

**WASTE PACKAGE SPECIFICATION AND
GUIDANCE DOCUMENTATION**

**WPS/604: Lifting Frame for Stillage and corner
lifting variant of 3 cubic metre Box Waste
Package: Description and Design Guidelines**

**March 2008
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Bibliography

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**WASTE PACKAGE SPECIFICATION AND GUIDANCE DOCUMENTATION
LIFTING FRAME FOR STILLAGE AND CORNER LIFTING VARIANT OF 3 CUBIC
METRE BOX WASTE PACKAGE: DESCRIPTION AND DESIGN GUIDELINES**

This document forms part of a suite of documents prepared and issued by the Radioactive Waste Management Directorate (RWMD) of the Nuclear Decommissioning Authority (NDA).

The Waste Package Specification and Guidance Documentation (WPSGD) provide specifications and guidance for waste packages, containing Intermediate Level Waste and certain Low Level Wastes, which meet the transport and disposability requirements of geological disposal in the UK. They are based on, and are compatible with, the Generic Waste Package Specification (GWPS).

The WPSGD are intended to provide a 'user-level' interpretation of the GWPS to assist Site License Companies (SLCs) in the early development of plans and strategies for the management of radioactive wastes. To aid in the interpretation of the criteria defined by the WPSGD, and in their application to proposals for the packaging of wastes, SLCs are advised to contact RWMD at an early stage.

The WPSGD will be subject to periodic enhancement and revision. SLCs are therefore advised to contact RWMD to confirm that they are in possession of the latest version of any documentation used.

WPSGD DOCUMENT NUMBER WPS/604 - VERSION HISTORY

VERSION	DATE	COMMENTS
WPS/604/01	February 2006	Aligns with GWPS (Nirex Report N/104) as published June 2005
WPS/604/02	March 2008	Updated to acknowledge NDA assumption of Nirex responsibilities Aligns with Issue 2 of GWPS (Nirex Report N/104) as published March 2007.

This document has been compiled on the basis of information obtained by Nirex and latterly by the NDA. The document was verified in accordance with arrangements established by the NDA that meet the requirements of ISO 9001. The document has been fully verified and approved for publication by the NDA.

1 INTRODUCTION

The Radioactive Waste Management Directorate (RWMD) of the Nuclear Decommissioning Authority (NDA) has been established with the remit to implement the geological disposal option for the UK's higher activity radioactive wastes. The NDA is currently working with Government and stakeholders through the *Managing Radioactive Waste Safely* (MRWS) consultation process to plan the development of a Geological Disposal Facility (GDF).

As the ultimate receiver of wastes, RWMD, acting as GDF implementer and future operator, has established waste packaging standards and defined package specifications to enable the industry to condition radioactive wastes in a form that will be compatible with future transport and disposal. In this respect RWMD is taking forward waste packaging standards and specifications which were originally developed by United Kingdom Nirex Ltd, which ceased trading on 1st April 2007 and whose work has been integrated into the NDA.

The primary document which defines the packaging standards and specifications for Intermediate Level Waste (ILW), and certain Low Level Wastes (LLW) not suitable for disposal in other LLW facilities is the Generic Waste Package Specification (GWPS) [1]. The GWPS is supported by the Waste Package Specification and Guidance Documentation (WPSGD) which comprises a suite of documentation primarily aimed at SLCs, its intention being to present the generic packaging standards and specifications at the user level. The WPSGD also includes explanatory material and guidance that users will find helpful when it comes to application of the specification to practical packaging projects. For further information on the extent and the role of the WPSGD, reference should be made to the *Introduction to the Waste Package Specification and Guidance Documentation, WPS/100*¹.

In order to facilitate the safe and efficient packaging, transport and disposal of ILW, RWMD has defined a limited range of standard waste containers and has issued specifications defining dimensions, lifting, handling and other key features of the containers as well as minimum performance requirements for the complete waste package.

Of the standard waste packages, the 500 litre Drum is currently anticipated to be the most widely used. This waste package is designed to be handled and transported in groups of four in a stillage² (Figure 1). The stillage will also be used as a means of safe and efficient stacking of 500 litre Drum waste packages in a GDF.

The lifting and stacking features of the stillage are dimensionally compatible with those of another of the standard waste packages, the corner lifting variant of the 3 cubic metre Box (Figure 2). Part of the rationale for the design of this variant is that it can be handled, transported and stacked using the same equipment as that used for the stillages containing 500 litre Drum waste packages.

This document provides design basis information for a standard lifting frame suitable for handling stillages containing 500 litre Drum waste packages and corner lifting variants of

¹ Specific references to individual documents within the WPSGD are made in this document in *italic script*, followed by the relevant WPS number.

² The stillage to which this document refers is referred to by RWMD as the 'disposal stillage' (although it was previously referred to as the 'stacking stillage'), the outline design of which can be found in [2]. The RWMD disposal stillage is assumed to be compatible with the Sellafield 'Compact Stillage', at least with regard to key dimensions and handling/stacking characteristics.

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the 3 cubic metre Box waste package. It has been issued to accompany, and should therefore be read in conjunction with the relevant specifications and guidance for those waste packages, namely:

WPS/300: Specification for 500 litre Drum Waste Package

WPS/315: Specification for corner lifting variant of the 3 cubic metre Box Waste Package

WPS/700: 500 litre Drum Waste Package Specification: Guidance Material and Design Guidelines

WPS/715: 3 cubic metre Box Waste Package Specification: Guidance Material and Design Guidelines for corner lifting variant.

In the absence of detailed designs for lifting and handling equipment, design of the stillage and definition of the standards and specifications for corner lifting variant of the 3 cubic metre Box waste package have been progressed by making reasonable assumptions regarding the design concepts which will be adopted for the lifting equipment. The design basis assumptions may impact upon the design of waste packages and stillages and are therefore set down in this document so that designers of handling equipment can be made aware of them.

2 PURPOSE

The purpose of this document is to supplement the information provided in the specifications for the 500 litre Drum and the corner lifting variant of the 3 cubic metre Box waste package by providing design basis information on the lifting frame which has been assumed in the derivation of those specifications. This document defines the interface between stillages and waste packages and the lifting and will be of use to designers of waste containers, stillages and handling equipment alike.

This document should not be considered as a full specification of the lifting frame since its scope is limited to consideration of these factors which have an impact on the specification of waste package and stillage design and performance.

3 GENERAL DESCRIPTION OF THE LIFTING FRAME

3.1 Function of the Lifting Frame

The function of the lifting frame is to ensure that corner lifting variants of the 3 cubic metre Box waste package and stillages containing 500 litre Drum waste packages can be handled in a safe manner by an overhead crane or a similar handling device.

3.2 Design Assumptions

The following are assumptions regarding the design of lifting frame which have been made in the design of the stillage and in the derivation of the specification for the corner lifting variant of the 3 cubic metre Box waste package:

- The lifting frame will be designed to handle stillages containing four 500 litre Drum waste packages each with a maximum gross mass of 2t which, and using an assumed gross mass of 1t is for the stillage itself (total gross mass of 9t) and for the handling 3 cubic metre Box waste packages with a maximum gross mass of 12t.

- The lifting frame will be designed to handle the load by means of four point lifting. Four point lifting will be used to provide a degree of redundancy and to minimise tilting due to load imbalance.
- The frame will be designed in accordance with BS 2573 [2] which specifies the classification, stress calculations and design criteria for crane structures. The group classification, as defined in BS 2573, is assumed to be 'A4', with a class of utilisation 'U3' (infrequent use), which in turn implies a state of loading 'Q3' (heavy loading). A snatch load factor of 1.4 is also assumed.
- The frame will incorporate lifting twistlocks meeting the general requirements of BS 5237 [3], to locate and attach the lifting frame to the load.
- Each twistlock will be of the true horizontal floating type, as defined in BS 5237, to enable them to position themselves separately with respect to the lifting attachments on the load.
- The twistlocks will be housed within a locating spigot of the type defined in BS 5237, designed to locate the twistlock in the apertures of the lifting features on the waste packages.
- Measures will be incorporated in the design of the lifting frame to minimise the risk of inadvertent release or other mishandling of packages. These are likely to include limit and/or probe switches and appropriate warnings to indicate the status of the twistlocks interlocks to detect the presence of a load and prevent unlocking of the twistlocks when laden, and a 'slack rope' interlock to indicate when the lifting frame has been lowered on to the container. In the event of failure of the lifting frame whilst attached to a load measures will be provided to allow the load to be lowered in a controlled manner and disengaged from the lifting frame by remote means. The consequences of a collision with a stationary object whilst laden will be considered in order to minimise the risk of releasing the load.
- The dimensions of the lifting frame will be determined by the need for it to be capable of being introduced with adequate clearance into the internal cavity of transport containers when emplacing or removing the load.

4 KEY INTERFACING INFORMATION

4.1 General

The lifting frame interfaces with the load solely via the twistlocks and locating spigots. To ensure proper operation of the lifting frame with the waste package (or stillage) it is essential that the lifting features on the stillage meet the requirements defined in the specification. Responsibility for ensuring that the design of the stillage meets these requirements remains with RWMD.

The following information is additionally provided to assist with the design of the lifting feature design.

4.2 Twistlock details

The maximum mass to be lifted by the lifting frame is 12t, this being the maximum mass of the corner lifting variant of the 3 cubic metre Box waste package. The nominal load to be supported by each twistlock is therefore 3t. However the SWL must also be chosen to cope with additional factors such as uneven load distribution, tilt, snatch loads, and RWMD's requirement that the twistlocks and frame be capable of supporting the package

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with only 3 twistlocks attached. All of the above factors will serve to increase the SWL requirements of the individual twistlocks.

A lifting twistlock of 12t SWL capacity, to the requirements of BS 5237 [3], will be adequate to satisfy these additional considerations.

The SWL of a lifting twistlock designed to BS 5237 is related primarily to the diameter of the shank to head undercut. For a SWL of 12t the undercut diameter has to be not less than 56mm and not more than 57mm, with a nominal shank diameter of 58mm. These details are illustrated in Figure 3. A further consequence is that the lifting frame must allow the twistlocks to float by a minimum of 4mm both laterally and longitudinally.

4.3 Locating Spigot Details

Spigot design requirements are specified in BS 5237. The spigot dimensions are determined by the major dimensions of the twistlock and are such that they ensure that when the twistlock is in the unlocked position the head of the twistlock does not extend beyond the outer dimensions of the spigot.

The major dimensions of the spigots to be employed on the lifting frame are shown in Figure 4 (based on Figure 2 in BS 5237 [3] to which reference may be made for other design details not shown).

4.4 Twistlock Insertion Depth

For the purpose of designing the lifting feature on the waste package the maximum insertion depth of the combination of spigot and twistlock head shall be taken to be 127mm as indicated on Figure 4. The minimum spigot depth will be 66mm and therefore the plate thickness of the lifting aperture on the waste package is to be a maximum of 56mm. This will ensure that when the twistlock is inserted into the lifting feature there will be a minimum 10mm clearance between the twistlock head bearing surface and the underside of the lifting plate.

4.5 Twistlock/Lifting Aperture Positions

The nominal positions of the lifting apertures for the corner lifting variant of the 3 cubic metre Box waste package are defined in WPS/315 and are illustrated in Figure 5. The same nominal positions are employed on the stillage.

In addition, these positions will also be used for the positioning of the twistlocks on the lifting frame. Limits on the twistlock positions will be established by RWMD making due allowance for float.

4.6 Aperture Dimensions

Nominal aperture dimensions for the corner lifting variant of the 3 cubic metre Box waste package are defined in WPS/315 and are illustrated in Figure 5, which also shows allowable tolerances on each of the dimensions. The same aperture dimensions are employed on the stillage.

To prevent damage to the twistlock head when entering the aperture a 3mm x 45° lead-in chamfer on the upper surface of the aperture should also be provided.

Figure 1 Stillage containing four 500 litre Drum waste packages

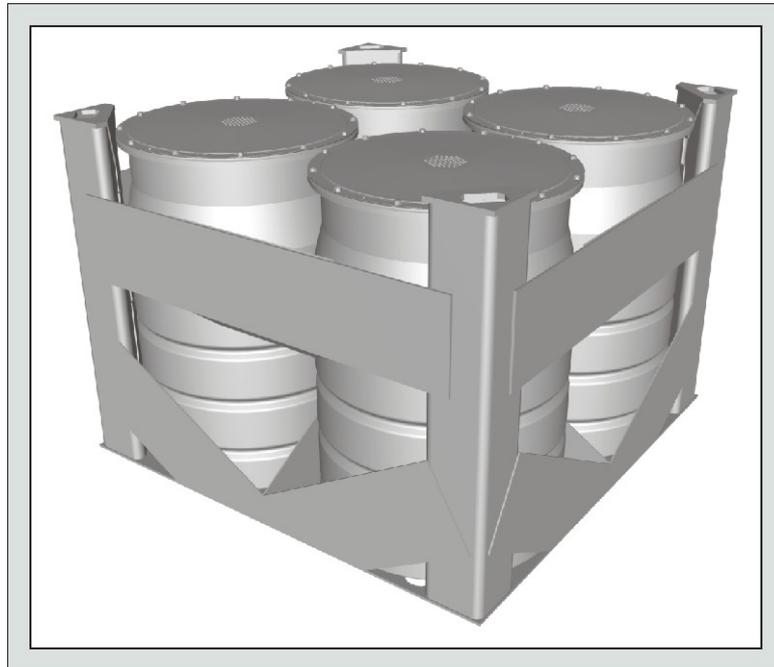


Figure 2 Corner lifting variant of the 3 cubic metre Box waste package

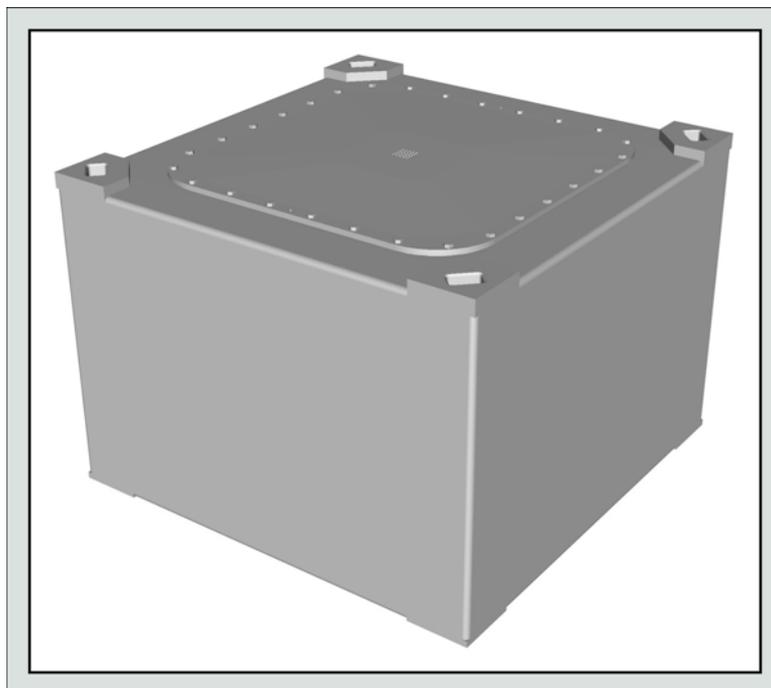
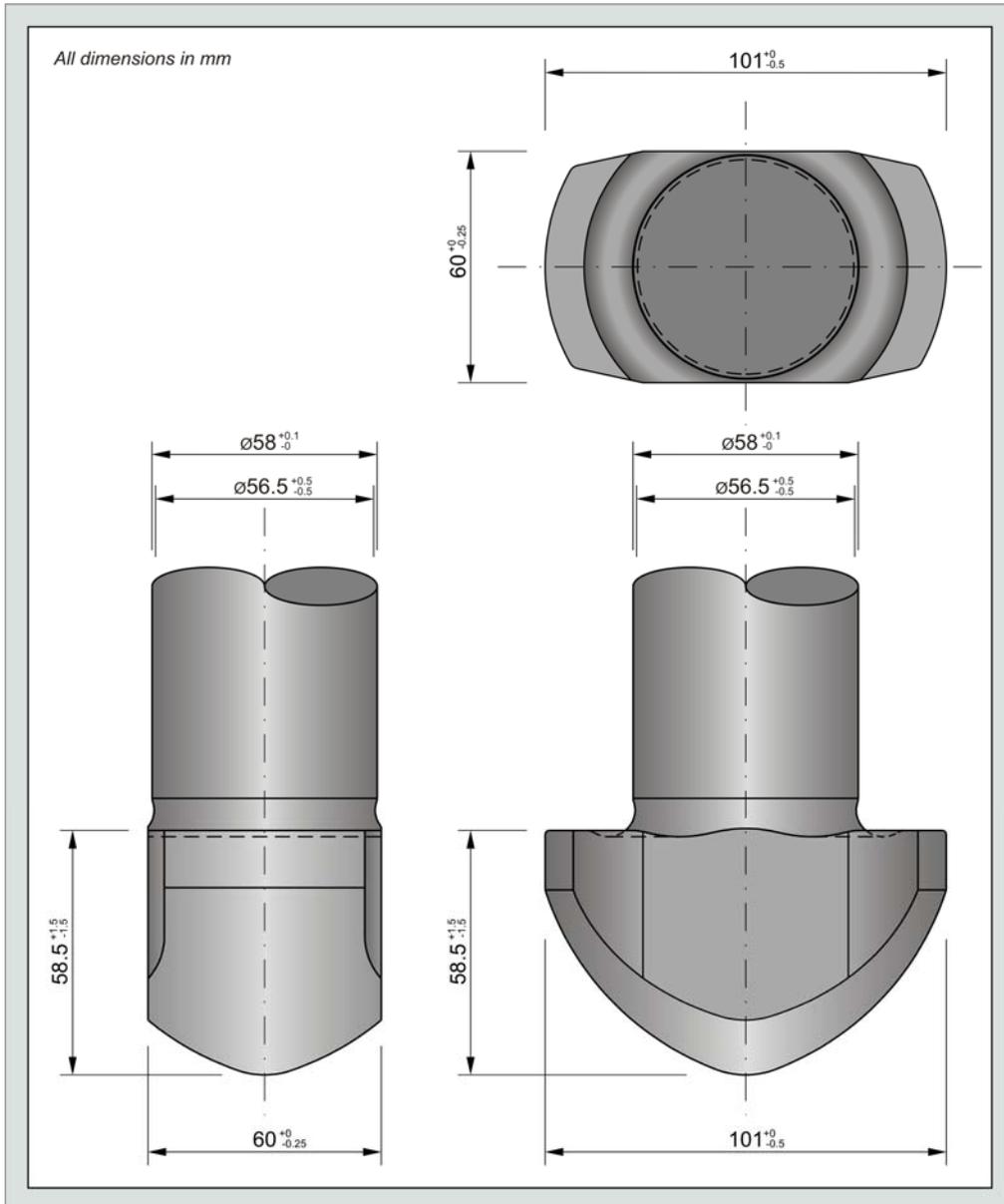
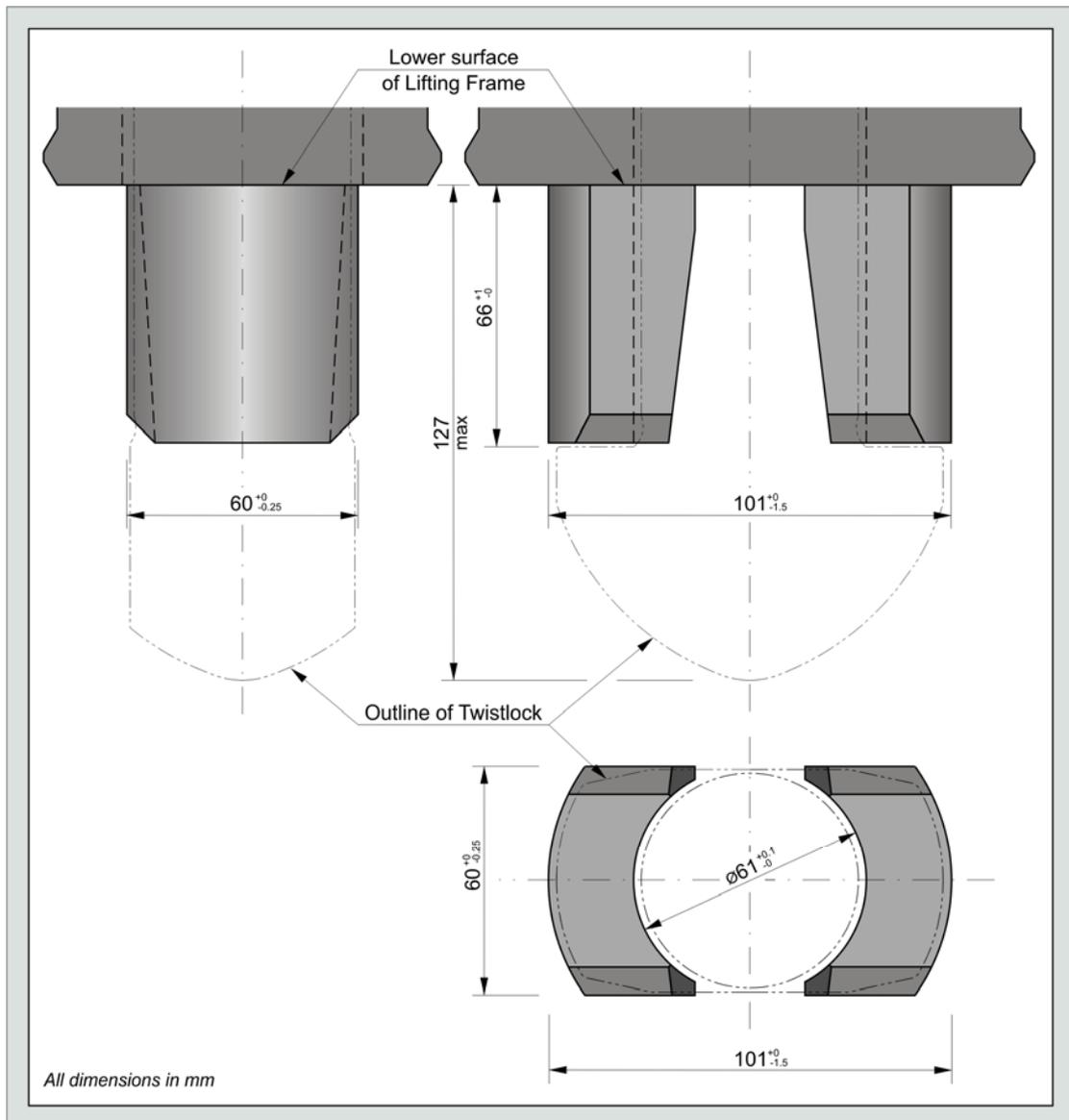


Figure 3 Twistlock dimensions³



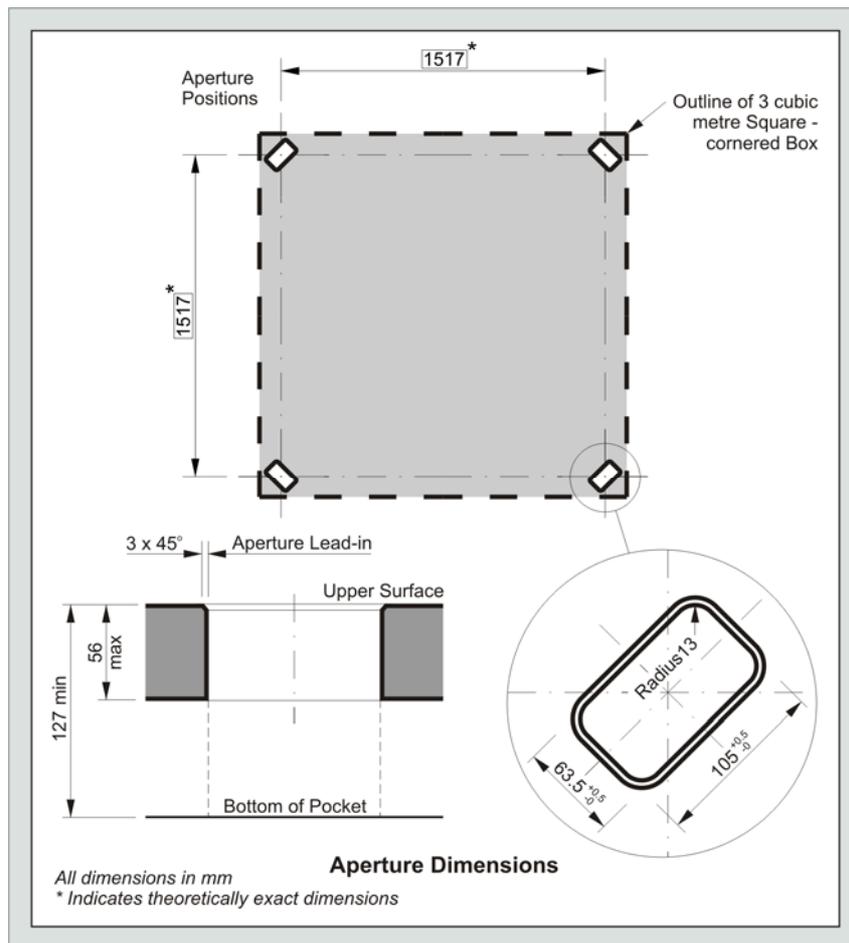
³ Based on Figure 1 in BS 5237 [3] to which reference may be made for other design details not shown.

Figure 4 Locating spigot dimensions⁴



⁴ Based on Figure 2 in BS 5237 [3] to which reference may be made for other design details not shown.

Figure 5 Lifting centres and aperture details for the corner-lifting variant of the 3 cubic metre Box waste package⁵



⁵ Note that, with the exception of the waste package outline, the dimensions shown are identical to those of the stillage for 500 litre Drum waste packages

5 REFERENCES

- 1 Nirex, *Generic Waste Package Specification*, Nirex Report N/104 Issue 2, 2007.
- 2 British Standards Institution, *British Standard Rules for Design of Cranes, Part 1 Specification for classification, stress calculations and design for structures*, BS 2573: Part 1, 1983.
- 3 British Standards Institution, *British Standard Specification for Lifting Twistlocks*, BS 5237: 1985.

