



# Operating and Maintenance Specification for LLWR IP-2 Package Design TC05

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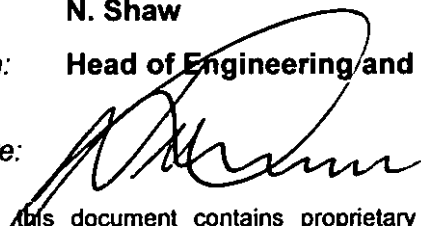
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## **Glossary of Terms and Definitions**

Within the specification the following definitions apply:

<b>ACEP</b>	Approved Continuous Examination Programme in compliance with the International Convention for Safe Containers
<b>ADR</b>	European Agreement concerning the carriage of Dangerous Goods by Road
<b>Approving Authority</b>	LLWR Package Approval Authority is responsible for the issue of Certificates of Approval for IAEA self assessment package types on behalf of the Contract Authority
<b>CFA</b>	Condition For Acceptance.(Consignee)
<b>Container Operator</b>	Owner of the Container
<b>Contract Authority</b>	LLW Repository Ltd
<b>Consignor</b>	Consignor according to the provisions of ADR
<b>CSC</b>	(International) Convention for Safe Containers
<b>DGSA</b>	Dangerous Goods Safety Advisor
<b>Design Authority</b>	Head of Engineering LLW Repository Ltd., Holmrook, Cumbria
<b>LLWR</b>	Site of the National Low Level Waste Repository
<b>EIM&amp;T</b>	Examination, Inspection, Maintenance and Testing.
<b>HP</b>	Health Physics
<b>HSE</b>	Health and Safety Executive
<b>IAEA</b>	International Atomic Energy Agency
<b>Industrial Package</b>	A packaging, tank or freight container containing LSA material or surface contaminated object (SCO).
<b>Inspection Authority</b>	An Inspection organisation approved by the Health & Safety Executive to approve designs as meeting ISO and CSC requirements.
<b>IP-2</b>	Industrial Package Type 2
<b>ISO</b>	International Standards Organisation
<b>Lifting Features</b>	Integral load features specially designed for lifting, such trunnions hoists, cast lugs, plain holes and screwed holes.
<b>LLW</b>	Low Level Waste

LQR	Lifetime Quality Record.
LSA	Low Specific Activity
MPI	Magnetic Particle Inspection
MQP	Maintenance Quality Plan
NDT	Non-Destructive Testing
Off-site Package	Packages designed to IAEA standards for operations for both on and off nuclear sites.
OI	Operating Instructions
O&M	Operating & Maintenance
OQP	Operational Quality Plan
Package	The packaging with its radioactive contents as presented for transport
PES	Periodic Examination Scheme in compliance with the International Convention for Safe Containers
RAM	Radioactive Material.
SCO	Surface Contaminated Object
SQEP	Suitably Qualified and Experienced Person

## 1 Introduction

This document provides the Relevant Parties (Consignors & Consignees, Maintenance & Inspection) guidance regarding the O&M requirements for the LLW Repository Ltd IP-2 Package Design TC05.

The package is designed for the transport and disposal of radioactive material in the form of LLW conforming to LSA or SCO material as defined in the IAEA Safety Standard Series TS-R-1, Regulations for the Safe Transport of Radioactive Material, 2009 edition [1]. Primarily the package is to be used to transport compactable, solid, low level waste arising from UK Consignors facilities to the Waste Monitoring and Compaction Facility at Sellafield. The explicit use and restrictions of the packaging are defined in the Certificate of Approval issued by the LLWR Package Approval Authority. If the package is to be consigned to an alternative facility, the requirements are to be submitted to the Approving Authority for review and acceptance prior to loading.

These packing and handling instructions detail the handling methods, pre-filling checks, loading procedure, pre-shipment checks, maintenance and examination requirements applicable to the containers designed for the transport and disposal of radio active waste .

**Permission must be sought from the Contract Authority in writing in the event of any/all of the following,**

- **An application for a operational concession.**
- **An application to use one of the options as listed on tables 2 & 4.**

**Note: Where it is found that any part of the Packing and Handling Instructions cannot be complied with the package shall be embargoed and advice shall be sought from the Contract Authority to allow the shipment to continue.**

*Contract Authority Contact Details:-  
[transportandlogistics@llwrsite.com](mailto:transportandlogistics@llwrsite.com)*

### **Temperature Range**

During routine conditions of transport it has been assumed for the purposes of design that the package will be operated within an ambient temperature range of  $-10^{\circ}\text{C}$  to  $+38^{\circ}\text{C}$

## 2 Scope

This document identifies the design intent for the Operating and Maintenance of the package and is to be used as an aid to producing detailed Operating and Maintenance Instructions. It provides an outline of the O&M tasks to be carried out at specified intervals together with the acceptance requirements that must be satisfied. Adherence to the O&M regime will ensure the equipment remains in a serviceable and safe condition to meet the design parameters and maintain regulatory compliance within the safety justification.

The O&M guidance addresses the following issues: -

- a) Package handling operations including turn-round maintenance, to be carried out as required at loading and unloading and consisting of minor tasks only, which can be carried out by the operational staff, under the Operational Quality Plan (OQP).
- b) Planned maintenance and frequency. As performed by maintenance in accordance with a Maintenance Quality Plan (MQP).
- c) Acceptance criteria requirements (norms and tests).

**NOTE:**

No Maintenance Instructions, Maintenance Quality Plans or Operational Quality Plans are to be produced from information detailed within this document without consultation with the Contract Authority

### **3 Compliance**

The Consignor is responsible for ensuring that Regulatory requirements governing the use of the package are complied with.

### **4 Responsibilities**

It is the responsibility of the Consignor to ensure that:-

- All local and regulatory requirements governing radioactive materials and transport packages are complied with.
- Reference is made to the Certificate of Approval for the container which identifies information on approved contents and other shipment and operating requirements.
- Personnel associated with filling, closing, loading and handling the container must carry out the required operations as quickly as practicable without compromising safety, in order to minimise personal radiation dose.

### **5 Package Description**

The package is uniquely identified by the LLW Repository Ltd IP-2 package design number TC05(formally known as the 0075) but it is also known and commonly referred to as an ISO skip. The package is essentially an undersize ISO freight container, which is primarily designed to transport compactable, solid, low level, waste in loose or bagged forms from UK Consignors facilities by road and/or rail to the Waste Monitoring and Compaction Facility at Sellafield and alternative facilities.

As noted in the introduction (section 1) If the package is to be consigned to an alternative facility, the requirements are to be submitted to the Approving Authority for review and acceptance prior to loading.

The package measures 3.40 m x 1.95 m x 1.74 m high and consists of a dry, undersize, ISO freight container of all-welded, carbon steel, construction. One end of the container has a door, which is hinged at the top and extends the full height and width of the container. This door is known as the tipping door and is used for emptying the contents into a suitable facility using a special purpose skip handling vehicle. The container has two loading hatches, one that is incorporated into the tipping door and one mounted in the opposite end wall. Each loading hatch features an outer bottom hinged door and a

pair of inner, side hinged doors. The container also has a top lidded opening that can also be used for loading the container.

**Note:-**

**Consignors are restricted to using the two loading hatches. If any other openings for loading are required then permission must be obtained in writing from the Contract Authority.**

To aid final disposal of the container to the LLWR at the end of its useful life, the container is fitted with a grout and ventilation port.

Key features of the package are shown in Figure 1.

The container complies with BS 3951 (ISO 1496/1) [2] except with respect to its size and rating and it is approved under the International Convention for Safe Containers (CSC) [3].

**6 Consignor Pre-loading Checks**

Ref	Container Opening	CONTRACT AUTHORITY Permission Required To Open		Acceptance Criteria
		No	YES	
1	Lid		✓	8 & 8.4
2	Tipper Door		✓	8
3	End Loading Hatches	✓		8.3
4	Inner Hatch Doors	✓		8.6

**Table 1: Container Openings**

**6.1 General**

The container should be in a “sound” condition before being used and as a minimum the checks detailed below are designed to ensure that the container is fit for use. All inspections must be carried out by a Suitably Qualified and Experienced Person (SQEP). If any significant damage is found it must be reported. Confirmation that all the following inspections have been carried out must be recorded, signed and dated by the person performing the operations on an OQP.

**6.2 Certificate of Approval**

The package certificate of approval for transport issued by the Approving Authority must be checked to ensure it is valid and will remain valid throughout the period during which the package is to be transported in the public domain.

## 6.3 Container Body, Door, Lid and Hatches

### 6.3.1 Visual inspection

#### **WARNING:-**

**INSPECTION OF THE CONTAINER BASE SHOULD BE CARRIED OUT FROM THE SIDE OF THE CONTAINER (DO NOT WORK UNDER THE CONTAINER).**

Visually examine all the external surfaces (including the base) of the container for signs of damage.

#### External Examination Acceptance Criteria

- i) Cracking of welded joints is unacceptable
- ii) Puncturing of the container body, tipping door, lid or hatches is unacceptable
- iii) Cuts or scratches in the container skin greater than 1.5 mm deep are unacceptable
- iv) Small dents are acceptable (less than 35 mm depth in container, door, lid and hatch panels, and less than 25 mm depth in corner posts), provided that no puncturing of the skin or distortion of the sealing faces has taken place

#### Internal Examination Acceptance Criteria

Visually examine the package internals for signs of damage and cleanliness. There shall be no visible mechanical damage other than that permitted above.

Visually examine lifting and tie-down features. There shall be no visible mechanical damage, corrosion, deformation, change in section, or cracks evident in the main body/welds of any lifting or tie-down features.

There shall be no water present in the container.

### 6.3.2 CSC (Safety Approval) Plate

The CSC safety approval plate must be checked to verify that the Container is in date i.e. within 5 years of the date of manufacture. Where the CSC plate is found to have expired, confirm that a valid ACEP decal is displayed adjacent to the CSC plate and the date the next examination is due is valid. Re-inspection and re-plating will be required if the period of validity has expired prior to filling or consignment. The Contract Authority Quality Group is to be contacted regarding Container re-inspections.

### 6.3.3 Decals

All decals must be legible and securely affixed to the container body.

### 6.3.4 Paint Finish

The external paint finish must be checked for damage/corrosion. Minor scuffing of the paint finish is acceptable but there shall no exposed bare metal. Any exposed bare metal should be reported to the Contract Authority.

#### 6.4 Tipping Door and Hatches (Including inner hatch doors)

Examine the clamps, hinges and mechanical locking mechanisms for damage ensuring that:

- all welds are free from defect;
- all clamps are present and undamaged;
- all clamp stud bolt/receiver threads are undamaged and the associated fastener can be freely rotated by hand once loosened;
- the mechanical latching mechanisms on the tipping door and inner hatch doors are functioning correctly;
- all hinge assemblies including the tipping door latching hinge pins are lubricated, pivot freely and show no signs of corrosion, damage, excessive wear or fatigue, and:
- all doors seat correctly

#### 6.5 Seals and Sealing faces

6.5.1 Particular attention should be given to checking the seals, the features that secure the seals to the container, and the mating sealing faces. The seals and sealing faces should be clean and free from damage or debris. If any damage is found on the sealing faces repairs must be carried out as required in accordance with 15.2.1. If a seal is found to be damaged it must be replaced in accordance with 15.4.

6.5.2 A light surface coating of silicon based grease must be maintained on the seal surface and there must be no signs of age or radiation hardening of the seal.

#### 6.6 Vent and Grout Ports

The vent port (See Figure 1), which is located in the container side panel must be sealed prior to shipment. See Section 9.4.

The grout port (See Figure 1), which is located on the container lid is closed and sealed when the container is supplied. This port is only used once the container arrives at the LLWR for final disposal. The grout port must remain sealed prior to shipment. See Section 9.2.

## 7 Package Handling Operations

It is a regulatory requirement to have in place an adequate safety case to demonstrate the safety of any operation concerning the handling of packages used to move radioactive material on licensed sites. Before consigning the TC05 package any users of this package must be reminded that in support of the safety case an OQP along with detailed operating instructions and operating rules shall be developed. Compliance should be demonstrated by a suitable QA system.

The detailed operating instructions referenced above shall consider all operational hazards and limits such as:

- Package inventory
- Package lift height
- Package payload size, weight, SWL, etc.
- Package radiation and contamination levels.

Table 2 shows the main activities required to be addressed for the Package for safe handling during turn-round.

Package Handling Activity	Reference Docs. (OQP's, OI's, EI's CFA etc)
1. Package Receipt	OQP, OI & CFA
2. Package Preparation Unloading Including Turn-round Maintenance (see Section 10)	OQP, OI
3. Package Preparation Loading Including Turn-round Maintenance (see Section 6)	OQP, OI
4. Package Preparation For Dispatch (see Section 9)	OQP, OI, EI & CFA

**Table 2: Package Handling Activities**

## 7.1 Package Handling Methods

### 7.1.1 General

The package is an undersize ISO freight container generally conforming to BS 3951 (ISO 1496/1) [2] and features ISO type corner fittings and forklift pockets. The recommended handling methods, which comply with BS ISO 3874 [4] are detailed below.

The package is also fitted with two pairs of removable lifting trunnions which are used when the package is being handled by a skip handling vehicle.

All facilities receiving the TC05 must in the first instance receive permission from the Contract Authority. When the trunnions are to be used it must be recognised that the maximum gross weight of the package is limited to 8 tonnes.

#### **WARNING:**

**BEFORE COMMENCING LIFTING OPERATIONS THE OPERATOR MUST ENSURE THAT:**

- **THE SKIP AND ITS LIFTING FEATURES ARE STRUCTURALLY SOUND; AND,**
- **ALL HANDLING/LIFTING EQUIPMENT IS SUITABLY RATED TO HANDLE THE PACKAGE SAFELY. SEE APPENDIX A FOR RELEVANT MASS INFORMATION APPLYING TO THE CONTAINER DESIGN.**

#### **CAUTION:**

**Before any lifting is carried out, the container must be free to be lifted by ensuring that the twistlock mechanisms that secure the package to the transport trailer are unlocked from the container.**

The TCO5 design when loaded must only be transported on skip handling vehicles fitted with a minimum of 2 ISO type twist lock restraints fitted diagonally opposite each other. If there are only 2 ISO type twist lock restraints fitted at one end then the opposite end must be restrained vertically down..

Ref	Method of Handling	Contract Authority Permission Not Required	Contract Authority Permission Required	Criteria Ref
1.	Lifting Using a Fork Lift Truck	✓		7.1.2
2.	Lifting Using ISO Bottom Corner Fittings	✓		7.1.3
3.	Lifting Using Top Fittings	✓		7.1.4
4.	Lifting Using Trunnions		✓	7.1.5
5.	Maximum Stacking Height	✓		7.1.6
6.	Transport tie-down	✓		7.1.7

**Table 3: Package Handling Methods**

### 7.1.2 *Lifting using a Fork Lift Truck*

**WARNING:**

**THE PACKAGE MUST ONLY BE LIFTED WITH THE LIFTING FORKS ALIGNED AND FULLY INSERTED.**

This method of lifting is the preferred method of lifting the package during routine handling operations. Forklift pockets, which are rated for the gross weight of the package, are an integral feature of the package base structure. Figure 2 shows the correct configuration of forklift and skip.

### 7.1.3 *Lifting Using ISO Bottom Corner Fittings*

**CAUTION:**

**The container width is less than the ISO standard width. Therefore a non-standard, package specific, top beam is required.**

This method of lifting usually employs a four-leg wire or chain sling fixed to a top beam which spans the container width as shown in Figure 3. When each leg is attached to the bottom fittings the container can be lifted. This method of lifting can be used to lift both the loaded and empty skip with suitably rated equipment.

### 7.1.4 *Lifting Using Top Fittings*

**CAUTION:**

**The ISO corner positions do not conform with the standard ISO centre to centre dimensions. Therefore a non-standard, package specific, lifting frame is required.**

**CAUTION:**

**The use of a four-leg sling from the top corner fittings is NOT suitable for lifting the package (i.e. container plus contents) although this lifting method can be used to lift the empty container if required.**

This method of lifting requires a spreader frame (See Figure 4) designed to ensure that only a vertical lift is applied to the top corner twistlock fittings. The attachment to the corner fitting must be as shown in Figure 4. This method of lifting is suitable for use on both loaded and empty containers.

#### 7.1.5 *Lifting using Trunnions*

**WARNING:**

**BEFORE USING THE TRUNNIONS THEY MUST BE CHECKED TO ENSURE THAT THEY ARE UNDAMAGED, CORRECTLY FITTED AND SECURED IN PLACE AS SHOWN IN Figure 6**

**WARNING:**

**ALL FOUR TRUNNIONS MUST BE USED SIMULTANEOUSLY.**

**WARNING:**

**THE TRUNNIONS MUST NOT BE USED WHEN THE GROSS MASS OF THE SKIP EXCEEDS 8000 KG.**

**CAUTION:**

**It may be necessary on some skip handling vehicles to remove the front chocks to achieve the necessary clearances for handling the skip.**

**CAUTION:**

**Where the skip is to be emptied via the tipping door into a suitable facility, this operation can only be carried out using a 'special purpose' skip handling vehicle to be accepted by the Contract Authority**

The ISO skip is fitted with two pairs of removable lifting trunnions. It is the design intent that when the ISO skip is being used to transport compactable waste on the Sellafield site it will be routinely handled (i.e. lifted and transported) using an existing fleet of skip handling vehicles which utilise the four lifting trunnions. This lifting arrangement is shown in Figure 5.

#### 7.1.6 *Maximum Stacking Height*

**WARNING:**

**THE GROUND UPON WHICH THE PACKAGES ARE TO BE STACKED MUST BE FLAT AND LEVEL AND SHOWN TO BE CAPABLE OF TAKING THE ACCUMULATED GROSS WEIGHT OF THE CONTAINERS.**

**CAUTION:**

**Spacers should be used between packages when stacked since the lid stands marginally proud of the top corner casting faces. A typical spacer arrangement is shown in Figure 7.**

**CAUTION:**

**Where empty containers are to be stacked outside it is recommended that ISO intermodal connecting twistlocks are used to aid stack stability in high winds. These are not required when stacking indoors.**

The package has been rated for a maximum stacking height of 3 units (i.e. 1+1+1). This must not be exceeded.

7.1.7 *Transport tie-down*

**CAUTION:**

Although the container is fitted with ISO corner fittings, they are positioned at non ISO standard centres. Therefore, a special road trailer or adapter stillage is required to effect tie-down of the container for transport.

For any other method of Container tie down permission from the Contract Authority must be sought.

**7.2 Container Operator Turn-round Maintenance.**

On package turn-round(i.e. loading & unloading), the following visual inspections and tests shall take place. Reference shall be made to the OQP. Records of these activities shall be kept and any defects or difficulties reported.

1. Inspect general condition of package and components.
2. Inspect lifting and fastening features. Report and record any defects or difficulties to Flask Quality Group at Sellafield.
3. Inspect other safety related features (vents, limit switches, physical interlocks etc)
4. Ensure required markings, identification labels/plates and warning labels are in place and free from damage.
5. Inspect seal and seal surfaces. (No damage/debris on surface)
6. Check for debris inside package.
7. Confirm Package functionality.
8. Confirm Package licence validity with the Approving Authority

Ref.	Inspection Requirement	Record Requirement	Acceptance Criteria Ref.	Required (✓)
1.	Package general condition	Corrosion, defect, wear.	6.3	✓
2.	Lifting and fastening features	Wear, interface, clearances, any defects or difficulties.	6.3.1 6.4	✓
3.	Other safety related features	Vents, control systems and mechanical interlocks etc.	No damage or malfunctions	✓
4.	Package markings	All regulatory markings/labels are present and legible.	6.3.2 6.3.3	✓
5.	Seals and seal surfaces	No damage or debris	6.5	✓
6.	Check Package Internally	No debris, damage , corrosion or water present	6.3.1	✓
7.	Package functionality	Malfunctions	6.4	✓
8.	Package Licence validity	Confirm package Licence validity.	6.2 6.3.2	✓

**Table 4: Inspection Requirements**

All appropriate operational and maintenance defects/incidents and abnormalities are to be documented and reported to the Operations Team Leader. Where required they shall be reported to Contract Authority

As part of the turnaround maintenance regime at the Container Operators all containment systems are to be checked in order to establish the seals integrity i.e. not just limited to the seals that the consignors have opened.  
The procedures as detailed in 6.5.1 and 6.5.2 are then to be followed

## 8 Loading the Container

### CAUTION:-

Removal of the lid and or tipper door by the consignor can only be done after permission has been granted by the Contract Authority

### 8.1 Positioning the Container

#### CAUTION:

Care must be taken to ensure that the container is not set down on any sharp objects, e.g. rubble or bricks that could damage/pierce the container floor.

#### CAUTION:

As far as practicable, the load within the ISO container should be equally distributed over its length and width, and in no case shall more than 60% of the load be distributed over 50% of the containers length.

Prior to loading; the container must be positioned on a hard, level, flat surface that is shown to be capable of taking the imposed loadings.

### 8.2 Environmental Consideration

During all loading operations, water must be prevented from entering the container body at any time. Ingress of water and dirt into the seal areas should also be prevented.

### 8.3 Opening the End Loading Hatches

#### WARNING:

**THE MASS OF THE HATCH IS SUCH THAT TWO OPERATIVES ARE REQUIRED TO LOWER THE HATCH INTO THE OPEN POSITION.**

#### WARNING:

**THERE IS MINIMAL CLEARANCE BETWEEN THE TOP EDGE OF THE OUTER HATCH DOORS AND THE GROUND WHEN IN THE LOWERED OPEN POSITION THEREFORE CARE SHOULD BE TAKEN WHEN OPENING THE OUTER HATCH DOOR TO AVOID TRAPPING THE OPERATORS' HANDS OR FEET UNDER THE LOWERED TOP EDGE OF THE HATCH DOOR.**

To open each loading hatch will require the removal of the three loose clamps located along the top edge of the hatch door and unscrewing the fastenings for the seven fixed clamps located along the other three sides of the hatch, see Figure 8.

Once all the clamps and fasteners have been released the two handles located on each side of the hatch door should be used to lower the hatch into the open position. Some temporary set may be observed in the rubber seals at this stage but this should recover after a few hours with the hatch in the open position.

#### 8.4 Lid Removal

To remove the lid, the nuts securing the 12 lid clamps must be unscrewed and the lid clamps removed. The lid can then be lifted off using suitably rated lifting equipment attached to the four lid lifting lugs.

After removing the lid it should be set down in a clear area onto suitable timber bearers which are spaced at regular intervals and span the width of the lid.

Care must be taken to ensure that:

- the lid is not placed in a position that will obstruct loading operations, and;
- the lid sealing face is not at risk of being damaged.

#### 8.5 Protecting Seals

Care should be taken to ensure that the seals and sealing faces are not damaged at any time during the filling operations. It is recommended that the seals are protected with a suitable cover during all loading operations. Figure 10 shows the standard way of protecting the lid seals.

#### 8.6 Operation of Inner Hatch Doors

##### **CAUTION:**

**The door stays must always be used to secure the inner hatch doors in the open position during loading operations (see Figure 11).**

To load waste into the skip, the padlock on the inner hatch doors must first be removed (see Figure 8). When delivered the skip is not supplied with a padlock. This is to be provided and fitted by the skip user and is for use only during the filling time to prevent unauthorised use.

The right hand door can be opened by the releasing of the centre shoot bolt (see Figure 11). Where waste items to be consigned will not fit through a single door, the left hand door can also be opened by undoing the two remaining shoot bolts, located at the top and bottom of the door (see Figure 11).

Both inner hatch doors are fitted with a door stay. When the doors are open the stays must be located into the locating positions on the outside of the container to hold the doors in the open position during loading operations.

## 8.7 Loading Uncompacted Waste

**WARNING:**

**WHEN FILLING THE CONTAINER CARE SHOULD BE TAKEN TO ENSURE THAT WHEN THE CONTAINER IS ALMOST FULL, HEAVY ITEMS ARE NOT PLACED BEHIND THE HATCH DOORS WHICH WHEN RE-OPENED WOULD ALLOW THE ITEMS TO FALL OUT AND MAY CAUSE INJURY TO THE OPERATOR.**

Care should be taken to ensure that the container is filled to capacity with compactable or combustible waste that conforms to the requirements of the receiving facility. For other waste forms Contract Authority permission is required  
When heavy objects are to be loaded into the container, care should be taken to restrain the objects so that no significant movement of the contents can occur during normal conditions of transport.

When the container has been filled with LLW the left hand inner hatch door must be closed and bolted first. The right hand inner hatch door must then be closed and bolted to the left hand door. If the outer hatch door is to be closed immediately it is not necessary to replace the padlock but if the outer hatch door closing operation is not to be completed until later the padlock should be put in place until the outer hatch door is closed.

Any waste material which has the ability to penetrate the container walls during normal conditions of transport must not be loaded adjacent to the internal surfaces of the container.

## 8.8 Internal Package Restraint.

If any internal restraint features are required, detailed design proposals for such restraints shall be submitted to the Contract Authority for technical assessment and approval by the Design Authority prior to commencement of loading operations.

## 9 Pre-dispatch Checks

### 9.1 Prior to closing the lid or outer hatch doors

Prior to closing the lid or outer hatch doors any protective measures used to protect the seals and / or sealing faces during loading should be removed. The seals and sealing faces should be visually inspected to ensure they are clean, free from damage or debris and that the seals are correctly seated and secured before applying a thin film of silicone based grease to the seals.

**NOTE:**

To inspect the sealing faces on the lid it must be positioned on suitable trestles or similar supports to enable inspection access.

**NOTE:**

Provided that the seals have not become dislodged or heavily contaminated with dirt or debris it should not be necessary to remove the seals from the container to clean them, it should only be necessary to wipe the surface of the seals and the mating sealing faces.

**9.2 Closing the Lid**

**WARNING:**

**EXTREME CARE MUST BE TAKEN WHEN GUIDING THE LID INTO POSITION DUE TO THE POTENTIAL TRAPPING HAZARD. DO NOT HOLD THE LID EDGE WHEN GUIDING THE LID INTO POSITION. (SEE Figure 12)**

The lid will only locate in one position on the container. The correct orientation is with the lid mounted grout port located at the tipper door end.

First check the lid mounted grout port blanking flange and gasket are fitted with the six nuts tightened to a torque  $38 \text{ Nm} \pm 2 \text{ Nm}$ . The lid can then be positioned on the container; cut-out features on each corner of the lid should prevent misalignment of the lid.

Once the lid is positioned the lid clamps should be refitted and the nuts tightened uniformly to avoid damage to the lid with the final operation being all nuts tightened to a torque of  $100 \text{ Nm} \pm 10 \text{ Nm}$ .

### 9.3 Closing the Outer Hatch Doors

After removing the padlock (if still fitted) from the inner hatch door the outer hatch door can be closed by swinging it up from its open position. The three clamps along the bottom edge should then be secured first to 'pull in' the double hinges and hold the door in position to enable the remaining clamps to be fitted and secured.

The clamp fasteners should be tightened uniformly to avoid damage to the hatch with the final operation being all the bolts tightened to a torque of  $100 \text{ Nm} \pm 10 \text{ Nm}$ .

After checking that both hatches are closed and that the tipper door and lid have not been disturbed, the package is ready for monitoring and labelling.

### 9.4 After closing the lid and outer hatch doors

Examine the vent port blanking flange retaining bolts; ensure they are free from damage. Fit the gasket and blanking flange, tighten the four bolts to a torque of  $38 \text{ Nm} \pm 2 \text{ Nm}$ .

NOTE: The Container should not be sealed more than 30 days in advance of the anticipated receipt date at the receiving facility.

The container shall again be subject to a visual examination of all exterior surfaces to ensure no damage has been sustained during loading operations.

### 9.5 Monitoring and Labelling

Prior to dispatch the Consignor shall monitor the radiation levels on the outside of the package and affix all necessary labels and placards in compliance with the IAEA Regulations [1].

### 9.6 Documentation

The Consignor shall complete the necessary consignment documentation as required by the IAEA Regulations [1], by the Consignors/Consignees Site Procedures and the CFA for the receiving facility waste acceptance criteria.

## 10 Unloading the Container

The ISO Container is designed to be unloaded into the receipt facility by using the tipper door that is fitted to one end.

### 10.1 Opening the Tipper Door

**WARNING:**  
**THE CONTAINER MUST NOT BE TRANSPORTED WITH THE CLAMPS REMOVED.**

**CAUTION:**  
**Before removing the clamps check that the two latches are engaged**

**CAUTION:**

Once the clamps are removed, extreme care should be taken during all further handling operations to prevent any accidental operation of the tipping door. The door could open, once the clamps are removed if the container is set down on rough ground whereby the two latches could be released or may already have been released when the container was set down.

During operational use the tipper door must only be opened in the designated area of the consignee facility. The facilities and methods used for this operation shall be reviewed by the Contract Authority prior to use. The tipper door will be opened automatically when the container is tilted to the correct position on the special skip handling vehicle at which point the two latches are automatically released allowing the tipping door to open.

Prior to tipping all the clamps and associated fasteners securing the tipper door must be removed. This operation can be carried out with the skip on the floor prior to it being lifted onto the special skip-handling vehicle, as the door is held closed by two latches engaging on its bottom edge.

## **10.2 Unloading Waste**

The uncompacted waste must be unloaded into the consignee facility in accordance with local operating instructions.

## **10.3 Closing the Tipping Door**

Prior to closing the tipping door on completion of unloading operations the seals and sealing faces must be checked in accordance with Section 6.5 and the door must be checked in accordance with Section 6.4

When all checks on the tipping door have been satisfactorily completed, close the door and uniformly tighten the clamp fasteners to a maximum torque of  $100 \text{ Nm} \pm 10 \text{ Nm}$ .

## **10.4 After closing the tipper door**

The container shall again be subject to a visual examination of all exterior surfaces to ensure no damage has been sustained during unloading operations.

## **10.5 Monitoring and Labelling**

The container must be checked for any external contamination following unloading operations and, subject to satisfactory monitoring results, the labels and placards shall be amended in compliance with the IAEA regulations to reflect the unloaded condition. The container can then be returned to the Consigning facility for reuse.

## **11 Container Storage**

Consignors are only permitted to be in receipt of TC05's for a maximum of 90 days. If any extension to this is required, permission must be sought from the Contract Authority

Fully loaded container are only permitted to be stored for a period of 50 days, if any extension to this is required, permission must be sought from the Contract Authority

## **12 Planned Maintenance**

It is a regulatory requirement to ensure compliance with the package design safety case that planned maintenance shall be performed under a Maintenance Quality Plan (MQP). The level of maintenance and frequency recommended in this document will ensure that suitable maintenance regimes are implemented throughout the design life of the package and a consistent approach is taken to package maintenance across the Fleet..

The CSC plate must be checked to verify that: the Container is still within its licensed period i.e. within 5 years of the date of manufacture, and; the Container can be filled and consigned within the period stated on the CSC plate.

Re-inspection (including confirmatory leakage tests) and re-plating will be required if the period of validity has expired prior to filling or consignment.

**Note:** Where re-inspection is required the Consignor shall contact the Contract Authority.

**NOTE:**

The examinations carried out under either PES or ACEP are in addition to the routine operating inspections and maintenance activities specified herein and must be carried out by a HSE approved container inspection authority.

Maintenance activities are presented in the tables below for the main package items as follows:

- Package Lid/Door Systems -Table 5
- Package Body – Table 6.
- Lifting and Tie-down Features - .Table 7

**On Package receipt: -**

- Review Maintenance Quality Plan (MQP).
- Record package identification. (Package design and serial number)
- Check receipt documentation.
- Carry out HP survey; ensuring results are within prescribed limits.
- Review previous maintenance LQR package and operational defect reports.

**On commencement and during maintenance: -**

- Ensure a safe system of work is in place.
- Ensure as package components are removed and when doors/hatches are opened, HP monitoring activities are carried out.
- Ensure that any spares used are inspected/certified, correctly identified. Record usage in the LQR.
- Ensure components removed are held in a controlled area.
- Ensure defective components are labelled and are quarantined.
- Record serial numbers and calibration date of test equipment or special tools used.
- Ensure before any functional tests are carried out all necessary clearances/permits to work are in place.
- Proof load testing must be repeated, whenever new untested or repaired load bearing components are fitted. If new inspected and certified components are used the package shall be tested using the appropriate self-weight.
- Special attention shall be given to lifting features, which may be affected by corrosion.
- Ensure all necessary records are completed

Ref.	Maintenance Activity	Maintenance Frequency Required (✓)			Acceptance Criteria Ref.
		weekly	12 months	5 years	
1.	Inspect for wear, damage and corrosion		✓	✓	15.1.1
2.	Ensure all components are in place		✓	✓	15.1.2
3.	Ensure required markings, identification labels/plates and warning labels are in place and free from damage.		✓	✓	15.1.3
4.	Inspect sealing faces for damage and deformity (lid, door, pressure test points and valves)		✓	✓	15.2.1
5.	Inspect seal retaining grooves/features and sealing surfaces for damage and scoring which could affect package sealing		✓	✓	15.2.1
6.	Replace seals			✓	15.4
7.	Anti-Galling		✓	✓	15.8
8.	Carry out lid / door inter space pressure test		✓	✓	15.6.1
9.	Inspect threads and inserts for wear		✓(1)	✓(2)	1. 15.7.1 2. 15.7.2
10.	Inspect bolts, screws and nuts for wear		✓(1)	✓(2)	1. 15.7.1 2. 15.7.2
11.	Lubrication of door and latch hinges		✓	✓	15.9
12.	Functional tests of hatch doors, tipping door and associated latches		✓	✓	15.11

**Table 5: Package Lid/Door Systems**

Ref	Maintenance Activity	Maintenance Frequency Required (✓)			Acceptance Criteria Ref
		* months	12 months	* 5 years	
1.	Inspect for wear, damage and corrosion		✓	✓	15.1.1
2.	Ensure all components are in place		✓	✓	15.1.2
3.	Ensure required Markings, identification labels/plates and warning labels are in place and free from damage.		✓	✓	15.1.3
4.	Package internals free from damage and corrosion. No debris present		✓	✓	15.1.4
5.	Assess paint internal/external surfaces. Touch up or repair as required.		✓	✓	15.2.2
6.	Inspect sealing faces for damage, which may affect satisfactory sealing.		✓	✓	15.2.1
7.	Inspect seal retaining grooves/features and sealing surfaces for damage and scoring which could affect package sealing.		✓	✓	15.2.1
8.	Inspect threads and inserts for wear		✓(1)	✓(2)	1. 15.7.1 2. 15.7.2
9.	Visually check internal components		✓	✓	15.1.2

Table 6: Package Body

**NOTE:-For frequency of Pressure/Vacuum testing of covers/compartments refer to 15.6.2**

Ref	Maintenance Activity	Maintenance Frequency Required (✓)			Acceptance Criteria Ref
		* months	12 months	5 years	
7.	Inspect lifting features for wear, damage, deformity and corrosion. Measure and record		✓	✓	15.3
8.	Confirm testing/certification documentation for proof load testing of assemblies and components is available.		✓	✓	Review previous LQR's
9.	Visually check that all components are in place.		✓	✓	15.1.2
10.	Check torque settings bolts/screws				15.10
11.	For welded component use NDT to check for cracks.			✓	15.5
12.	Self weight test body lifting features			✓	15.3
13.	Self weight test lid lifting features			✓	15.3
14.	Proof load test body lifting features. (repaired/new untested components only)			✓	15.3 15.5
15.	Proof load test lid lifting features. (repaired/new untested components only)			✓	15.3 15.5

Table 7: Package Lifting and Tie-down Features

### 13 SQEP Requirements

All personnel involved in operations and maintenance activities must have received training to ensure that they meet the required competency level to perform the required tasks.

## **14 Record Requirements**

Appropriate through life quality records shall be kept. Typically but not exclusively the LQR'S shall include:

- Records of all EIM&T carried out on the packages.
- Copy's of signed completed check lists for maintenance and operational activities.
- Operational and maintenance defects and difficulties and incidents.
- Records of all spares used including certification.
- References to original manufacture's LQR package shall be included if available.

Requirements for keeping records are defined in RSP 5.01 [8].

## **15 Acceptance Criteria**

### **15.1 General Inspections**

#### *15.1.1 General*

Packages shall be in good condition free from damage, corrosion and wear which will affect safety and operational requirements.

There shall be no visible damage to the seals, and they shall be in good working condition.

All mechanical interlocks shall be fully functional and free from wear. There shall be smooth engagement of movable parts. Interlock mechanisms shall be within tolerances as detailed on the design drawings.

#### *15.1.2 Components*

All components are to be in place, securely fitted and free from damage. Refer to package design drawings for details of all fitted components.

#### *15.1.3 Markings*

All required labels / markings to be legible and securely fitted. Refer to Package design drawing and OI's.

#### *15.1.4 Internal*

Package internals are to be free from damage and corrosion. No debris to be present

## 15.2 Surface Finishes.

### 15.2.1 Sealing face's

Minor degradation of the sealing surfaces is expected through life.

Inspection is required at the specified maintenance periods. The sealing faces shall be clean, free from foreign bodies or damage that could affect satisfactory sealing.

After any repair work to the seals, sealing faces or seal securing features, the seal must be leak tested to a level of  $1 \text{ bar cm}^3 \text{ s}^{-1}$  Standard Leak Rate (SLR) or better. If that leak test indicates a failure to comply with the leakage level, and subsequent inspection determines the seals are the cause of failure, then the seals must be discarded and new seals fitted. The procedure establishing the leak test method is defined in Appendix B.

### 15.2.2 Package Surface's

Package surfaces both internal and external shall be in good condition free from damage and corrosion. Where surfaces are painted they shall be in good condition. The paint should be fully adhered and not flaking. Any damage to the paint finish must be reported to Contract Authority. Care must be taken to ensure that the container decals are not obliterated during any paint repair.

Where operational records indicate excessive decontamination requirements, assess cause and consider possible repainting.

Repairs shall be carried out to an approved repair procedure endorsed by the Contract Authority

## 15.3 Lifting and Tie-down Features

There shall be no visible mechanical damage, corrosion, deformation, change in section or cracks evident in the main body/welds of any lifting or tie-down features.

Burrs or sharp edges shall be dressed off.

To ensure there is no wear which will have a detrimental effect when interfacing with approved lifting accessories dimensions of lifting feature sections shall be within tolerances as detailed on the design drawing. If this is not the case the Design Authority shall be consulted.

For self-weight testing purposes the package-unladen weight can be used, unless the package laden weight difference, is excessive (i.e. >20%) and in such a case advise is to be sought from the Package Design Authority via a concession. A visual confirmation of package performance is acceptable. Weights may be obtained from the package design drawings.

If the inspector chooses to use NDT to assess defects see section 15.5.

## 15.4 Seals

**CAUTION:**

**When handling the seals care must be taken to ensure the seal is not bent into small loops as this could damage the vulcanised joints.**

A worsening history of seal leakage test records will indicate the onset of unacceptable performance and diagnosis is required.

The seals shall be in a sound condition and there should be no visible signs of damage, age hardening or radiation induced hardening. Where evidence of damage, age or radiation induced hardening is found the seals must be replaced.

The fitting of a replacement seal must be undertaken with care. Operators must ensure that the seal mounting face and associated sealing face is clean and free from any defect liable to give rise to a leak test failure. When securely fitted and correctly orientated, a light surface coating of silicone based grease should be applied to the surface of the seals.

A seal interspace leakage test should be carried out in accordance with Appendix B.

## 15.5 NDT

### 15.5.1 *Magnetic Particle Inspection*

NDT testing is only required if a defect has been identified by the Container Operator.

Inspection shall be carried out in accordance with BS EN 1290 [9] with acceptance levels in accordance with BS EN 1291 [10].

Defects are not acceptable for welds associated with lifting or tie-down features. Any defects that are found shall be reported to the Design Authority for sentencing.

All personnel performing MPI shall be qualified in accordance with BS EN 473 [11], PCN Level 2 minimum or an equivalent International Standard.

## 15.6 Pressure / Vacuum Testing

### 15.6.1 *Seal inter-space test*

The seal interspace test shall be conducted in accordance with the procedure specified in Appendix B.

### 15.6.2 *Whole body Pressure test*

Whole body pressure/leakage testing is normally carried out during manufacture, to test the materials and the manufacturing process. Such testing can be hazardous and is considered unnecessary to repeat through life since wholesale degradation of the package structure is highly unlikely. A whole body test will only be carried out if a significant defect has been identified by the Container operator. The test will then be carried out in accordance with Appendix B to verify containment integrity.

## 15.7 Clamp bolts and receiving threads

### 15.7.1 Visual Inspection

Threads shall be continuous, have a full form and be free from burrs and sharp edges for their design length.

### 15.7.2 Gauge Testing

#### Male Threads

Threads accept 'GO' gauges for the full design length.

Threads shall not accept a 'NO GO' threaded gauge any further than three full thread pitches.

Threads shall accept a 'GO' calliper gauge at any point along the thread design length.

Threads shall not accept a 'NO GO' calliper gauge at any point along the thread design length.

#### Female Threads

Threads shall accept 'GO' gauges for the full design length.

Threads shall not accept a threaded gauge for more than three full pitches.

## 15.8 Anti-Galling

Where appropriate, threads shall be lubricated (sparingly) using a dry film lubricant such as Rocol DFSM.

## 15.9 Lubrication

Lubrication of door and latch hinges, shall be carried out using a silicon based grease.

## 15.10 Torque Settings

The torque settings for lid, hatch and tipping door clamps is 100 Nm  $\pm$ 10 Nm.

## 15.11 Functional Tests

Correct functionality of package to be confirmed, such as operation of the hatch doors, tipping door and associated latches etc. The functional test shall satisfy the requirements of all plants which receive the package.

## 16 References

- [1] IAEA Safety Standard Series No TS-R-1 Regulations for the Safe Transport of Radioactive Material, 2009 edition
- [2] BS 3951: Part 2: Section 2.1 (ISO 1496/1), Freight Containers. Part 2, Specification and Testing of series 1 freight containers. Section 2.1, General Cargo Containers for General Purposes Amendment 1: 1AAA and 1BBB Containers Fifth Edition; Amendment 1: 03/01/93; Amendment 2: 07/01/98.
- [3] International Convention for Safe Containers, 1972 (CSC). 1996 Edition
- [4] BS ISO 3874: Series 1 Freight Containers - Handling and Securing Fifth Edition; 1997. Corrected and Reprinted 07/15/1999; Amendment 1 11/15/2000; Amendment 2 7/01/2002.
- [5] Not Used
- [6] Not Used
- [7] RAP.11.04: Repository Site Procedure. Authorisation of Suitably Qualified and Experienced Persons (SQEPs).
- [8] RSP.5.01: Repository Site Procedure. Records Management
- [9] BS EN 1290: Non-destructive testing of welds — Magnetic particle testing of welds
- [10] BS EN 1291: Non-destructive testing of welds — Magnetic particle testing of welds — Acceptance levels
- [11] BS EN 473: Non-destructive testing. Qualification and certification of NDT personnel. General principles.
- [12] TCSC 1068: Transport of Radioactive Material Code of Practice: Leakage tests on packages for transport of radioactive materials.

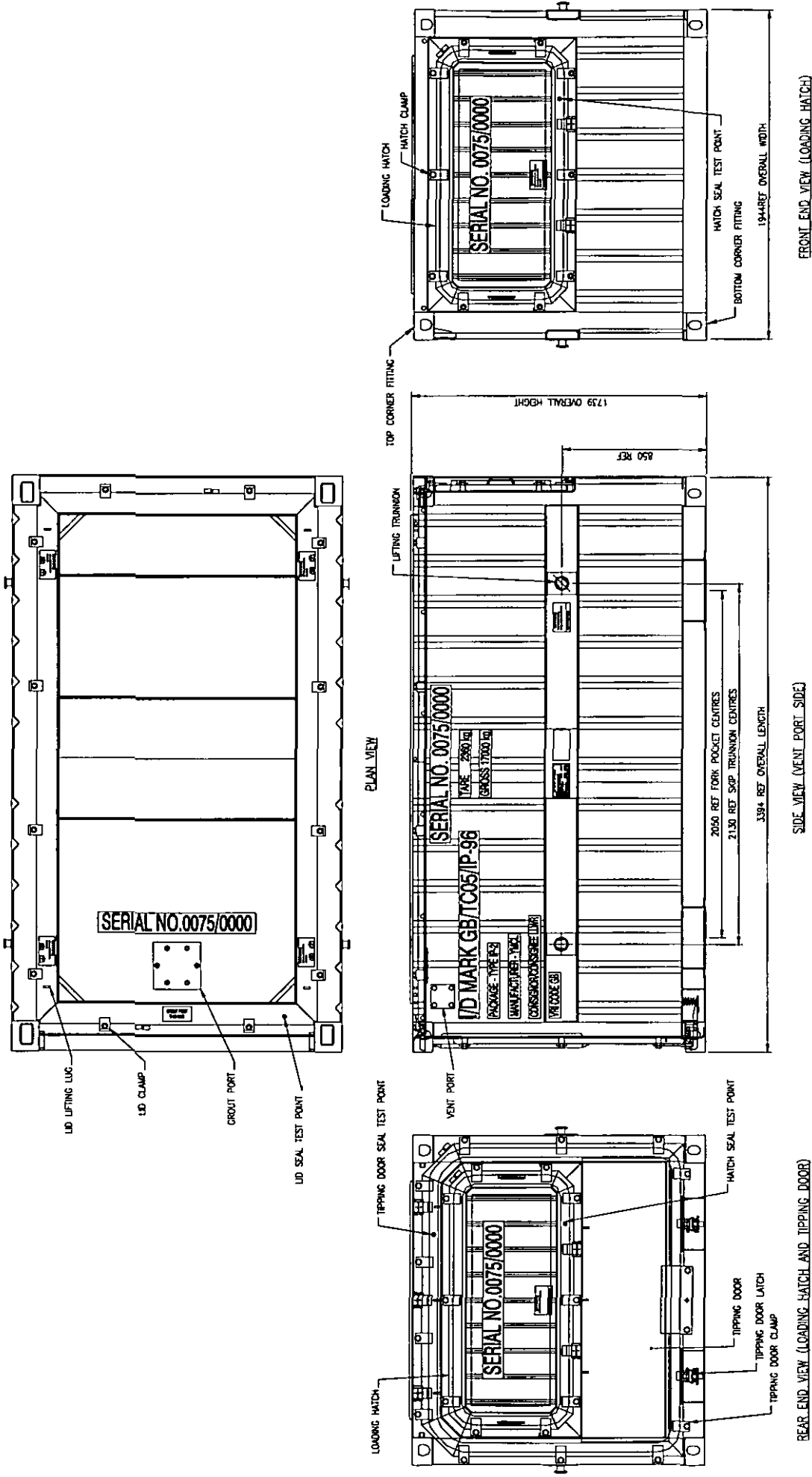
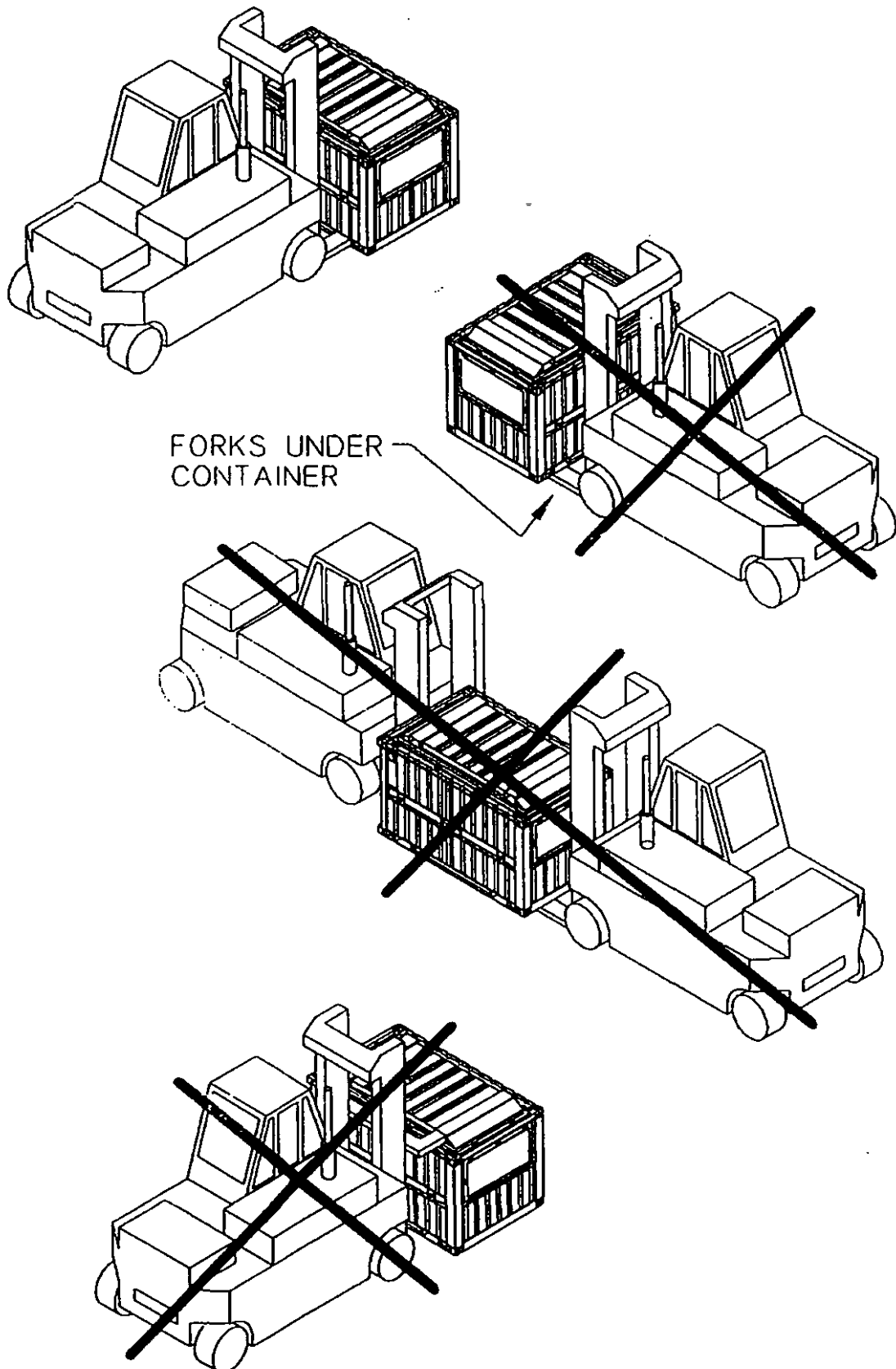


Figure 1: IP-2 Package Design TC05

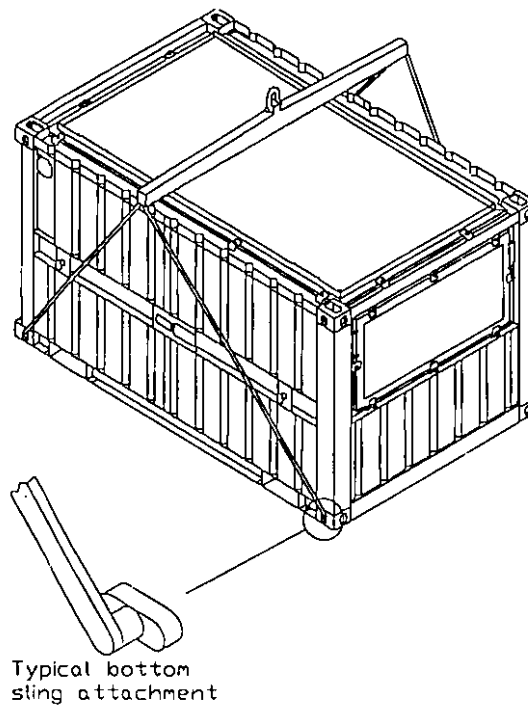
LLWR Commercial

A company owned by UK Nuclear Waste Management Ltd

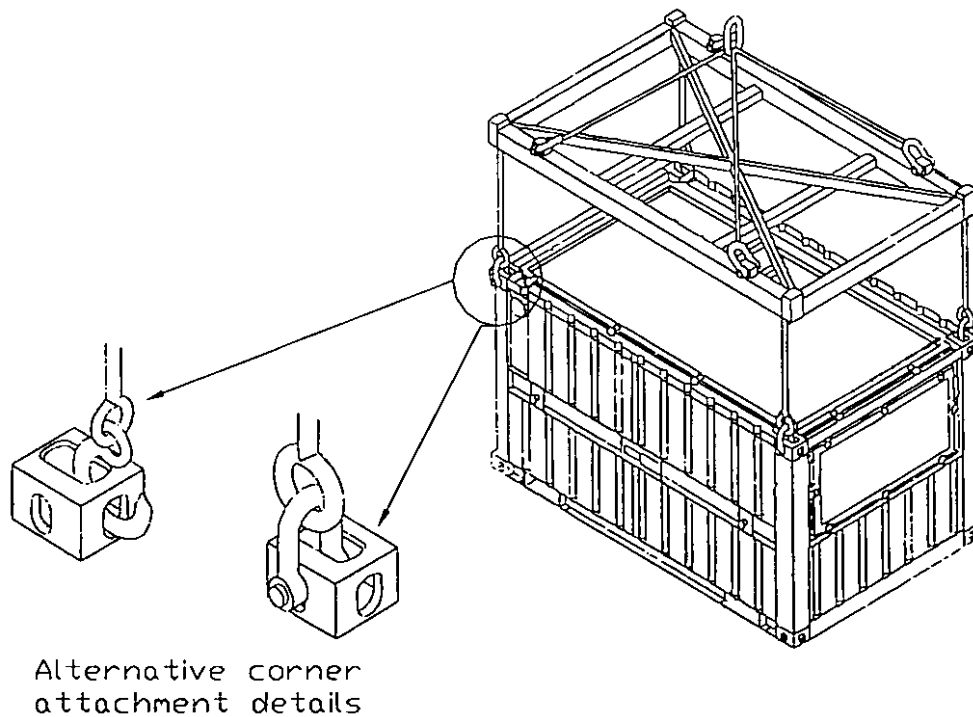
Registered Address: Old Shore Road, Drigg,  
Holmrook, Cumbria,  
United Kingdom, CA19 1XH



**Figure 2 Lifting with forklift truck**



**Figure 3 Lifting with bottom lift sling & top beam**



**Figure 4 Lifting using top fittings and special lifting gear**

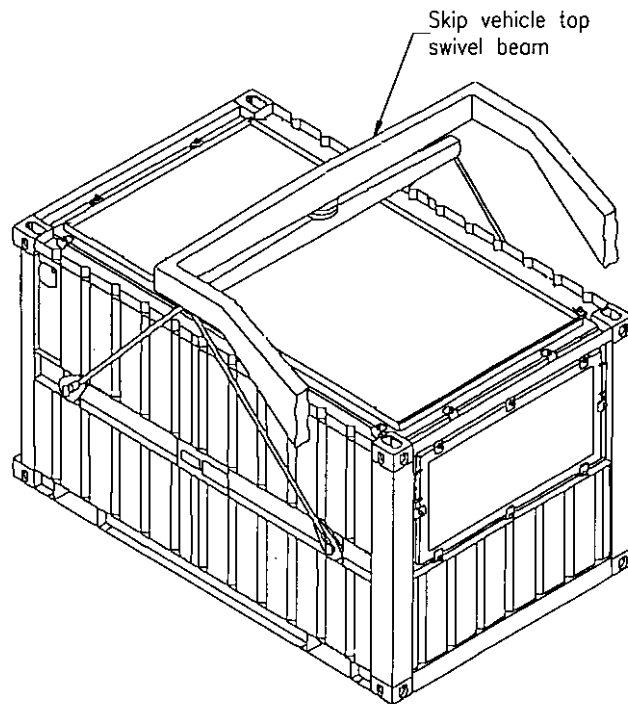


Figure 5: Lifting with skip handling vehicle

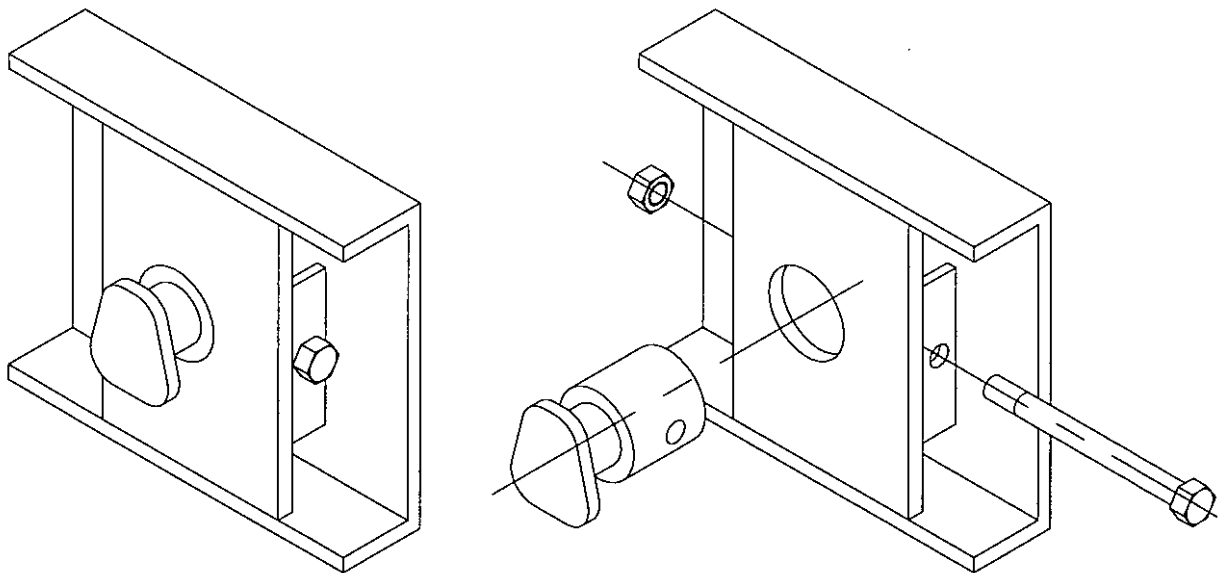


Figure 6 Trunnion Lifting Assembly

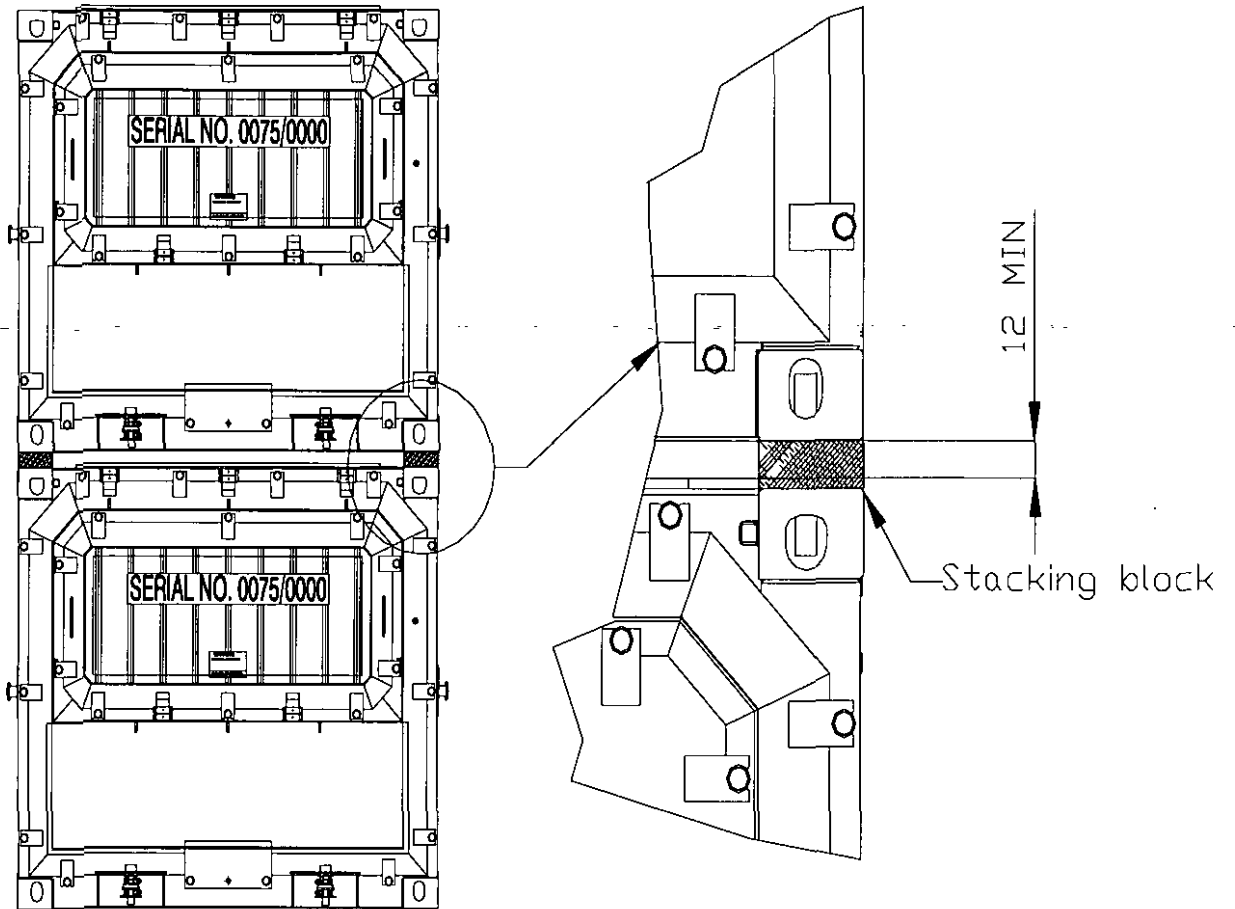
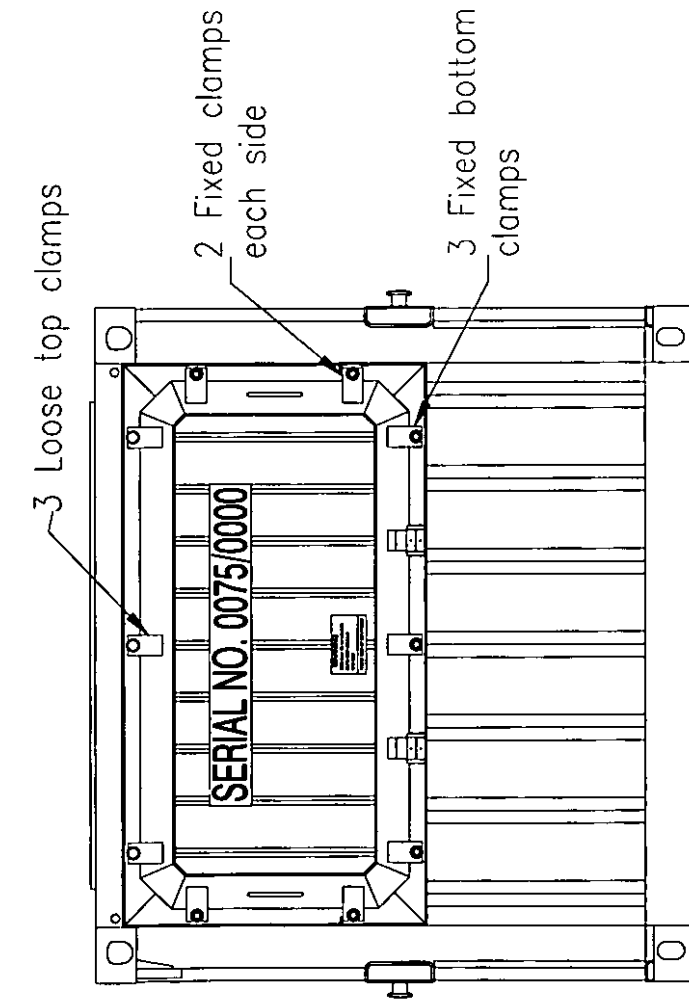
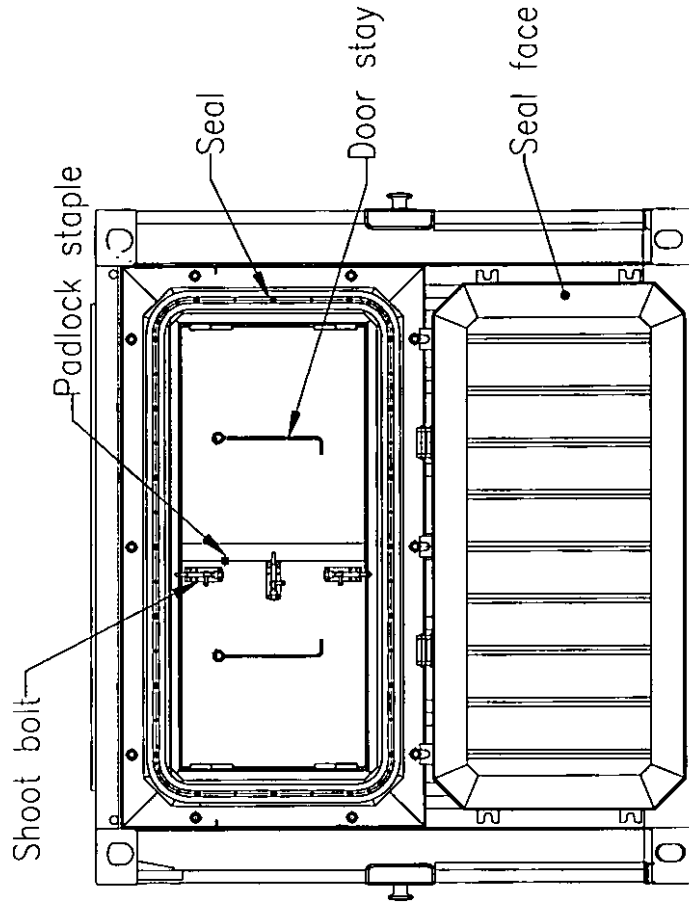


Figure 7 Stacking blocks/spacers shown in position

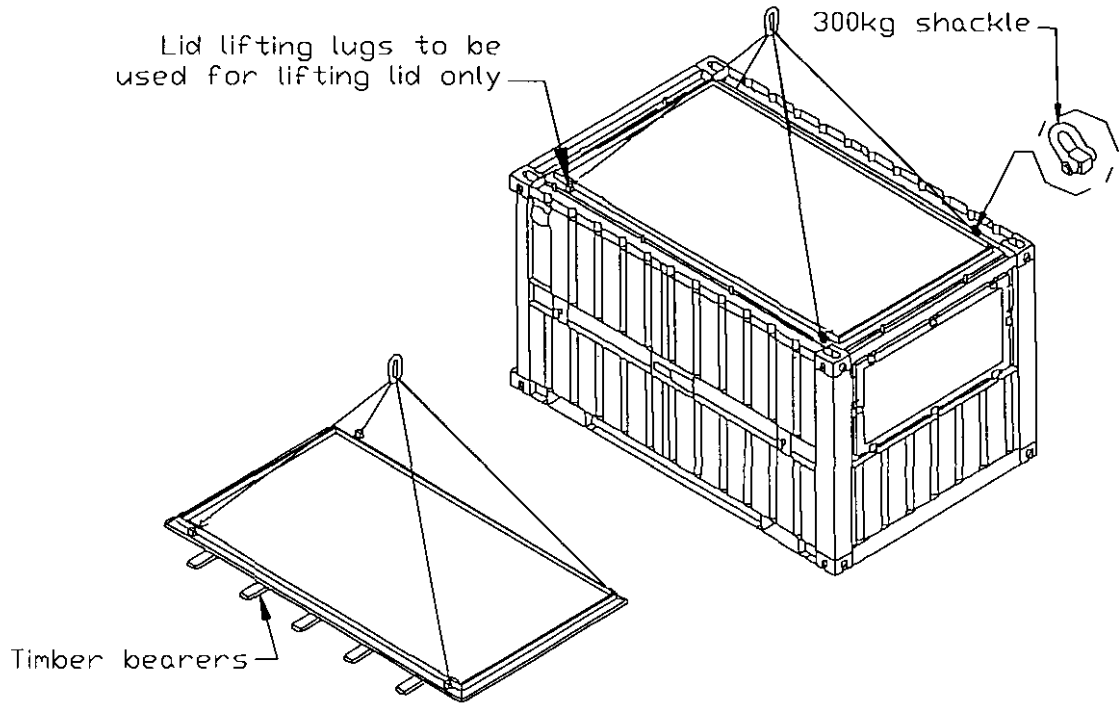


Hatch shown in closed position



Hatch shown in open position  
with inner hatch doors closed

Figure 8 End hatch details



**Figure 9 Lid lifting system**

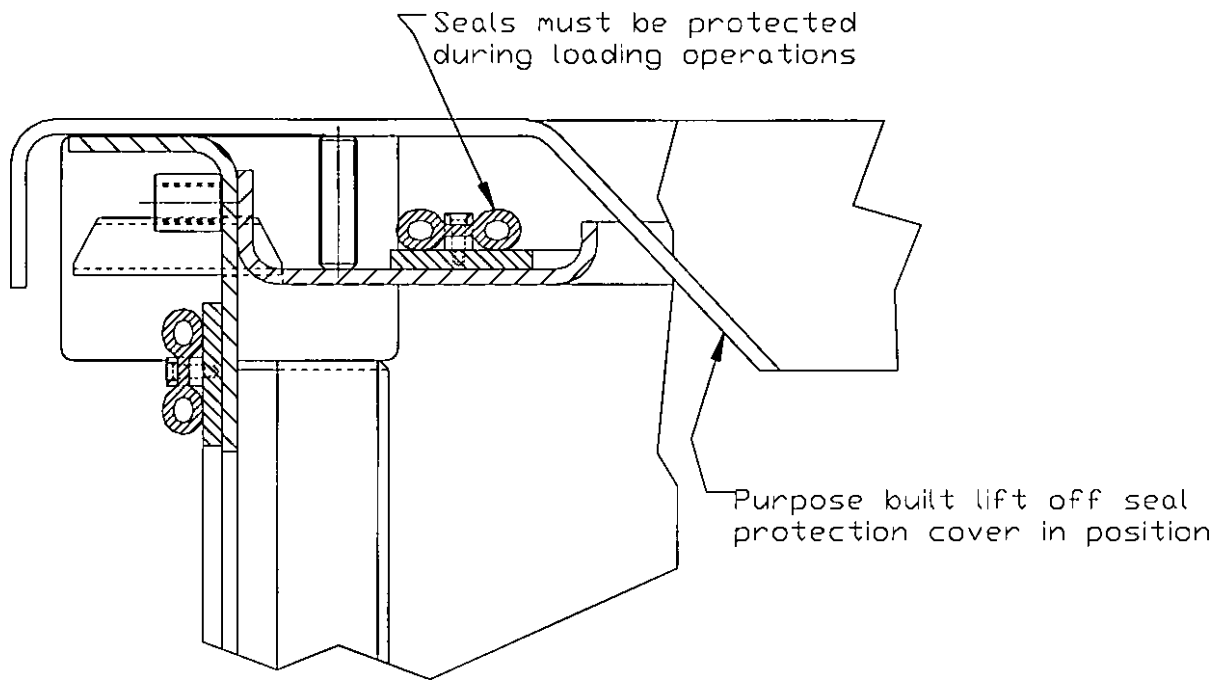


Figure 10 Seal protection system

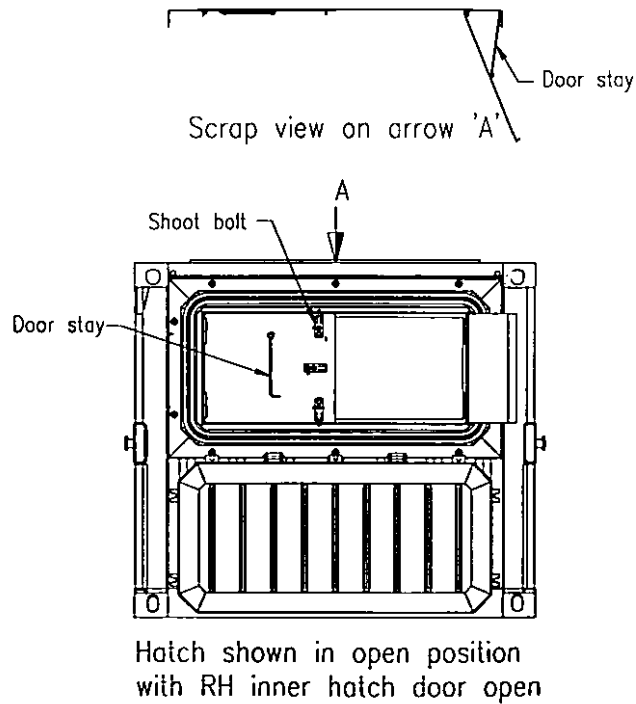
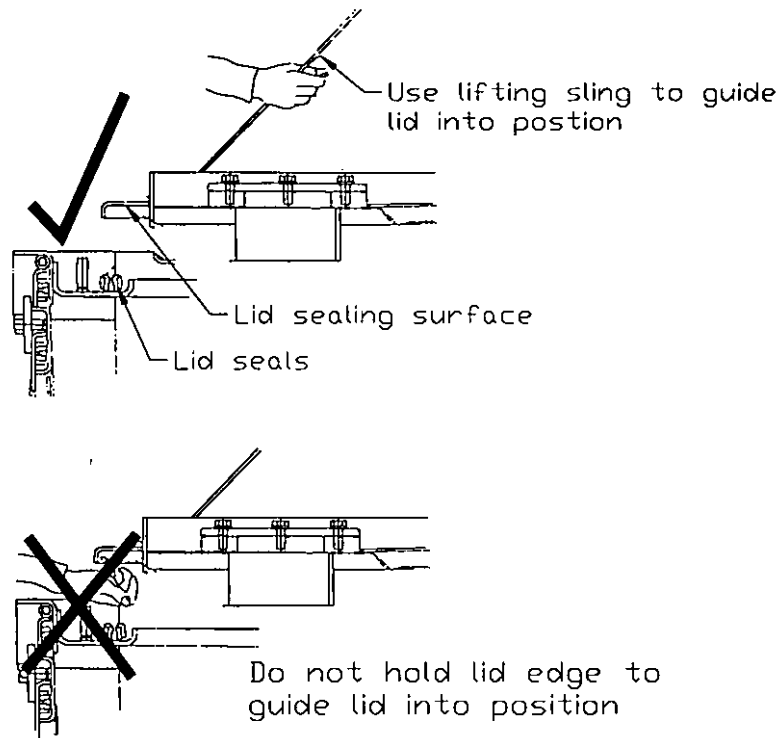


Figure 11 Inner hatch door retention catch



**Figure 12 Lid positioning**

Appendix A –

Package Data

<b>IP-2 Package Design TC05</b>	
<b>GA Drg. No.</b>	0BE 1883457
<b>Indicative Weights (kg)</b>	
Maximum Tare	2360
Maximum Gross	17000
Maximum Gross (Using Trunnions)	8000
<b>Indicative External Dimensions:</b>	
Height (mm)	1750
Width (mm)	1950
Length (mm)	3400
Volume (m <sup>3</sup> )	11.5
<b>Indicative Internal Dimensions:</b>	
Height (mm)	1500
Width (mm)	1860
Length (mm)	3190
Volume (m <sup>3</sup> )	8.5
<b>Maximum Stacking Height:-.</b>	3
<b>Door, Hatch and Lid Seal Configuration</b>	Double
<b>Seal Leakage Test Method</b>	Interspace

## Appendix B

### Leakage Testing

#### Introduction

Two leakage tests are specified:

1. A container body leakage test, which shall be carried out following any repair to the container body or door. This test is comprised of a soap bubble test on all welds followed by an isolation pressure fall test on the container body with all apertures closed.
2. An isolation pressure fall test on the door seal interspace, which is carried out to verify the continued integrity of the hatch door, lid and tipping door seals during routine maintenance; prior to conducting a container body leakage test, and; following replacement of the door seal.

The Container operator shall prepare detailed procedures for:

- leak testing the container by the soap bubble and pressure drop methods, and;
- leak testing the door seals by the pressure drop method, in order to demonstrate the package containment integrity.

Records of all leak tests shall be kept using a form which identifies the unique Package Design and Serial Number, all test parameters and any other comments. The approximate positions of any leakage points found under test must be recorded on a line diagram together with details of repair. The form shall be signed by the Container operator representative verifying that the container has satisfactorily completed the leakage test(s).

#### Leakage Test Equipment

In order to carry out the leakage tests, apparatus is required which can be attached to the test points of the container. The apparatus shall enable the container and closure seal interspace to be pressurised up to a maximum of 1200 millibar (absolute). It shall be capable of measuring pressure range from ambient (barometric) to 1500 millibar (absolute) with an accuracy of  $\pm 1$  millibar when isolated from the pressurising supply.

Instruments (e.g. CALT 5 or similar) shall be used to monitor the temperature and pressure decay during the pressure fall test.

All test equipment must be calibrated to nationally recognised standards and have a valid calibration certificate.

#### Seal Leakage Test Procedure

##### **WARNING:**

**COMPRESSED AIR CAN BE POTENTIALLY DANGEROUS. ENSURE SAFE WORKING PRACTICE AT ALL TIMES. AN ASSEMBLED CONTAINER HAS A LARGE VOLUME, WHICH TAKES SEVERAL MINUTES TO PRESSURISE. DO NOT LEAVE THE CONTAINER UNATTENDED WHILST IT IS BEING PRESSURISED.**

The Container operator shall prepare a procedure for testing the integrity of the closure seals. This test is required to demonstrate an allowable leakage rate of  $1.0 \text{ bar cm}^3 \text{ s}^{-1}$  SLR

or better for the closure seals. The test shall be carried out to verify the continued integrity of the door seal during routine maintenance; prior to conducting a container body leakage test; and following replacement of the door seal.

The following table has been compiled to enable non-specialised pressure measuring equipment, to be used to establish a satisfactory pressure test, meeting the Standardised Leak Rate (SLR) criteria.

Parameter	Minimum	Maximum	Accuracy of reading
Ambient temperature	0°C	38 °C	± 5°C
Ambient pressure (P <sub>a</sub> )	970 mbar	1030 mbar	± 1 mbar
Initial interspace pressure (P <sub>1</sub> )	1120 mbar	1200 mbar	± 1 mbar
Final pressure	= P <sub>a</sub> + 50 mbar	P <sub>1</sub>	± 1 mbar
Test duration	10 mins	10 mins	+ 0.5 mins
Interspace volume	See below	See below	See below

**Table 8**

**NOTE:**

**All pressures are absolute and measured in millibar (mbar).**

The Interspace volume under test shall be known prior to testing. The procedure and calculation to determine the interspace volume capacity is given below.

Ensure that all sealing faces are clean, and the seals lightly lubricated with a silicon-based grease.

It is a requirement that the seal interspace test is achieved with the door clamps tightened to the normal operating level.

The seal leak rate in bar cm<sup>3</sup> s<sup>-1</sup> has to be established before SLR can be determined. Where a CALT 5 type instrument is not used, the formula to be used for determining the leak rate for the volume under consideration is given below.

**Leak Test equations**

**Leak Rate Formula**

The leak rate for the volume considered is calculated using the following formula from TCSC 1068 [12]:

$$L = \frac{V \times T_o \times (P_1 - P_2)}{60 \times H \times T} \cdot \text{bar} \cdot \text{cm}^3 \cdot \text{s}^{-1}$$

Where:  $L$ = Leak rate (bar cm<sup>3</sup> s<sup>-1</sup>)  
 $V$ = Volume (Total volume of test interspace and equipment) (cm<sup>3</sup>)  
 $T_o$ = Reference temperature 298 K (Kelvin)  
 $P_1$ = Start pressure (bar)  
 $P_2$ = Final pressure (bar)  
 $H$ = Test duration (mins)  
 $T$ = Ambient air temperature in K

### Standardised Leak Rate (SLR) Formula

Once the leakage rate has been found, the SLR can be established using the following formula from TCSC 1068 [12]:

$$L_s = \frac{L_a \times \mu_{ga} \times (P_{us}^2 - P_{ds}^2)}{\mu_{gs} \times (P_{ua}^2 - P_{da}^2)} \cdot \text{bar} \cdot \text{cm}^3 \cdot \text{s}^{-1} \text{SLR}$$

Where:  $L_s$ = Standardised leak rate  
 $L_a$ = Leak rate  
 $\mu_{ga}$ = Dynamic viscosity of air at measured test temperature  
 $\mu_{gs}$ = Dynamic viscosity of air at standard temperature (298 K)  
 $P_{us}$ = Upstream pressure of air under standard conditions 1.0 bar (abs)  
 $P_{ds}$ = Downstream pressure of air under standard conditions 0.0 bar (abs)  
 $P_{ua}$ = Upstream pressure of air under test conditions, bar (abs)  
 $P_{da}$ = Downstream pressure of air under test conditions, bar (abs)

### Measurement of Seal Interspace Volume by 3 way valve (for double sealed variants only)

1. Record ambient atmospheric pressure ( $P_a$ )
2. Attach the test apparatus to the test point.
3. Pressurise seal interspace to between 1120 and 1200 mbar abs.
4. Close valve, record pressure ( $P_1$ ) and remove pressurising medium.
5. Affix calibrated known volume ( $V_c$ ).
6. Open valve and record pressure reading ( $P_2$ )
7. Apply parameters recorded to the following calculation to determine seal interspace volume:

$$V = \frac{(P_2 - P_a) \cdot V_c}{(P_1 - P_2)}$$

### Container Body Leakage Test Procedure (Soap bubble method)

#### WARNING:

**COMPRESSED AIR CAN BE POTENTIALLY DANGEROUS. ENSURE SAFE WORKING PRACTICE AT ALL TIMES. AN ASSEMBLED CONTAINER HAS A LARGE VOLUME, WHICH TAKES SEVERAL MINUTES TO PRESSURISE. DO NOT LEAVE THE CONTAINER UNATTENDED WHILST IT IS BEING PRESSURISED.**

**CAUTION:**

**Prior to actual pressurisation of the container body ensure that the pressurising equipment has been connected with the following:**

- **a suitably sized bursting disc or relief valve designed to burst or relieve pressure at a nominal 100 mbar gauge;**
- **a pressure gauge designed to measure pressures in the range 50 to 150 mbar gauge; and,**
- **an airline fitted with a pressure regulator set to a maximum of 200 mbar gauge.**

The Container operator shall prepare a procedure for testing the integrity of the body (with the exception of the closure seals) by the soap bubble method. This test is carried out to demonstrate that there are no individual leaks exceeding a leak rate of  $\leq 10^{-1}$  bar cm<sup>3</sup> s<sup>-1</sup> SLR. The test shall be carried out following any repairs to the container body or door. This test shall be carried out only AFTER successful closure seal leak tests have been completed and a valid health physics monitoring certificate has been issued showing the contamination levels within the container are at acceptable levels.

Where the leakage test is to be carried out following a repair, it must be carried out prior to the application of any paint finish to the area of repair. Only the container welds are leak tested as it is presumed that there would not be any leaks in plate or sections except where joints are made and sealed by welding operations.

The container should be placed on suitable trestles during the test so that all surfaces of the container are accessible.

A leakage rate of  $\leq 10^{-1}$  bar cm<sup>3</sup> s<sup>-1</sup> SLR is indicated by absence of air bubbles developing in soap solutions when applied to all containment welds, whilst the air pressure in the container is raised to a low but adequate air pressure above ambient.

The test gas shall be air at a pressure of 60 to 70 millibars above ambient. The soap solution shall be 'Teepol' (or equivalent) diluted with water in the ratio of 3:1 by volume and shall be applied to the welded joints on the outer surfaces of the container by hand spray gun.

All leaks shall be sealed to an approved weld repair procedure. Leaks which have been sealed shall be checked by re-applying soap solution.

An absence of air bubbles in the soap solution indicates that leakage through all weldments has been eradicated.