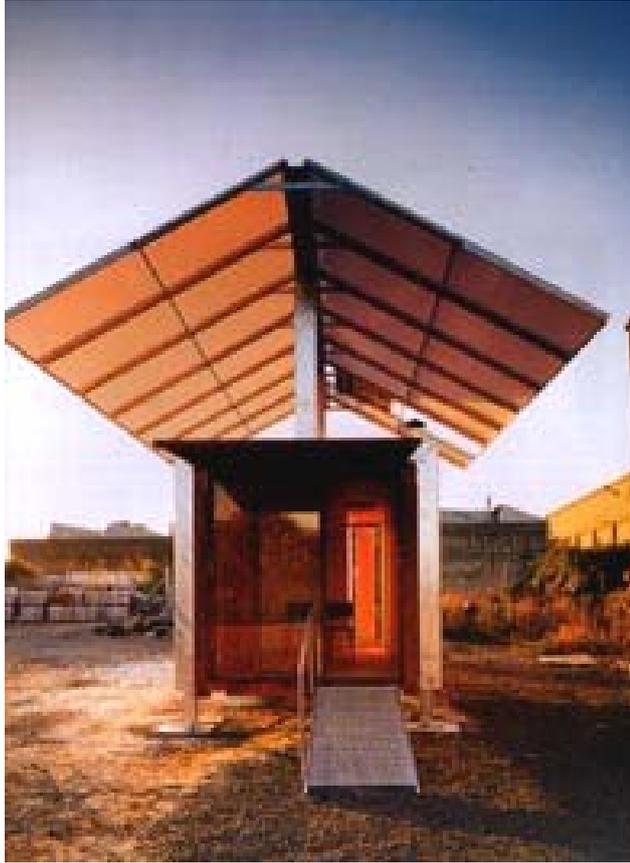
ATTACHMENT 1

KIRIBATI SHIPPING CONTAINER SUBJECTED TO VANDALISM



ATTACHMENT 2

ROOF STRUCTURES FOR SHIPPING CONTAINERS USED TO STORE RECORDS



These photographs illustrate the type of roof structure that could be used in conjunction with a shipping container (Photographs taken by Earl Carter, on behalf of Sean Godsell; reproduced with permission)





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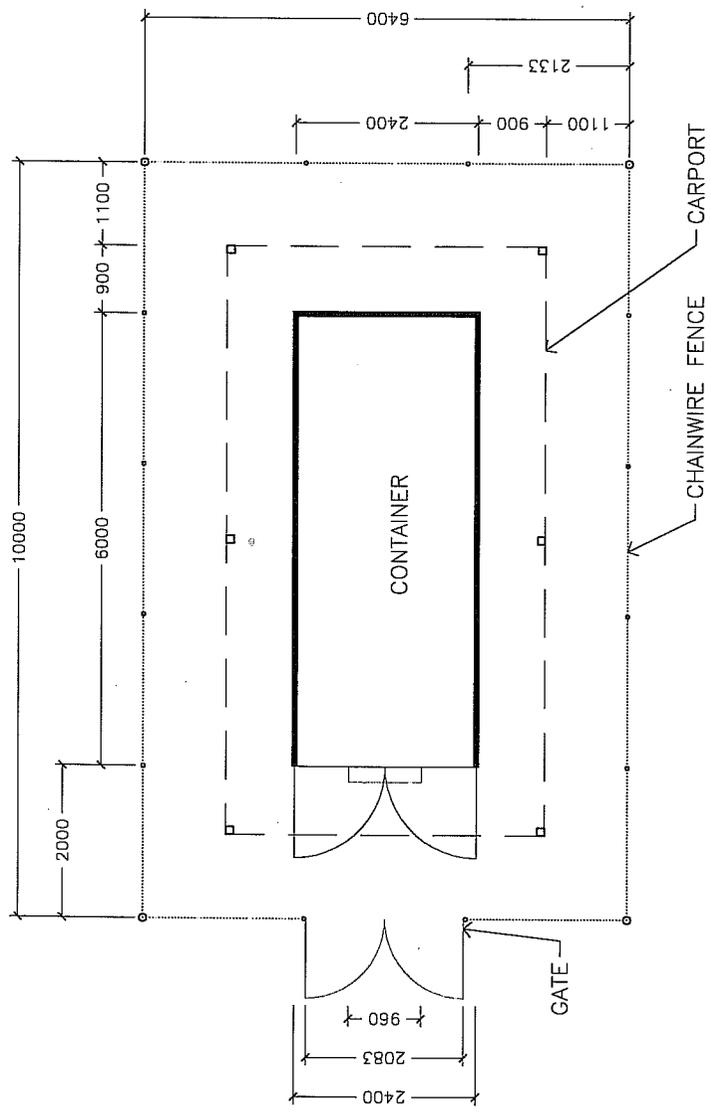
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 Drawn: P. BROOKS
 Checked & Approved: P. BROOKS
 Verified: _____ Date: _____

Project: NATIONAL ARCHIVES OF AUSTRALIA

Drawing Type: SITE PLAN

Content/Title: SHIPPING CONTAINER

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	Amend



01 SITE PLAN



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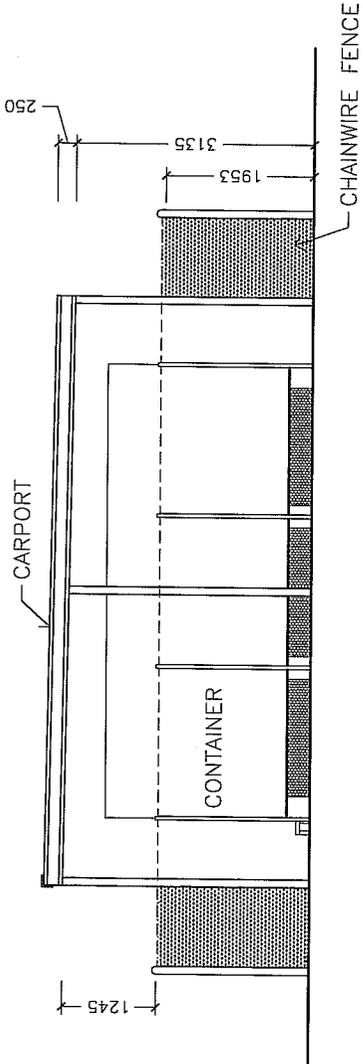
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Drawing Type: SIDE ELEVATION
 Content/Title: SHIPPING CONTAINER

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02 ELEVATION



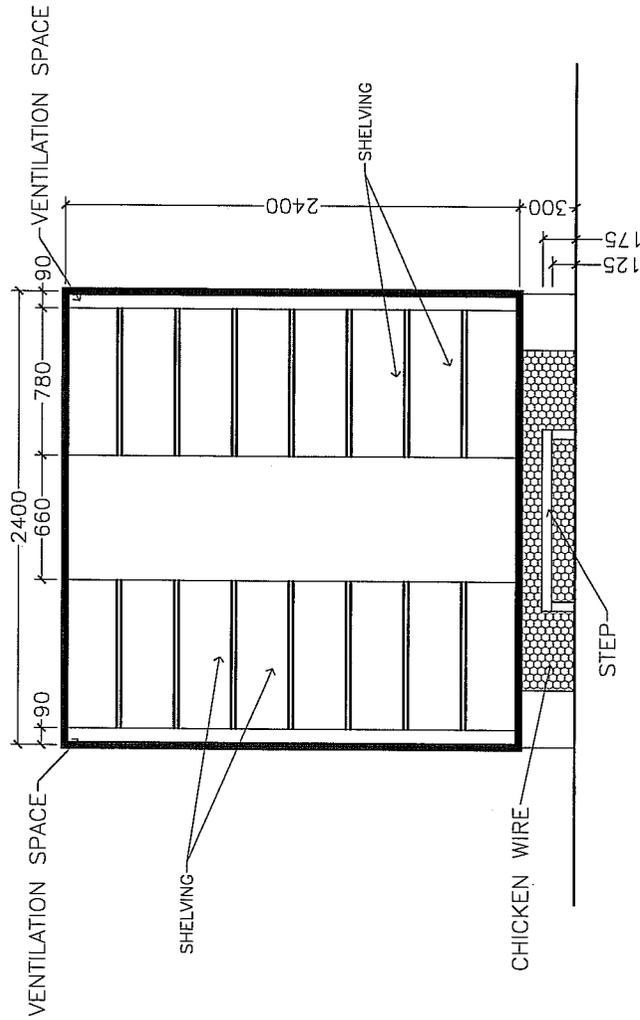
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 Designer: P. BROOKS
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 Scale: _____
 Date: _____

Project: NATIONAL ARCHIVES OF AUSTRALIA
 Drawing Type: FRONT VIEW

Contents/Title: SHIPPING CONTAINER

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Scale: 1:20		Checked By:	
Job No. NAA-03		Approved:	03



03 FRONT VIEW, DOORS OPEN SHELVING IN PLACE