A Guide to the Approval of Freight Containers as Type IP-2 and Type IP-3 Packages

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Department for Transport

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Users should note that this document is intended as an informative and explanatory guide to the regulations governing the transport of radioactive material. It is not intended as an authoritative or comprehensive statement of the law, nor a substitute for the source legislative material. It should be read in conjunction with the statutory provisions and any determinations, directions and regulations to which it refers. It is based on established policy and does not introduce any new issues of principle.

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1. Introduction

1.1 It has become clear that, since the introduction in the IAEA regulations of the option to qualify freight containers as Type IP-2 or Type IP-3 packages by one of two alternative methods, the interpretation of how this should be implemented has differed widely throughout the nuclear transport industry. This paper has therefore been produced to provide UK Competent Authority guidance on what a user should do to comply with the regulations. It is hoped that, as a result, some degree of consistency in approach will be achieved. The IAEA provisions are already contained in UK legislation for road under "The Radioactive Material (Road Transport) (Great Britain) Regulations 2002" [5] and, for rail, "The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2004"[6]. It should also be noted that for international movements the requirements of the applicable modal regulations will also need to be complied with.

1.2 The use of the freight container for the transport of radioactive material was first introduced in the International Atomic Energy Agency's Safety Series No. 6 Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition [7]. This was more in respect of its use as an overpack than as a packaging in its own right. The first issue of the Agency's 1985 Safety Series No. 6 regulations [8] introduced new definitions for different material forms (LSA-I, LSA-II, LSA-III, SCO-I and SCO-II) and specified the packaging standard appropriate for each material form (Type IP-1, Type IP-2 or Type IP-3). These regulations also introduced the concept of freight containers as Type IP-2 and Type IP-3 packages in paragraph 523 and allowed the design and testing regime specified in ISO document ISO 1496/1-1978, "Series 1 Freight Containers - Specification and Testing - Part 1: General Cargo Containers" [9] to be used as an alternative to the Type IP-2 and Type IP-3 test requirements of paragraphs 519 and 520. Paragraph 523 did however have one additional requirement not included in ISO 1496/1 [9] and that was that "*...if they were subjected to the tests prescribed in that document they would prevent loss of shielding which would result in more than a 20% increase in the* ***radiation level*** *at any external surface of the* ***freight container****."*.

1.3 It was soon realised that, as written, paragraph 523 did not provide equivalence with paragraphs 519 and 520 in one very important aspect, namely containment. The weather-proofness test of ISO 1496/1 was not considered to be sufficiently searching. In fact, as with the other ISO 1496/1 tests, it is designed to protect the contents of the freight container from the environment rather than the radioactive material transport requirement of protecting the environment from the radioactive contents. This was remedied in the 1985 IAEA Regulations (As Amended 1990) [1] by the introduction of the requirement to "*prevent the loss or dispersal of the radioactive contents*" following subjection to all the tests prescribed in ISO 1496/1. This would therefore entail some form of leak resistance evidence, possibly in the form of leak testing, which required validation to the satisfaction of the approving authority or competent authority if requested to do so. Alternatively other methods, suitably justified, could be used to show that the package containment system was adequate when considering the particular radioactive material contents to be transported. This then fell more into line with the containment requirements of paragraphs 519 and 520.

1.4 The latest IAEA regulations to apply to the transport of radioactive materials are published as TS-R-1, 1996 Edition (As Amended 2003) [4] (hereinafter referred to as TS-R-1 [4]) and the definition of Freight Container is detailed in paragraph 223:

> *223.* ***Freight container*** *shall mean an article of transport equipment designed to facilitate the carriage of goods, either packaged or unpackaged, by one or more modes of transport without intermediate reloading. It shall be of a permanent enclosed character, rigid and strong enough for repeated use and must be fitted with devices facilitating its handling, particularly in transfer between* ***conveyances*** *and from one mode of transport to another. A small* ***freight container*** *is that which has either any overall outer dimension less than 1.5 m, or an internal volume of not more than 3 m^3. Any other* ***freight container*** *is considered to be a large* ***freight container****.*

1.5 The definition (paragraph 223) used to describe a packaging for the transport of radioactive materials, does not tie the designer to ISO 1496/1; it is TS-R-1 [4], paragraph 627 that does this, and the important aspect of this link is in respect of the packages ability to pass the tests prescribed in the ISO document. The ISO 1496/1 tests should be used to justify that a package meets the definition in TS-R-1 [4], paragraph 223. Indeed the most practical way to comply with the requirements of paragraph 627 is to design the package to Type IP-2 or Type IP-3 standards dependent on the particular LSA or SCO contents to be carried. This approach then allows the use of the ISO 1496/1 tests to prove acceptability as an alternative to the Type IP-2 or Type IP-3 test requirements called for in paragraphs 622 and 623. The basis of this allowed alternative testing regime is that all the ISO 1496/1 tests together provide equivalence to the dynamic testing required by TS-R-1 [4].

1.6 The Type IP-2 or Type IP-3 standards in TS-R-1 [4] referred to above are:

- the Type IP-1 requirements (paragraph 621) - *The General Requirements for all Packagings and Packages* and the size restriction given in paragraph 634,
- the containment and shielding requirements specified in paragraph 622, and
- in the case of a Type IP-3, there is a further need to meet the Type A requirements contained in paragraphs 634 - 647. However paragraph 646 in this instance is replaced by paragraph 627 (c). As freight containers, when used as packagings rather than as overpacks, invariably travel under Exclusive Use, in a practical sense the need for Type IP-3 status is rarely required (see table below).

Contents	Industrial package type	
	Exclusive Use	Not under exclusive use
LSA-I		
Solid	Type IP-1	Type IP-1
Liquid	Type IP-1	Type IP-2
LSA-II		
Solid	Type IP-2	Type IP-2
Liquid and gas	Type IP-2	Type IP-3
LSA-III	Type IP-2	Type IP-3
SCO-I	Type IP-1	Type IP-1
SCO-II	Type IP-2	Type IP-2

Industrial Package Requirements for LSA Material and SCO

1.7 Taking the above requirements into account a standard off-the-line ISO freight container could only be used as a Type IP-2 or Type IP-3 package if it meets all the relevant IAEA regulatory requirements for the transport of radioactive materials as specified in TS-R-1 [4], paragraphs 621, 622 and 623 as appropriate.

1.8 The rest of this paper is primarily concerned with the use of freight containers as Type IP-2 packagings.

2. Review Carried Out in the Revision of IAEA SS6 [1], SS7 [2] and SS37 [3]

2.1 In reviewing the IAEA 1985 regulations (SS6 [1], SS7 [2] and SS37 [3]) for what has now become the TS-R-1 [4], and the IAEA TS-G-1.1 (ST-2) advisory material [10], the IAEA held a Consultant Services Meeting (CSM) [11] in Berlin in August 1995 specifically to consider the various alternative requirement in the 1985 edition (As Amended 1990) regulations [1], and to consider adding alternative requirements for intermediate bulk containers (IBC's).

2.2 The terms of reference of this CSM were to consider the justification for the use of tested packagings as an alternative to the Industrial Package Type 2 and Industrial Package Type 3 test requirements and to consider the need to amend the proposed relevant text for the 2nd draft of the 1996 Edition of SS6 and to prepare a report accordingly. The main issues identified by the CSM (as detailed in the report of the meeting) were:

i) The need to compare each set of alternative test requirements with the standard requirements for Type IP-2 and Type IP-3 packages.

ii) Pay attention to comparability of acceptance criteria.

iii) Pay attention to the adequacy of quality control.

iv) To attempt to correct any significant differences which emerged from i).

2.3 The CSM made recommendations for changes to SS6 [1], SS7 [2] and SS37 [3] for all the alternative requirements for Type IP-2 and Type IP-3 packages: these recommendations were adopted by the IAEA Revision Panel IV (September 95) and have been incorporated in the 1996 edition of the IAEA SS6 regulations (most recently published as TS-R-1 [4]). These changes, as they affect freight containers, are discussed in more detail in Sections 3 and 4 of this paper. Work proceeded on revising SS7/SS37 and this has now been issued as one document referenced TS-G-1.1 (ST-2) [10].

2.4 The review of the alternative requirements for freight containers centered on the provision of containment necessary to meet the '*prevent loss or dispersal'* acceptance criteria. This review arose because it had been identified in Working Papers considered at the CSM, that paragraph 523 of the IAEA SS6, 1985, (As Amended) regulations [1] could be interpreted as allowing standard ISO freight containers to be qualified as Type IP-2 packages, and it was recognised that these containers provided no proven

containment capability for any loose particulate radioactive material that may be within the contents of such a package.

2.5 The CSM recommended clarification of these containment requirements - the recommendations being:

> *"The commonly quoted "loss or dispersal of radioactive contents" criteria should be generically coupled with "during and after testing" in SS37, with particular attention (to) during testing for freight containers."*

2.6 The CSM also recommend changes to SS37 [3] as below:

> *"The CSM agreed that new advisory material is essential concerning:*
>
> - *evaluating "loss of contents" during and after testing.*
> - *Spelling out that only closed versions of freight containers are allowed as IP-2 or IP-3.*
> - *ensuring that advice concerning "acceleration" is properly applicable to freight containers."*

2.7 The revised requirements for freight containers in paragraph 627 of TS-R-1 [4] together with the proposed amendments to SS37 [3] (now published as TS-G-1.1 (ST-2) [10]), are intended to ensure that there are adequate requirements specified to ensure that Type IP-2 freight containers provide equivalent safety (especially with respect to containment), to packages designed to the standard requirements in TS-R-1 [4], paragraph 622. Text is included in TS-G-1.1 (ST-2) [10] to indicate that standard off-the-line ISO freight containers cannot be used as Type IP-2 packages unless they have been demonstrated to meet the regulatory containment and shielding performance requirements. TS-G-1.1 (ST-2) paragraph 627.2 states:

> *"...Consideration should be given to the construction details of the container to ensure that the containment requirements can be met..."*

3. Requirements for Type IP-2 Freight Containers in the IAEA TS-R-1 Regulations 1996 Edition (As Amended 2003) [4]

3.1 The packaging standard for Type IP-2 packages is given in TS-R-1 [4], paragraph 622. This specifies a basic packaging standard which requires packages to be shown to provide retention of contents and limited increase in radiation levels if the package is subjected to drop and stacking tests appropriate to normal conditions of transport.

3.2 As well as explicit reference to Industrial Packages, TS-R-1 [4] also allows acceptable alternative packages where such package types exist for which there is a well established (equivalent) test regime. These alternative packages are UN tested packages (less than 450 kg) (see paragraph 624), tank containers (see paragraph 625), tanks (see

paragraph 626), freight containers (see paragraph 627) and metal intermediate bulk containers (IBC's) (see paragraph 628).

3.3 The reason for the inclusion of these alternatives in the TS-R-1 [4] is that it is unnecessary to carry out new tests: i) where alternative tests are essentially the same as the regulatory tests (e.g. for UN drums and metal IBC's), or ii) where it is deemed to be more appropriate to use the alternative requirements (e.g. for tank containers, tanks and freight containers).

3.4 The adoption of the alternative requirements and limits for freight containers is discussed in TS-G-1.1 [10]. The advice given is:

627.2. Freight containers designed and tested to ISO 1496-1 are restricted to the carriage of solids because they are not regarded as being suitable for free liquids or liquids in non-qualified packagings. Consideration should be given to the construction details of the container to ensure that the containment requirements can be met. Only closed freight containers can be used to demonstrate compliance with the Type IP-2 and Type IP-3 containment requirement of no loss or dispersal of radioactive contents, and monitoring during and after testing is necessary to demonstrate this. Closed freight containers also include freight containers with openings on top, if these openings are safely closed during transport.

627.3. Freight containers must be shown to retain and contain their contents during accelerations occurring in routine transport because ISO Standard Tests for freight containers do not include dynamic tests.

3.5 The standard requirements for Type IP-2 packages given in IAEA TS-R-1 [4], paragraphs 621 and 622 are:

Requirements for Type IP-1

*621. A **Type IP-1** shall be designed to meet the requirements specified in paras 606-616 and 634, and, in addition, the requirements of paras 617-619 if carried by air.*

Requirements for Type IP-2

*622. **A package**, to be qualified as a **Type IP-2**, shall be designed to meet the requirements for **Type IP-1** as specified in para. 621 and, in addition, if it were subjected to the tests specified in paras 722 and 723, it would prevent:*

*(a) loss or dispersal of the **radioactive contents**; and*
*(b) loss of shielding integrity which would result in more than a 20% increase in the **radiation level** at any external surface of the **package**.*

3.6 The alternative requirements in TS-R-1 [4] for freight containers given in paragraph 627 are:

> *627. **Freight containers** may also be used as **Type IP-2** or **Type IP-3**, provided that:*
>
> *(a) The **radioactive contents** are restricted to solid materials;*
> *(b) They satisfy the requirements for **Type IP-1** specified in para. 621; and*
> *(c) They are designed to conform to the standards prescribed in the International Organization for Standardization document ISO 1496/1:, "Series 1 Freight Containers - Specifications and Testing - Part 1: General Cargo Containers" excluding dimensions and ratings. They shall be designed such that if subjected to the tests prescribed in that document and the accelerations occurring during routine conditions of transport they would prevent;*
>
> *(i) loss or dispersal of the **radioactive contents**; and*
> *(ii) loss of shielding integrity which would result in more than a 20% increase in the **radiation level** at any external surface of the **freight containers**.*

3.7 The tests, and associated pass criteria, for freight containers are specified in ISO 1496/1. These tests have been developed over many years and are designed to ensure that ISO freight containers, in normal transport, remain undamaged and protect their contents from the environment. The IAEA additional requirement for freight containers to meet the "no loss or dispersal of contents" and “restriction of radiation level increase”, is intended to ensure that the freight container will protect the environment and operators from the radioactive contents. In particular it should be noted that the general regulations for all packagings (paragraph 612) requires a package to withstand *‘the effects of acceleration, vibration and vibration resonance’*, consequently the tie-down points (internal and external) should be designed to ensure that movement of the contents will not affect the integrity of the freight container under normal conditions of transport. This becomes particularly important when the contents are large and/or heavy compared to the freight container. If the contents are not tied down some form of inert packing should always be used to prevent contents movement during transport. It must be demonstrated that such packing is well specified and will not itself cause the container to lose its containment capability under the accelerations occurring during routine conditions of transport.

3.8 The above IAEA paragraph (627) results in the following specific requirements for IP-2 freight containers.

Requirements	Comments
Radioactive contents is restricted to solids.	No free liquids or gases allowed, even small quantities with solid waste, unless irreversibly absorbed by solid.
Type IP-1 requirements in paragraph 621 apply.	These are the general requirements which are easily met.
The freight container must be subjected to all the ISO 1496/1 tests with the pass criteria being as stated in that document as well as meeting the IAEA requirement of "prevent loss or dispersal" and the restriction on radiation increase. Any tests not carried out must be with the agreement of the Competent Authority.	The freight container dimensions and ratings can be different from those in the standard.
The freight container must be designed to provide containment and restrict movement of contents:	These conditions may require features not provided by standard ISO freight containers.
• during the ISO 1496/1 tests, and	Proof required before, at extreme loading and after each test.
• during the accelerations occurring under routine conditions of transport.	Methods to restrict the movement of contents to be incorporated to meet this requirement. Advice is given in TS-G-1.1 [10], paragraphs 627.3 and 627.4.

3.9 As a result of discussions during the IAEA Revision Process the current version of TS-G-1.1 [10], paragraph 627.1, emphasises that The International Convention for Safe Containers (CSC) [12] is not equivalent to ISO 1496/1. The guidance information given is that packages should be designed and tested to ISO 1496/1 and can be approved to CSC [12].

> *627.1. Freight containers designed and tested to ISO 1496-1 and approved in accordance with the CSC Convention have been proved, by the use of millions of units, to provide safe handling and transport under routine conditions of transport. It should be noted however that ISO 1496-1 addresses issues relating to container design and testing whereas the CSC Convention is primarily concerned with ensuring that containers are safe for transport, are adequately maintained and are suitable for international shipment by all modes of surface transport. The testing prescribed in CSC is not equivalent to that prescribed in ISO 1496-1.*

This is, in fact, the normal approval route in the UK. It should be emphasised, however, that approval to CSC [12] is not a requirement for approving radioactive materials transport containers to the IAEA regulations although it is recommended that CSC [12] approval be obtained as a matter of good working practice as it provides a well established method of controlling standards. The main difference between CSC [12] and ISO 1496/1 is that the latter specifies more detailed design requirements whilst CSC [12] relies on meeting specific performance tests to prove the design. As identified in TS-G-1.1, paragraph 627.1 above, the testing specified in the two documents also differs

in minor ways, i.e. internal loads for testing fork lift pockets, stacking requirements and the fact that CSC [12] does not specify a weather-proofness test.

4. Interpretation of the IAEA TS-R-1 Regulations 1996 Edition (As Amended 2003) [4] for Type IP-2 Freight Containers

4.1 Prior to 1985 the transport of LLW in the UK involved the use of drums and other packages meeting the requirements of the IAEA SS6, 1973 Revised Edition (As Amended) regulations [13]. These packages being carried on trucks or within standard ISO freight containers (not Type IP-2 freight containers).

4.2 At that time, no freight containers had been qualified as Type IP-2 packagings in the UK. Discussions were held at meetings between the UK Competent Authority and industry members on what features and test requirements were required for Type IP-2 freight containers, over and above those specified in ISO 1496/1.

4.3 The criterion set by the UK Competent Authority was that standards for the Type IP-2 freight containers should be equivalent to those accepted for other performance tested packages, i.e. any Type IP-2 freight container design should provide adequate containment.

4.4 It was recognised in the discussions that the ISO tests are designed primarily to ensure that freight containers are of an adequate standard to protect the contents from the environment. Consequently, it was obvious that an Type IP-2 freight container must be required to have a containment capability adequate to retain radioactive materials in fine particulate form (as might be present in LLW). It was further recognised that many of the ISO tests related to the general strength of the freight container and that only the racking tests (transverse and longitudinal) and the side wall and end wall loading (combined with possible internal pressurisation) were likely to result in the release of particulate contents.

4.5 One important conclusion of the discussions was that Type IP-2 freight containers should be provided with a containment system which could be shown to be leakproof (i.e. "prevent loss or dispersal" (as now required by TS-R-1 [4], paragraph 627(c)(i)), not just after, but before and during, the ISO tests. This was deemed to be necessary to ensure that the containment system remained leakproof during flexing of the freight container body which occurs when in transit under routine conditions. When assessing this 'leakproofness' of the container the form of the radioactive material contents should be taken into account in determining the level of leak tightness required. This could range from the need to show adequate containment of massive solids through to fine particulate.

4.6 For finer material contents the demonstration that such a containment system meets the IP-2 requirement generally entails some form of leak testing utilising, for instance, double seals on the containment closure. If single seals are used, adequate test methods would have to be devised and validated by the designer. One useful document that could

be used to determine leakage standards and methods is "ISO Standard - Leakage Testing on Packages for the Safe Transport of Radioactive Materials - ISO 12807:1996(E)" [14].

It should be noted that the leaktightness capability of a double door configuration is questionable, especially during the extremes of the racking tests required by ISO 1496/1, and the design of a Type IP-2 freight container should take this into account. Proof of containment should be shown, at least, for the racking tests and the side wall and end wall tests called up in ISO 1496/1, taking into account the particular radioactive material to be carried, as these are the tests most likely to affect containment or shielding capability. Where a leak test cannot be carried out on a particular design of freight container, alternative procedures should be developed and justified to the Approving Authority, which should ensure that such procedures meet the requirements of the Regulations. These alternative procedures would also need to be justified to the UK Competent Authority if requested to do so. As a minimum, the leak tests required (in addition to the normal periodic maintenance tasks) are as follows:

At build:
a) Containment closure leak test before, at extreme loading and after each ISO 1496/1 test, referred to above, using, for example, the air pressure drop method.
b) Container body leak test to prove welds etc., using, for instance, a soap bubble test. Suitable instruments, to the required standard, could also be used.

Each trip:
If the freight container is equipped with containment closure test points, and a practical leak test can be carried out in the field, this method could be used to check the closure at each trip. As a minimum however, a check, to an approved prescribed procedure, on the seal(s) and seal face(s) (if they have been disturbed) could be employed to give confidence that the seal(s) still perform to the designed standard before shipment. It may be necessary to leak test (or wipe test) more frequently during the early life of a new design to assess the possible degradation of the sealing system. Thereafter, once the necessary evidence has been gathered, it might be acceptable to reduce the frequency of testing accordingly.

Annual maintenance:
a) Containment closure leak test.
b) Visual inspection of body.

Repair:
Containment closure leak test and/or container body leak test depending on the area of repair. Repairs should only be authorised where the ability of the freight container to meet the requirements of the regulations would be unaffected.

4.7 The test methods used and the acceptance standards required need to be deterministic, as this is the basis of the regulations, and justified, bearing in mind the radioactive contents of the freight container. Probabilistic methods should not be used.

4.8 Advice on the containment criteria of "*prevent loss or dispersal*" can be found in TS-G-1.1 [10] as follows:

> *622.1. Consideration of the release of contents from Type IP-2 packages imposes a containment function on the package for normal conditions of transport. Some simplification in demonstrating no loss or dispersal of contents is possible owing to the rather immobile character of some LSA material and SCO contents and the limited specific activity and surface contamination. See also paras 646.2-646.5.*
>
> *646.3. ...A qualitative approach, dependent upon the packaging under consideration and its radioactive contents, may be employed...*
>
> *646.4. For solid, granular and liquid contents, one way of satisfying the requirements for 'no loss or dispersal' would be to monitor the package (containing a non-active, control material) on completion of a vacuum test or other appropriate tests to determine visually whether any of the contents have escaped. ... Thereafter, a careful visual inspection of the package may confirm that its integrity is maintained and no leakage has occurred...*

4.9 The use of filters is acceptable to prevent the build up of pressure inside the freight container (or increase in external pressure) during use, but the type, and its ability to prevent the radioactive contents escaping, will need to be justified. For the 'at build' cavity test, referred to above, the filter(s) would need to be blanked off.

4.10 It has been proposed [15] that unqualified primary containers carried in unqualified ISO freight containers together provided a high enough degree of containment to enable such combination packages to be qualified as Type IP-2 packages. This approach is not favoured by the UK Competent Authority as it involves probabilistic rather than deterministic justification to show compliance with regulatory requirements. The provision in TS-R-1 [4] for the use of freight containers as Type IP-2 packages only applies where the freight container provides the primary packaging function, including the containment of the radioactive contents. This results from the fact that the situation with the freight container is essentially unique in that ISO 1496/1 testing is carried out only on the freight container packaging and not the assembled package, therefore the Type IP-2 package requirements have to apply to the freight container itself. It follows, therefore, that either the internal primary containers have to be qualified as Type IP-2 packages or the ISO freight container should be acceptable as a Type IP-2 package in its own right.

4.11 A freight container is limited to the transport of solid radioactive material when used as a Type IP-2 package, therefore the transport of LSA-II liquid and gas can only be carried out if the material is contained in some other approved Type IP-2 package(s), and then only under Exclusive Use (see definition in TS-R-1 [4], paragraph 221). A Type IP-3 package is required for transport of LSA-II liquid and gas radioactive material not under Exclusive Use (see the table in clause 1.6 of this Guide). A freight container can then be used as an overpack to consolidate the consignment as long as such consolidation meets the requirements of TS-R-1 [4]. It is expected that bulk liquid and

gas radioactive material would be transported in tank containers or tanks qualified under TS-R-1 [4], paragraph 625 or 626 respectively. The definition of an LSA-II liquid is found in TS-R-1 [4], paragraph 226(b):

LSA-II

(i) Water with tritium concentration up to 0.8 TBq/L; or
*(ii) Other material in which the activity is distributed throughout and the estimated average **specific activity** does not exceed 10^{-4} A_2/g for solids and gases, and 10^{-5} A_2/g for liquids.*

If sludges are to be carried, any settling should not increase the specific activity beyond the 10^{-5} A_2/g limit.

5. Comparison of the Requirements for Standard Type IP-2 Packages and the Specific Requirements for Type IP-2 Freight Containers in IAEA TS-R-1 1996 Edition (As Amended 2003) [4]

5.1 The basic requirements for standard Type IP-2 packages qualified to paragraph 622 of the TS-R-1 [4] are the same as those specified for freight containers qualified to the alternative requirements in paragraph 627 of the IAEA TS-R-1 regulations [4], these being:

- Designed to requirements for Type IP-1 packages.
- Acceptance criteria when subjected to the appropriate tests being:
  - No loss or dispersal of the radioactive contents,
  - Restriction of increase in external surface radiation level to no more than 20%.

5.2 The difference in the requirements for standard Type IP-2 packages and Type IP-2 freight containers lies in the test methods as given below:

Standard Tests for Type IP-2 Packages (TS-R-1 [4], paragraph 622)	**Specific Tests for Freight Containers Qualifying as Type IP-2 Packages** (TS-R-1 [4], paragraph 627)
Drop and stacking tests specified in paragraphs 722 and 723 respectively of the TS-R-1 regulations [4]. These tests are appropriate for general Industrial Packages such as drums or boxes which might be subjected to drops and impacts similar to those specified in the tests detailed in paragraphs 722 and 723.	Full testing regime as given in ISO 1496/1 [9]. These tests are appropriate for Type IP-2 freight containers as has been shown by the large number of standard ISO freight containers in worldwide shipment. Note: The advice given in IAEA TS-G-1.1 [10] paragraph 627.3 (see clause 3.4 of this Guide) that (Type IP-2) freight containers must be shown to retain their contents during accelerations occurring in routine transport, generally results in Type IP-2 freight containers having to be purpose designed as it is questionable whether standard ISO Freight Containers would meet this requirement.

5.3 The above shows that, even though the approval route is different for standard Type IP-2 packages and Type IP-2 freight containers, they can each result in a safe means of transporting radioactive materials. The method of transport and the controls employed in the approval and use of Type IP-2 freight containers has shown that the testing requirements covers the situations likely to be encountered in transport, which is the same basis used to justify the test regime specified for other Type IP-2 packages.

6. Conclusions

6.1 It is clear that if a freight container is to be approved to the Type IP-2 package requirements of the TS-R-1 [4] then it has to be designed, tested and approved for the particular radioactive contents it is designed to carry. A standard ISO freight container is not generally designed to be leak tight under routine conditions of transport even though it may be effective in protecting its contents from the rigours of international transport, as it is designed to do. However it may not necessarily be effective in protecting the environment from the radioactive contents. Once this situation is understood the logical conclusion is that freight containers as Type IP-2 radioactive material packagings need to be designed and manufactured under the same strict rules as for other types of radioactive material packagings, the only difference being the method by which their acceptability is proven.

6.2 In summary the following lists the main points for consideration:

- Standard ISO freight containers are generally not suitable for classification as Type IP-2 packages.
- As a Type IP-2 package the freight container on its own must be approved as such. Any inner packages accredited with some containment capability must each be shown to meet the requirements of the regulations (e.g. Type IP-2).
- Where necessary (dependent on the form of the contents) containment seals must be included in the freight container design and leak tested accordingly.
- The movement of the contents of the freight container must be adequately restricted.

7. References

1. Regulations for the Safe Transport of Radioactive Material, 1985 Edition, (As Amended 1990), Safety Series No. 6, IAEA, Vienna (1990).

2. Explanatory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (1985 Edition), Second Edition (As Amended 1990), Safety Series No. 7, IAEA, Vienna (1990).

3. Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (1985 Edition), Third Edition (As Amended 1990), Safety Series No. 37, IAEA, Vienna (1990).

4. IAEA, Regulations for the Safe Transport of Radioactive Material, 1996 Edition (As Amended 2003), Safety Requirements, Safety Standards Series No. TS-R-1, IAEA, Vienna (2004).

5. The Radioactive Material (Road Transport) Regulations 2002. Statutory Instrument 2002 No. 1093.

6. The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2004. Statutory Instrument 2004 No. 568.

7. Regulations for the Safe Transport of Radioactive Material, 1973 Revised Edition, Safety Series No. 6, IAEA, Vienna (1973).

8. Regulations for the Safe Transport of Radioactive Material, 1985 Edition, Safety Series No. 6, IAEA, Vienna (1985).

9. ISO Standard. Series 1 Freight Containers - Specification and testing - Part 1: General cargo containers, (ISO 1496/1-1978), ISO, Geneva (1978).
Note: When applying this guidance the most recent edition of ISO 1496/1 should be used.

10. IAEA, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material, Safety Guide, IAEA Safety Standards Series No. TS-G-1.1 (ST-2), Vienna (2002).

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