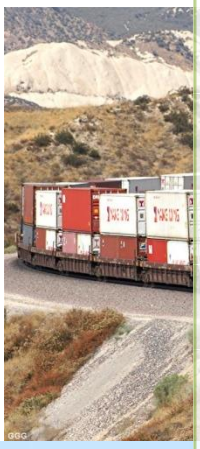
Freight Container Guidance Document



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Principal Authors

Mark Hawk, Oak Ridge National Laboratory

Ronald B. Natali, Oak Ridge National Laboratory Subcontractor

Erich Opperman, Savannah River Nuclear Solutions

Acknowledgements

Angela McGee, Packaging Engineer, Oak Ridge National Laboratory

George Smith, Senior Engineer, Container Certification, American Bureau of Shipping

Roy Rothermel, Structural Engineer, Savannah River Nuclear Solutions

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Nuclear World Transport Institute) Publication

"Uranium Concentrates Industry Good Practices for ISO Containers in Multimodal Transports, Revision 0," World Nuclear Transport Institute www.wnti.co.uk.

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INTRODUCTION

The Department of Energy (DOE) and its contractors utilize a number of Department of Transportation (DOT) packagings, e.g., Excepted, Industrial, Type A, and Type B, when transporting radioactive materials both on and off DOE sites. Among the DOT packagings are Industrial Packagings (IP), which are used to ship low specific activity (LSA) materials or surface contaminated objects (SCO) as defined in Title 49 Code of Federal Regulations (CFR), *Transportation*, Subtitle B, *Other Regulations Relating to Transportation*, Part 173, *Shippers-General Requirements for Shipments and Packagings*, Section 403, *Definitions*. (CFR 49 173.403) The requirements for Industrial Packagings are found in 49 CFR 173.411, *Industrial Packaging* (49 CFR 173.411). In 2004, the DOT modified the requirements in 49 CFR 173.411(b)(6), which allowed the use of a standard freight container (see Appendix A for definition) as an Industrial Packaging Type IP-2 or Type IP-3, as long as the requirements listed below are met.

Per 49 CFR 173.411(b)(6), freight containers may be used as Industrial Packages Type IP-2 or Type IP-3 provided that:

1. The radioactive contents are restricted to solid materials;
2. They satisfy the requirements for Type IP-1 specified in 49 CFR 173.411(b)(1); and
3. 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 (IBR, see Section 171.7 of this subchapter)[1]. 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:
    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 freight containers.

Over the past few years, freight containers have become the container of choice for DOE contractors in shipping LSA or SCO material. However, because the practices of procuring, loading and securing, modifying, and maintaining a freight container vary across the DOE complex, the Packaging Management Council (PMC) in coordination with the Energy Facility Contractors Group (EFCOG) Packaging and Transportation Subgroup and under the direction of the DOE Environmental Management, Office of Packaging and Transportation (OPT) developed this Freight Container Guidance Document.

The main purpose of this document is to provide guidance in order to comply with the DOT regulations, including. 49 CFR 173.411(b)(6). The document also provides additional practices and methods that may be over and above compliance with these regulations. This document is organized in a manner in which the user makes determinations beginning with the process of packaging selection, development of a technical specification, procurement, receipt inspection, and end user requirements. It is recommended that any user of this document be familiar with ISO 1496-1.

[1] In 49 C.F.R. § 173.411(b)(6)(iii), the reference made to ISO 1496-1 is the 1990 Edition of the standard. This guidance document was prepared using the 1990 Edition; however, the users of this document should be aware that a 2013 Edition of ISO 1496-1 has been issued. The user of this document should also be knowledgeable as to what edition of the ISO 1496-1 standard was utilized in the manufacturing of any purchased freight container.

The appendices offer the user:

- Definitions (Appendix A)
- Historical information on the commercial practices associated with the freight container certification process (Appendix B)
- Commercial process for freight container certification (Appendix C)
- DOT regulatory requirements (Appendix D)
- Sample procurement specifications for new or like-new freight containers meeting the requirements of 49 CFR 173.411(b)(6) (Appendix E)
- Minimum safety factor of 3 against yielding (Appendix F)
- Manufacturers technical specifications (Appendix G)
- Twenty percent dose rate requirements (Appendix H)
- Example receipt inspection, pre-use inspection, and pre-shipment checklists (Appendix I)
- DOT letters of interpretations dealing with freight containers (Appendix J)
- Questions and answers from a discussion with the American Bureau of Shipping (Appendix K)
- Example of possible modifications that can be made to a freight container and still meets the requirements of 49 CFR 173.411(b)(6) (Appendix L)
- Matrix showing third party certification compliance to ISO 1496-1 (Appendix M)
- Example procurement specification for modifications to a freight container (Appendix N)
- Quality assurance matrix (Appendix O)
- Stress a freight container encounters during shipping (e.g., road, rail, and water) (Appendix P)
- Example of third party certification documents (Appendix Q)

This document is a living document and will continue to change as it matures. As it does, the PMC, in coordination with EFCOG and DOE/EM, will continue, when appropriate, to update this document so DOE contractors can learn from each site's issues and concerns that will allow them to consistently apply methods associated with the procurement and use of freight containers. Thus, it is encouraged that DOE contractors submit questions and lessons learned to the PMC to improve this document.

1. PURPOSE

The purpose of this document is to provide guidance to the packaging community of DOE and National Nuclear Security Administration (NNSA) Complex in understanding the procurement, use, and maintenance of standard freight containers as radioactive material packagings.

2. SCOPE

The scope of this document is to provide guidance to DOE contractors who want to use a standard freight container as an Industrial Packaging Type IP-2 or Type IP-3 for domestic purposes based upon the DOT 49 CFR 173.411(b)(6).

3. PACKAGING SELECTION CONSIDERATIONS

When packaging radioactive materials (RAM), the goal is to contain and to protect the public from exposure to radiation hazards by complying with the DOT regulations. A freight container can be used as a Type IP-1, Type IP-2, or Type IP-3 when all applicable conditions for their respective packaging have been met. The process for selecting the correct radioactive material packaging (i.e., freight container) begins with an understanding and careful evaluation of the characteristics of the radioactive material contents, including physical form and radioactive properties with regard to activity, radiation type, and shielding.

When a freight container is used as Type IP-1, the container must meet the general design requirements prescribed in 49 CFR 173.410. When the freight container is used as a Type IP-2 or Type IP-3 package, the radioactive material contents is restricted to solid materials. The regulatory requirements in 49 CFR 173.411(b)(6) require freight containers must be "designed to conform to the standards prescribed in ISO 1496-1 in addition to meeting the general design requirements for all radioactive material packages including Type IP-1. When the design is subjected to the tests prescribed in ISO 1496-1 and the accelerations occurring during routine conditions of transport, they will prevent:

- Loss or dispersal of the radioactive contents; and
- Loss of shielding integrity, which would result in more than a 20% increase in the radiation level at any external surface of the freight container.

The shipper/offeror provides guidance for meeting the above regulations by considering two categories of radioactive material contents: 1) dispersible; and 2) non-dispersible. The radioactive nature of the material being shipped must be considered when showing compliance with the increase in radiation levels.

> **Note:**
>
> 49 CFR 173.411(b)(6) applies only to "ISO 1496-1: *Series 1 freight containers – Specification and testing - Part 1: General cargo containers for general purposes*. This freight container classification is explained in detail in ISO 668, *Series 1 freight container – Classification, dimensions, and ratings*. General cargo containers are for general-purpose cargo suitable for international exchange and conveyance by road, rail, and sea, and having top and bottom corner fittings meeting ISO 1161, *Series 1 freight container – Corner fittings - Specification*. Specialized containers such as thermal

containers or tank containers are not included. *Series 1 Freight Container* refers to containers with specific dimensions. For example, a 1CC container is uniformly 8’ wide, 8’ to 9’6” high, and 20’ long, and a 1AA container is uniformly 8’ wide, 8’ to 9’6” high, and 40’ long. If the freight container is to be used for waste material, numerous waste acceptance criteria do not allow the use of a 40-foot container. For smaller waste streams, some generators have found that utilizing a 10-foot freight container helps with blocking/bracing and are easier to fill than the standard container.

The size, shape, and dispersible or non-dispersible nature of the contents will determine how the material is handled, loaded, and secured within the freight container. This will also ensure that the shielding levels remain compliant.

Figure 3-1. *Piping with internal contamination and openings sealed with plastic and tape. This content can be considered non-dispersible.*

Figure 3-2. *Degraded packagings with dispersible contents inside or packagings with external contamination are considered dispersible contents.*

The following sections provide the user guidance on selecting a freight container with the necessary design features to enable shipment of dispersible or non-dispersible radioactive material contents.

3.1 Freight Container Considerations for Dispersible Radioactive Material

Dispersible contents consist of solid materials of a small particle size that can migrate, or become airborne, and thus are subject to leakage from the freight container. Dispersible contents include particulates, powders, fines or solid activated materials that can break or crumble during transportation. Migration of the dispersible contents can occur due to conditions of transport such as vibrations, accelerations, changes in pressure and temperature, and friction and motion between components. If dispersible material is available for release, the shipper needs to specifically ensure that it is contained and will not leak from the freight container. Examples of dispersible contents include unpackaged low level waste, piping or components with exterior contamination, oxidized radioactive components or materials packaged in degraded containers (see Figure 3-2) that will not withstand routine conditions of transport (e.g., badly deteriorated drums or boxes).

A freight container for dispersible contents **must be sufficiently particle tight, or sift-proof,** so that under the static loads imposed by ISO 1496-1, and simultaneously the accelerations occurring during routine conditions of transportation, radioactive material leakage does not occur. A standard freight container is designed for large cargo items and to be weather tight (keep rain out).

The design of a freight container is not intended to keep dispersible materials contained inside and as a result will not qualify as a packaging for small particle dispersible materials. In order to ensure dispersible materials are contained within the freight container additional sealing features need to be added so the (dispersible) contents remain confined within inner packagings.

The approach for packaging dispersible radioactive material contents is to either use a standard freight container with modifications (e.g., to door system, floors and vents) to tighten its sealing capability, or to provide further containment of the radioactive material content by using inner packagings.

Modifications to a standard freight container may include enhancements to the door sealing capability by providing back up or additional door seals, and/or applying caulk, tape, plastic films or coatings over the door seal joints. The floor system can be coated, covered, or lined, and wall vents can be replaced with nuclear filters that allow pressure equalization while retaining solid RAM particles. Modifications to freight containers that have been successful at DOE sites are discussed in Appendix L.

Another way dispersible RAM can be achieved is by packaging the RAM in boxes, drums, heavy gage plastic bags, plastic wrap, coating or otherwise immobilizing contaminated surfaces, or any enclosure that renders the dispersible RAM unavailable for release under routine conditions of transport. The inner packaging is required to maintain its structure and containment function (without tearing or failure) under the routine conditions of transport. The inner packaging must ensure that dispersible material is not capable of release and migration within the freight container. **The inner packaging combined with the freight container must meet the general design requirements of 49 CFR 173.410.**

3.2 Freight Container Considerations for Non-Dispersible Radioactive Material

Non-dispersible contents consist of solid radioactive materials of a sufficiently large (particle or component) size so as not to leak from the freight container. Non-dispersible contents include solid activated materials, metals, or alloys that will not break down or disintegrate into fine particles during transport. RAM, in the form of contamination, can be found inside hardware components such as piping, tanks, or HVAC duck work that may have closed openings (e.g., like flanges or ends encapsulated with a plastic bag (see Figure 3-1). Non-dispersible radioactive materials must either be of a form that is shown by the shipper to be:

- Robust enough to remain as a solid unit without disintegration or breaking down into smaller particles; or
- Be confined in inner packaging (bagging, drums, and boxes) that can be shown to withstand routine conditions of transport.

The shipper/offeror is responsible for evaluating the RAM contents to ensure the content is non-dispersible under the routine conditions of transport. This involves an evaluation of the radioactive content form and structure, how it is packaged, and how it is loaded and secured within the freight container. This evaluation needs to ensure that the requirements of 49 CFR 173.410 (f) and (g) are met.

Materials packaged, bagged, or large enough where they cannot be placed in an intermediate form of containment need to be retained or secured within the freight container. By securing the materials within the freight container they will not change position or sustain damage as a result of puncture, crushing, interaction with other cargo or friction during transport, or significantly degrade during transport. Tanks, piping or other hardware items need to be secured by blocking, bracing and/or tie down so that movement within the freight container is minimal and damage and a release in content will not occur (49 CFR Part 177, *Carriage by Public Highway,* Subpart B, *Loading and Unloading*, Section 842, *Class 7 (Radioactive) Materials*(d)).

4. DEVELOP THE TECHNICAL REQUIREMENTS FOR THE PACKAGING

4.1 International versus Domestic Use

When a shipper/offeror wants to use a freight container for an international shipment the regulatory requirements are different than when it is used for a domestic only shipment. The regulatory requirements for an international shipment are in 49 CFR Part 450, *General* to Part 453, *Control and Enforcement*. The United States Coast Guard states in 49 CFR Part 451, *Testing and Approval Containers*, Subpart A, *Approval of Existing Containers*, that a freight container must be designed and tested and found to comply with the technical conditions set out in Annex II of the International Convention for Safe Containers (here after known as CSC). In the June of 1996 the CSC supplemented section 15 to Annex II, which states, "Containers tested in accordance with the methods described in ISO Standard 1496-1 should be deemed to have been fully and sufficiently tested for the purpose of the CSC…" Therefore, if the freight container meets the requirements of ISO 1496-1, it also meets the requirements of the CSC.

The shipper/offeror knows that when a CSC plate is affixed to a freight container it signifies that the freight container meets the requirements of Annex II of the International Convention for Safe Containers; however, it does not mean that the freight container meets the requirements in ISO 1496-1. In order to ensure that the freight container complies with the requirements of ISO 1496-1 the shipper/offeror should obtain the manufacturer's or third party certifier's Prototype Certificate, Production Certificate and the Container Test Report. These documents will indicate what tests have been performed or what third party certifier document they are designed and tested to. For example, when the American Bureau of Shipping (ABS) is certifying a freight container they follow their Rules of Certification. This is a document published by the ABS that identifies what they require in order for ABS to certify a freight container. Similar documents are published by other third part certifiers (see Appendix A for the definition of Rules of Certification). Unless specific exceptions are made, the design and testing of a freight container in accordance with these Rules of Certification, will meet the ISO 1496-1 requirements. Appendix M lists the ISO 1496-1 testing requirements and various third party certifiers' documents used to show compliance.

When a shipper/offeror wants to use a freight container in a domestic shipment there are no regulatory requirements for design and testing of the container. Only when the shipper/offeror ships radioactive materials is a standard identified. That standard identified is found in 49 CFR 173.411(b)(6), which states the following:

> 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.

4.2 Regulatory Requirements

The regulatory requirements for use of a freight container as an Industrial Packaging Type IP-2 or Type IP-3, are found in the 49 CFR 173 Subpart I, *Class 7 (Radioactive) Materials*. These regulations are identified in Appendix D of this document along with suggested methods of compliance. The 49 CFR

173.410(b) lifting attachment requirements regarding: (1) a minimum safety factor of 3 against yielding; and (2) the exclusive load failure consideration, are addressed in Appendix F.

4.3 Use of New (one time use) or Used Containers

When a shipper/offeror decides they want to use a freight container as an Industrial Packaging they have two options: (1) obtain a new or like new freight container; or (2) obtain a used freight container. Both are manufactured in foreign countries for the purpose of exporting cargo.

4.3.1 New or One Time Used

Economically, one of the best options for the original owners of a freight container is a one-time shipment. A one-time-shipment involves a broker in the United States (US) who purchases a new container. To get the new container to the US, the original owner may fill them with cargo and ship them to the US, empty the cargo, and then deliver them to the broker so they can make them available to their customers as new (one time used) freight containers.

There are a number of benefits to purchasing a new freight container.

- The CSC plate is current.
- The container is structurally sound.
- Documentation is requested in the Procurement Documents that demonstrate compliance to ISO 1496-1.
- Gaskets on the door are in good condition.
- Door locks and mechanisms work.
- There is no rust or corrosion on the container that will affect its functionality.
- The flooring and floor joists are in good condition.

4.3.2 Used Freight Container

A freight container is considered used when purchased by its owner for international shipments and then removed from service. The service life is usually an average 8-10 years after the CSC plate was originally affixed to the freight container. Once removed from service they are sold to either brokers or companies who modify them and in turn sell them to other companies. It is these containers that DOE contractors usually purchase and use. There are a number of concerns that need to be taken into account when a DOE contractor decides to purchase a used freight container.

- The CSC plate may be expired. This will be a concern if the freight container will be used for an international shipment.
- The freight container may not be structurally sound due to corrosion, damage, or degradation. If the CSC plated is expired, there is no guarantee that the container is structurally sound, therefore, the container will need to be re-inspected to ensure that it is structurally sound.
- Due to the age of the freight container, the availability of documentation needed to show compliance to ISO 1496-1, may be difficult to obtain.
- A detailed inspection will be required to ensure components (e.g., door mechanisms) are in good working order , gaskets are in good condition, minimal rust is found, damaged components are identified and replaced, and/or no holes are found in the freight container are found.

Choosing to use a used freight container may be based on cost and availability. If the shipper/offeror wants to have the freight container brought back in compliance with the CSC/ISO 1496-1 requirements,

then the use of qualified inspectors and repair organizations such as the Institute of International Container Lessors (IICL) will be required. If the shipper/offeror does not need that level of rigor, then they may choose to use their own criteria to inspect the freight containers.

4.4 Documents Required to Meet Regulatory Requirements

A key to documentation demonstrating compliance to regulatory requirements is traceability. Each freight container is marked as per ISO 6346, *Freight container – Coding, identification and marking,* third edition, 1995. When a freight container is marked, there are four markings that are mandatory: owner code; equipment category identifier; serial number; and check digit. In Figure 4-1 below "ABZ" is the owner's code, "U" is the equipment category identifier, "001234" is the serial number, and the "5" in the box is the check digit. See Section 6.4 Marking, for additional information.

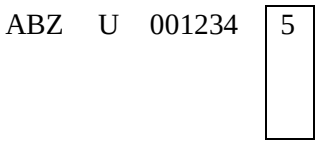

Figure 4-1. Mandatory Freight Container Markings
This is the marking that each owner is required to place on each freight container they have manufactured.

When meeting regulatory compliance, traceability to similar markings as noted above, is required for each freight container. With the exception of Type IP-1, the shipper/offeror needs to have documentation showing that the freight container meets the ISO 1496-1 requirements and the requirements identified in 49 CFR 173.411(c).

4.4.1 Meeting the Requirements of ISO 1496-1

As noted in the Introduction, in order to use freight containers as an IP-2 or IP-3, the following requirements must be met:

- The radioactive contents are restricted to solid materials;
- The containers satisfy the requirements for Type IP-1 specified in 49 CFR 173.411(b)(1); and
- The containers 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 for general purposes;* excluding dimensions and ratings, as incorporated in 49 CFR Section 171.7. They shall be designed such that if subjected to the tests prescribed in that document (i.e., ISO 1496-1) and the accelerations occurring during routine conditions of transport, they would prevent:
    - Loss or dispersal of the radioactive contents; and
    - 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.

When characterizing the waste placed in a freight container, the waste should be restricted to solids only, as per 49 CFR 173.411 (b) (6). Documentation demonstrating that the waste is solid must be maintained

by the shipper/offeror. It is recognized that there is some waste acceptance criteria within DOE that allow a certain percentage of liquids in the waste packaging for disposal. For transportation purposes, if the contents contain incidental liquids, the shipper/offeror will mitigate the presence of the liquid by including the appropriate amount of absorbent material in the freight container.

Documentation must be obtained that demonstrates that the freight container's design/model meets the design and testing requirements identified in ISO 1496-1. The reference number identified in Figure 4-2 and the serial number described in section 4.1 of this section is crucial to obtaining the appropriate freight container documentation.

Each freight container design is assigned a reference number by an approval agency. That number, along with the approval agency's identifier and country of origin, are entered on the CSC Plate (see Figure 4-2).

This is the reference number that explains the country of origin, "USA," the countries approval agency, "AB," American Bureau of Shipping, and freight container design reference number, "568/03-111."

The Approval Agency reference number identified on the CSC Safety Approval Plate provides traceability to the plan review, testing and certification for a particular container model from a specific manufacturer.

Figure 4-2. CSC Safety Plate

Once the approval agency has accepted the proposed design, they issue a Prototype Test Certificate. This certificate allows the manufacturer of the proposed design to build a number of freight containers to the proposed design and have them tested. The Prototype Test Certificate and Container Test Report usually document the tests that were conducted according to the approved test plan. The shipper/offeror must review these tests to ensure they are the tests identified in ISO 1496-1. Most Prototype Test Certificates list the tests results and state that the freight container has passed the tests. For the purpose of showing compliance with 49 CFR 173.411(b)(6)(iii)(B), DOE contractors may feel they need to obtain the actual test documentation showing if deformation occurred during the performance of these tests. Approval agencies do not approve designs that result in permanent deformations outside allowable tolerances of the ISO standard. (See ISO 1496-1, Sections 4.1 and 6.) In addition, the tests being performed are witnessed by the approval agency's surveyor and documented in the Container Test Report.

Once an approval agency evaluates and accepts test results, they issue the Production Certificate. This certificate allows the manufacturer of the approved design to fabricate the freight container. The Production Certificate also lists the assigned serial numbers for the quantity to be fabricated. These

documents can be obtained from the third party approval agency that has been authorized by the country's designated competent authority. Some third party approval agencies combine both the Prototype Test and Production Certificates into a single document.

Table 4.1 identifies the documentation that would be acceptable when demonstrating compliance to ISO 1496-1 as required by 49 CFR 173.411(b)(6).

Table 4-1. ISO 1496-1 Regulatory and Documentation Requirements

Regulatory Compliance	Documentation
The radioactive contents are restricted to solid materials.	Documentation that the contents match the packaging used, i.e., freight container.
Satisfy the requirements for Type IP-1 specified in 49 CFR 173.411(b)(1).	Documentation showing that each element in 49 CFR 173.410 has been met and if an element is determined to be "not applicable" justification is provided.
Containers 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 loss or dispersal of the radioactive contents.	Documentation showing a design evaluation has been performed to ensure that there will be no loss or dispersal of the radioactive contents during routine conditions of transport.
Containers 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 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.	Documentation showing a design evaluation has been performed to ensure that during routine conditions of transport there will be no 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. This documentation could be in the form of a loading and load securement procedure.
Containers are designed to conform to the standards prescribed in the International Organization for Standardization document ISO 1496-1.	Documentation must be provided that demonstrates that all tests identified in ISO 1496-1 have been performed and the freight container has passed those tests. Documentation that can be obtained through the approval agency is, the Prototype Certificate, Container Test Report, and Production Certificate.
Each third party approval agency has developed their own Rules of Certification as documented in Appendix A, Definitions. As noted above, these agencies have developed similar documents showing compliance to the ISO 1496-1. Below are examples of four documents commonly used to show compliance to this standard.	
Prototype Certificate	Prototype Test Certificate is a document that is issued by the third party approval agency when they have verified all designs and calculations supporting the design and methods of construction for the freight container have met the design considerations and the performance tests as required in the agency's Rules of Certification. Prior to this document being issued the surveyor will witness the construction of each freight container, verify the materials of construction are as designated

	in the design drawings, verify fabrication techniques, i.e., welding, and witness each test that is required in their Rules of Certification. Therefore, when a prototype container meets the requirements of the Rules of Certification based on the surveyor's observations and it has been determined that the prototype has passed the required tests; this document is issued by the third party approval agency (See Appendix Q).
Container Test Report	Container Test Report is a document that records the actual tests and their results of each test performed as required in the approved test plan (See Appendix Q).
Production Certificate	Production Certificate is a document that is issued by the third party approval agency upon the satisfactory conclusion of container plan review, prototype approval, the production tests required by the approved test plan, the acceptance of the manufacturer's quality control procedures, and the survey of each container. These units, when considered acceptable to the third party approval agency, will be certified and a Production Certificate will be issued. The Production Certificate will list the serial numbers for each container. (See Appendix Q)
Technical Specification	Manufacturer's specification that includes the bullets listed in the third paragraph of 4.4.2 below. (See Appendix G)

4.4.2 Meeting the Requirements of 49 CFR 173.411(c)

Documentation requirements for industrial packaging are identified in 49 CFR 173.411(c). This documentation requirement is for meeting all types of industrial packaging identified in 49 CFR 17.411. When a freight container meets the requirements in 49 CFR173.411 (b)(6), the shipper/offeror needs to show compliance to 49 CFR 173.410 and ISO 1496-1. Compliance to ISO 1496-1 is focused on design and testing requirements.

In meeting the requirements for IP-2 and IP-3, a shipper/offeror must identify and be able to provide verification to DOT upon request that the requirements of 49 CFR 173.410 were considered and complied with prior to the shipment being released. Inclusive within 49 CFR 173.410 are the requirements of 49 CFR 173, Section 24, *General Requirements for Packagings and Packages* and Section 24b, *Additional General Requirements for Bulk Packages*.

To comply with 49 CFR 173.411(c) for IP-2 and IP-3 packagings, the shipper/offeror is required to have on hand documentation showing compliance to all applicable requirements in 49 CFR 173.410, as noted in 49 CFR 173.411(b)(6), as well as a complete set of documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that specification for the package. Comparative data shall be an analysis that includes documents used for the basis of comparison identified in 49 CFR 173, Section 461. Some of the documents that would meet this requirement are in Table 4-1, but in addition to those documents the shipper/offeror may obtain,

from the manufacturer, the technical specification for the type and model of the freight container. The manufacturer's technical specification is a document that provides the user with the following information.

- Operational environment: states the temperature range (e.g., -30°C (-22°F) to 70°C (158°F)).
- Classification societies: lists approval agencies.
- Requirements: Lists the standards, regulations, and rules required in the manufacturing of the freight container.
- Dimensions and ratings: describes of the freight container and its ratings.
- Construction: describes how the freight container will be manufactured.
- Preservation: describes surface preparation and the coatings to be applied.
- Markings: shows how the container will be marked. This does not include the IP-2 or IP-3 marking requirements.
- Testing and Inspection: describes the tests that will be performed, test load, how the test was performed, and how the freight container will be inspected.
- Materials of Construction: provides a listing of materials by component and the yield point and tensile strength of that material.
- Drawings: shows how the freight container is fabricated (e.g., configuration and design details, materials construction, joints/welds, location of vents/filters, and component details).

4.4.3 Conclusion

The information discussed in Sections 4.4.1 and 4.4.2 will provide the shipper/offeror the documentation needed to perform or conduct the engineering evaluation as required in 49 CFR 173.411(c). This evaluation also includes reviewing the requirements in 49 CFR 173.410(f) and (g), which requires the packaging to be capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under normal conditions of transport, and the materials of construction of the packaging and any components or structure to be physically and chemically compatible with each other and with the package contents.

Appendix P contains a link to an online document titled *Freight Container Handbook*, by German Marine Insurers. This handbook provides general information regarding cargo loss prevention and the types of stress a freight container might encountered during transport.

4.5 Quality Assurance Requirements

Quality Assurance (QA) requirements for freight containers may be imposed on the original manufacturer through the certification process by the approval agency, when a DOE contractor chooses to make modifications to a freight container, and/or when they purchase a used freight container.

4.5.1 Quality Assurance Requirements by Approval Agency

As part of the certification process, the approval agency may require the manufacturer to have a quality control program. For example, when a manufacturer uses the American Bureau of Shipping (ABS) as their approval agency, they are required to submit a quality control manual, which gives in detail those inspections, and controls to be followed to assure the quality of the production units are comparable to the prototype. The quality control manual should contain a description of the organization, material

identification, workmanship quality, control records, fabrication quality control methods, and quality control surveillance. This manual is to be initially submitted to ABS for review in order that compliance may be verified with their Rules of Certification. Subsequent to a satisfactory review by ABS, the manufacturing facility is subject to an audit by the attending approval agency representative (surveyor) to confirm compliance with the quality control procedures outlined in the submitted manual. When changes or revisions are made to the manual, including any quality control procedures, they are to be submitted to ABS for review and acceptance.

When a DOE contractor desires to purchase a new freight container, they can work with the respective approval agency to determine what specific quality control or quality assurance program was in place at the time of manufacture. Knowing what quality processes were in place at the time of manufacture will help the DOE contractor determine the method of procurement and acceptance.

4.5.2 Quality Assurance Requirements Required by the Department of Transportation

With respect to quality assurance, the regulations are almost non-existent. Quality assurance is not found in the definitions cited in 49 CFR Part 171, *General Information, Regulations and Definitions*, Subpart A, *Applicability, General Requirements, and North American Shipments*, Section 8; *Definitions and Abbreviations*. Language about quality assurance and quality control appear only in 49 CFR 173 Subpart I, *Class 7 (Radioactive) Materials*. In 49 CFR 173.403, *Definitions*, DOT provides their definition of quality assurance:

> Quality Assurance means a systematic program of controls and inspections applied by each person involved in the transport of radioactive material, which provides confidence that a standard of safety prescribed in this subchapter is achieved in practice.

The last portion of this definition states, "…which provides confidence that a standard of safety prescribed in this subchapter is achieved in practice." The use of the word subchapter means all the subparts included in Subchapter C, *Hazardous Materials Regulations*, Parts 171 through 180. Thus, DOT is implying that the shipper/offeror will have a process or program with systematic controls and inspections applied by an organization involved in the transport of radioactive materials. When implemented, these program controls ensure that the standard of safety prescribed in Subchapter C is achieved. The selection of a quality assurance program and it's adequate implementation using a graded approach is the sole responsibility of the shipper/offeror.

4.5.2.1 Specific Quality Control Requirements by the DOT

DOT includes specific quality control requirements in 49 CFR 173 Subpart I—the only section of the regulations that deals specifically with quality. There are two sections that deal with quality control: (1) the construction of the package (Section.474, *Quality Control for Construction of Packaging*) and (2) the use of the package (Section.475, *Quality Control Requirements Prior to Each Shipment of Class 7 (Radioactive) Materials*).

4.5.2.1.1 Quality Control for the Construction of the Package (49 CFR 173.474)

As required by the regulations, the shipper/offeror must perform the following prior to the first use of any packaging used for a shipment of Class 7 (radioactive) materials:

- Determine that the packaging meets the quality of design;
- Determine that the construction of the packaging meets the specific requirements as identified in 49 CFR Subchapter C Parts 171 – 180;and
- Determine that the shielding, containment, and, when required, the heat transfer characteristics of the package are effective within the applicable limits specified for the package design.

As noted in Section 4.5.2 above when a DOE contractor implements DOE Order 414.1D, *Quality Assurance*, they will meet the regulatory definition of Quality Assurance (QA). Upon delivery of the freight container, the supplier provides the DOE contractor with all the required documentation identified in the purchase order that ensures the construction of the packaging meets all the applicable requirements identified in Subchapter C.

4.5.2.1.2 Quality Control Requirements Prior to Each Shipment (49 CFR 173.475)

DOT requires the verification of a number of elements prior to each shipment of a Class 7 (radioactive) material, including the following.

- The packaging is proper for the contents to be shipped.
- The packaging is in unimpaired physical condition, except for superficial marks.
- Each closure device of the packaging, including any required gaskets, is properly installed, secured, and free of defects.
- For fissile material, each moderator and neutron absorber, if required, is present and in proper condition.
- Each special instruction for filling, closing, and preparation of the packaging for shipment has been followed.
- Each closure, valve, or other opening of the containment system through which the radioactive content might escape is properly closed and sealed.
- Each packaging containing liquid in excess of an A2 quantity and intended for air shipment has been tested to show that it will not leak under an ambient atmospheric pressure of not more than 25 kPa, absolute (3.6 psia). The test must be conducted on the entire containment system, or on any receptacle or vessel within the containment system, to determine compliance with this requirement.
- The internal pressure of the containment system will not exceed the design pressure during transportation.
- External radiation and contamination levels are within the allowable limits specified in this subchapter.

As noted with the implementation of the DOE QA Program all of these elements can be verified through an inspection process aided with the use of a checklist. A sample checklist in Appendix I can be used to determine compliance to these regulatory requirements.

4.5.3 Quality Assurance Requirements Established by the Department of Energy

As a DOE contractor, QA requirements are imposed through DOE Order 414.1D or 10 CFR, *Energy*, Part 830, *Nuclear Safety Management*, Subpart A, *Quality Assurance Requirements*. Both the Order and the Rule require that the DOE contractors develop and implement a QA program and may be implemented by using a national or international standard, e.g., ISO 9001:2008, ASME NQA-1-2008/2009a. These

standards may be used to implement the quality assurance and quality control requirements identified in section 4.5.2. Appendix O has a matrix of how an 18-element program would implement the requirements in both the Order and the Rule. DOE also requires, as part of that QA program, that contractors flow down all applicable QA requirements to their suppliers. When determining the QA requirements to flow down for a freight container, it is recommended that the contractor determine the critical characteristics for a freight container and then determine which QA requirements will ensure those characteristics are properly implemented.

One concern when dealing with suppliers of freight containers is that the manufacturers of freight containers are usually outside of the United Sates and predominately in Southeast Asia. Therefore, if a DOE contractor were to purchase directly from a manufacturer they would be dealing with international regulatory requirements. Thus, in order to perform a supplier evaluation at the manufacturer's facility, considerable traveling would be required that may add an additional cost burden to the overall cost of a freight container.

4.5.4 Conclusion

The DOE contractor must recognize that when purchasing a new or like new freight container or purchasing a used freight container they are usually already built and in the United States. The DOE contractor must recognize the difference in purchasing a new, like new or used freight container. If the DOE contractor purchases a used freight container, it will already be built and ready for delivery. Thus, DOE would not be able to implement and enforce a DOE QA program for production. Only when purchasing a customized built freight container or a large quantity (250 or more) of freight containers can the DOE contractor actually pass specific QA requirements down to the manufacturer. Either the third party approval agency surveyor or a DOE contractor representative could then validate those requirements during the manufacturing process.

The QA requirements that a DOE contractor will pass down to their supplier will need to be requirements a supplier can implement. Suppliers of freight containers are usually freight brokers or suppliers who obtain freight containers to refurbish or modify for their customers.

It is recommended that since all of the freight containers in commercial use are approved by an independent third party approval agency (e.g., American Bureau Shipping, Lloyds Register), a DOE contractor is to work with their supplier to obtain the necessary documentation that shows that the freight container has passed all the necessary design and testing requirements identified in ISO 1496-1.

5. PROCUREMENT SPECIFICATIONS FOR FREIGHT CONTAINERS

As stated earlier, there are three types of freight containers that DOE contractors purchase for either onsite or off site shipments. First, are new or like new freight containers. Second, are used freight containers. A used freight container is one that has been in use and now has been taken out of service and sold to a broker. These containers may have some slight damage, expired CSC plate, or just may have reached their service life. Third are modified freight containers. This can be a new/like new or used freight container. These freight containers are modified based on the shipper/offeror's specific requirements. Some of these modifications include adding a steel floor, extra internal tie-down anchor

points, additional gasket doorsills, or a slip-in bulk head just behind the door (Appendix L). All of these types of freight containers are made available to DOE contractors.

As described in Section 3, the shipper/offeror determines what the contents of the freight container will be (e.g., dispersible, non-dispersible) and they will either use the freight container as an IP-2 or IP-3. Once these preliminary decisions have been made, the shipper/offeror develops the technical requirements for the freight container to be purchased. The technical requirements document contains criteria to be included in the purchase requisition such as regulatory requirements, standards, approval agency documentation that ensures compliance to ISO 1496-1, and any other documentation that documents compliance to regulatory and design requirements to purchase an acceptable freight container (See Appendices E and N).

Table 5-1 lists recommended technical requirements that a shipper/offeror may include in a purchase requisition for purchasing either a new/like new, used, or modified freight container.

Table 5-1. Recommend Technical Requirements for Freight Container Procurements

General Requirements For All Freight Containers		
▪ Identify all regulatory requirements that effect a freight container (49 CFR parts 450-453, 49 CFR 173.411(b)(6)) ▪ Identify all the applicable ISO standards that affect a freight container (ISO 1496-1, 6346, 668, 1161) ▪ Request the broker/supplier to use the reference number (see chapter 4) on the CSC plate, to obtain the Prototype Certificate, Production Certificate, drawings, and copy of the test plan and results of the tests demonstrating compliance to ISO 1496-1 from the approval agency. These documents are to be traceable to the serial number of the container. ▪ When reviewing the regulatory requirements in 49 CFR 173.411(b)(1) documentation must be obtained to show compliance with applicable requirements ▪ Obtain a Certificate of Compliance issued by the broker/supplier verifying compliance to the technical requirements, regulatory and ISO requirements, material specification, purchase order, etc. ▪ Identify the applicable critical components of the freight container		
New/Like New or Single Trip Container	**Used Freight Container**	**Modified Freight Container**
▪ QA requirements that are passed down to the broker/supplier based on the critical components selected for a new/like new/ or single trip freight container. ▪ Inspections of additional requirements, (e.g., IP-2, IP-3, Purchase order) by the DOE contractor. ▪ Verify CSC plate is current and within the applicable time requirements. ▪ Marking requirements ▪ Painting, inside and out, color, type of paint, e.g., lead free.	▪ A used freight container is one that is no longer in service due to damage or an expired CSC plate. When this occurs the shipper/offeror will need to ensure the freight container still meets ISO 1496-1. Having an Institute of International Container Lessors (IICL) 5 inspector inspect the freight container will accomplish this. This inspector will ensure it meets the applicable requirements and either make the repairs or oversee the repairs. Once these are done they or the shipper/offeror will have a US Coast Guard Inspector or their authorized representative come and inspect the freight container. Upon approval, the inspector will mark the CSC plate. These two inspections demonstrate the freight container meets ISO 1496-1. ▪ QA requirements that are passed down to the broker/supplier based on the critical components selected for a used freight container. ▪ Inspections of additional requirements (e.g., IP-2, IP-3, Purchase order) by the DOE contractor ▪ Marking requirements (e.g., DOT Markings, ISO 668 Markings).	▪ Complete specifications for the modification of the freight container. This may include drawings, regulatory and standard citations. ▪ When a modification affects the structural integrity of the freight container the shipper/offeror may require that the approval agency review the modifications to ensure that the ISO 1496-1 requirements have not been violated. ▪ When performing modifications to a new or used freight container, review the recommended technical requirements. ▪ QA requirements that are passed down to the broker/supplier based on the critical components selected for a used freight container. ▪ Inspections of additional requirements (e.g., IP-2, IP-3, Purchase order) by the DOE contractor. ▪ Marking requirements (e.g., DOT Markings, ISO 668 Markings).

6.0 END USE

6.1 Inspection

There are three inspections that may take place on a freight container. The first is upon receipt from the manufacturer. The second is prior to loading the freight container. The third is prior to shipment.

6.1.1 Receipt Inspection

Through the procurement process, the shipper/offeror has identified all the requirements that the manufacturer (i.e., the broker, fabricator, or organization that you have the purchase agreement with) must follow when providing a freight container to a DOE contractor. From this procurement document the shipper/offeror may develop a receipt inspection checklist that can be used to inspect the freight container upon arrival. Appendix I provides a sample receipt inspection checklist that a shipper/offeror may choose to use as is or use as a model to develop one of their own. The purpose of the receipt inspection process is to make sure that all of the requirements identified in the purchase agreement, (e.g., design, testing, quality assurance, documents, records) are met. In all cases the DOE contractor is urged to use a graded approach to ensure that the appropriate receipt inspection takes place.

For a freight container that has been modified, the receipt inspection process must include a process where the modification can be verified upon receipt. When the modification cannot be verified upon receipt, the manufacturer shall provide the applicable documentation verifying that the modification has been performed correctly.

As a cautionary note, when performing the inspection for determining that a freight container is light tight from within the container, the inspector shall perform this activity with a minimum of two individuals, with the proper communication devices, and, when required, with the proper personnel protection equipment (PPE).

6.1.2 Pre-Use Inspection

Some DOE contractors, after performing their receipt inspections, store their containers prior to use. Whether the container is stored or used upon arrival, the shipper/offeror shall perform a preload inspection prior to use. When the freight container is delivered to the location where the loading is to take place, there should be sufficient room to walk around the freight container, freely open the doors, and with access to easily enter and leave the freight container with the appropriate loading equipment. The freight container is also being on solid ground and level. If the freight container is not level, doors will have difficulty closing and sealing.

As a cautionary note, when performing this activity, employees should be aware of all safety requirements and, when required, use the proper PPE. Appendix I has a sample of a pre-use inspection checklist that a shipper/offeror may use as is or use as a model to develop their own pre-use inspection checklist.

6.2 Loading and Securing Contents

This section addresses the loading and securement of the radioactive material contents within a freight container (i.e., packaging). The radioactive material contents need to be securely packed, cushioned, and restrained within the freight container. General transportation in commerce has shown that most damage issues are the result of improper loading and internal cargo shifting due to being insufficiently secured. In other words, most containers are damaged and even destroyed from the inside (see Figure 6-1).

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Figure 6-1. Damaged Freight Container from Internal Contents

The regulations that drive radioactive material content securement within the packaging are summarized below.

- 49 CFR173.448 (a): each shipment of Class 7 radioactive materials must be secured to prevent shifting during normal transportation conditions.
- 49 CFR 173.411(b)(6)(iii): freight containers shall be designed that if subjected to the tests prescribed in ISO 1496-1 and the accelerations occurring during routine conditions of transport, they 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 freight container.

The above requirements are meant to ensure that radioactive material placed within a packaging remains stationary and does not shift or move under the shipping forces experienced during transportation (See table 6-1 or Appendix P Section 2.3.4). Typical securement systems consist of blocking, bracing, and tie-downs. The packaging content (e.g., components, bags, drums, boxes, piping, tanks) must withstand static shipping forces due to the weight, density, and stacking of the content, and dynamic shipping forces due to vibration, jolting, and accelerations arising from changes in direction, starting, and stopping (See table 6-1 or Appendix P Section 2.3.4). The "1g" is defined as the acceleration due to gravity or in practical terms, 1g is equivalent to the weight of the item.

For domestic shipping 49 CFR Chapter III, *Federal Motor Carrier Safety Regulations*, Part 393, *Parts and Accessories Necessary for Safe Operation*, Section 102, *What are the Minimum Performance Criteria*

for Cargo Securement Devices and Systems? identifies that accelerations (0.8 g forward, 0.5g rearward, and 0.5g lateral) per Table 6-1, may be used to evaluate securement systems. Other requirements , such as those stated in 49 CFR 393, Section 106, *What are the General Requirements for Securing Articles of Cargo?*, may be considered when determining load securement systems.

Table 6-1. Maximum Forces Acting on a Freight Container During Transport

Force	*Road Transport	Rail Transport Subject to Shunting	Rail Transport Combined
Forward Acting Force	0.8g	4.0g	1.0g
Backward Acting Force	0.5g	4.0g	1.0g
Sideways Acting Force	0.5g	0.5g	0.5g
1g = 9.81 m/s^2 *49 CFR 393.102 **Container Handbook, online http://www.containerhandbuch.de/chb_e/stra/index.html			

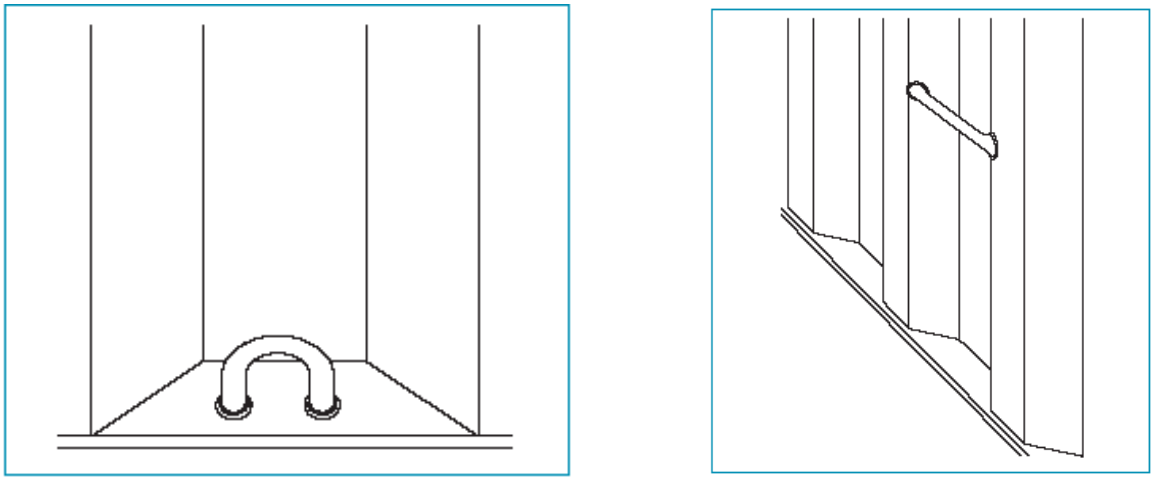
Example: What are the dynamic shipping forces on a 1000 pound (lbs.) component that needs to be secured within a freight container when transported on a road?

Answer: Using the "g-value" accelerations from Table 6-1, the resulting forces acting on the component are calculated in the bullets below. These forces must be resisted by the securement system so that the component does not move. The securement system must be sized to withstand these shipping forces to keep the component from moving:

- Forward (breaking): 1000 lbs. x 0.8g = 800 lbs.
- Rearward (acceleration): 1000 lbs. x 0.5g = 500 lbs.
- Lateral (cornering): 1000 lbs. x 0.5g = 500 lbs.

Shipping forces in rail transport can be much higher due to switching operations as shown in Table 6-1 and in Appendix P Section 2.3.5. It is recommended that you carefully evaluate the securement system for keeping radioactive materials stationary within freight containers whenever shipping by rail.

One caution that should always be noted is that if any additional anchor points are added (see Figure 6-2) for load securement to the inside of the freight container, an evaluation will need to be done to ensure that you are still in compliance with ISO 1496-1 design and testing requirements.



[2]**Figure 6-2.** *Freight container Anchor Points are attached to frame rails (left) and Lashing Points to other Freight Container components (right) for load securement*[2]

It is noted that all RAM content loaded into freight containers should consider the same three conditions outlined for cargo securement on a conveyance in the DOE *Load Securement Guide*. The load securement conditions below have been slightly modified to address securement of **RAM content within a freight container**, rather than cargo on a conveyance.

- RAM content is **fully contained** by structures of adequate strength to withstand forward, rearward, and sideways forces. Fully contained cargo is deemed to meet the performance criteria of:
    - Content cannot shift or tip;
    - Content is restrained against horizontal movement by the freight container structure, other content, and/or dunnage, shoring bars, tie-downs, or a combination of these; and
    - Content **fills the freight container.**
- RAM inner packaging or components shall be prevented from shifting or tipping if content is **immobilized or secured** within the freight container by (see Figure 6-3)::
    - Blocking;
    - Bracing;
    - Friction Mats;
    - Tie downs;
    - Other Content;
    - Void Fillers; or
    - A combination of these.

      Content (e.g., drums) are immobilized by structures of adequate strength or a combination of structures, blocking, and bracing to prevent shifting or tipping. The drums in Figure 6-3 have been loaded tightly into freight container and braced so that movement is not possible. If

[2] "Uranium Concentrates Industry Good Practices for ISO Containers in Multimodal Transports, Revision 0," World Nuclear Transport Institute www.wnti.co.uk.

drums are palletized as in Figure 6-4, the pallet must be sufficiently strong to hold the weight of the drums.

Figure 6-3. Drums that are properly blocked and braced

Figure 6-4. Properly palletized drums

All items that may be transported in a freight container (e.g., large bulk items, pipes, machinery, bagged material, boxes, metal waste boxes, burrito wraps, and lift liners bags) must be secured so that movement cannot occur during transport. With each type of package or item that is placed in freight containers the shipper/offeror shall ensure that the items do not move during normal conditions of transport. The load securement ensures that, during normal conditions of transport, the packaging or items inside the freight container do not shift, therefore, causing an increase in dose rate at the surface of the package. If the

increase of dose rate is greater than 20%, it may cause the consignment to be out of compliance with 49 CFR 173.411(b) (6) (iii)(B) (see Appendix H).

6.3 Closure instructions

Closures, as required by 49 CFR 173.24(f), are not normally provided by the manufacturer of a freight container and, as a result, will need to be either produced by the broker or the shipper/offeror. Below is a sample of what a closure instruction might be for a new or used freight container without any modifications.

6.3.1 Example of a Closure Instruction for a Freight Container

With the doors closed and as you approach the doors look for the two sets of door-locking handles. The age of the freight container will determine the ease of operation in opening the doors. Each door will have two locking bars with door locking handles welded to them. Start by releasing the door-locking handle retainer so you have access to the door-locking handle. With the right door, start by grabbing the top door-locking handle and rotate it out 90° or greater so the top and bottom cams attached to the locking bar release at the top and bottom of the door. Now follow the same process for the left door.

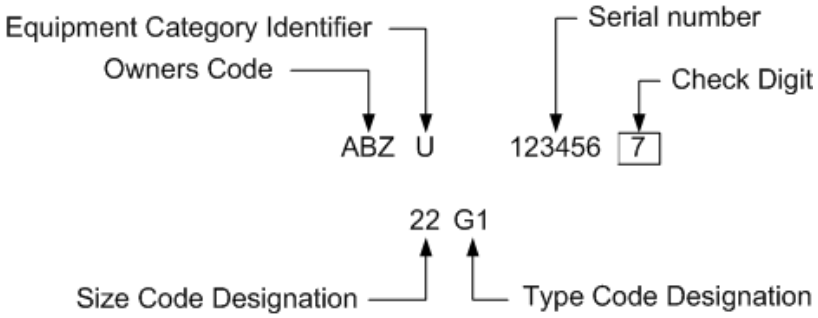
Now that both doors cams have been released grab the locking bar or door-locking handles and pull each door open. Swing each door open to allow the freight container to breathe and air out. Inspect the gasket around the door to ensure it is in good condition and does not need to be repaired or replaced. Once the freight container has been filled and the load is blocked and braced so that it cannot move, close the freight container. Prior to closing the doors re-check the door gasket to ensure that it has not been damaged during the loading process. If it has, repair or replace the door seal. To close the freight container doors, close the left door first and then the right door so they are flush up against the header. With the door-locking handles extended greater than 90° from the face of the door itself, and starting with the left door, engage the top and bottom cams that are attached to the locking bar into the cam retainer. Begin to push the door-locking handle towards the door panel until it becomes flush with the door. Lock the handle in place using the door-locking handle retainer. Once this is done, do the same for the door locking handle on the right door. With the right door closed, lock the handle in place using the door-locking handle retainer. When all the door-locking handle retainers are in place, secure with a padlock, if appropriate.

When a DOE contractor modifies a freight container, their closure instructions will need to include any additional work that the modification might require prior to or just before closing. As part of the closure of a freight container, the DOE contractor may choose to combine the closure of the container with their pre-shipment checklist in Appendix I.

6.4 Marking

Freight container markings are determined by ISO 6346, *Freight container – Coding, identification and marking.* The DOE contractor, when purchasing a new, like new, used, or modified freight container, can expect to find the markings as shown in Figure 6-5.

The markings shown in Figure 6-5 are mandatory as required by ISO 6346 Section 3.2, *Identification*



Marks. Explanation of these markings is found in Table 6-2. Freight Container Markings.

Figure 6-5. ISO Markings for a Freight Container

Table 6-2. Freight Container Markings

Marking	Explanation	Example
Owners Code	Consists of three capital letters which are unique and shall be registered with the International Container Bureau	"ABZ"
Equipment Category Identifier	The equipment category identifier consists of one capital letter of the Latin alphabet. "U" – For all Freight Containers "J" – For detachable freight container-related equipment "Z" – For trailers and Chassis	"U"
Serial Number	The container serial number shall consist of six Arabic numerals. If the series of significant numerals does not total six, sufficient zeroes to make up six numerals shall precede them.	"123456"
Check Digit	The check digit provides a means of validating the transmission accuracy of the owner code and serial number and shall be determined by ANNEX A, ISO 6346, *Freight Container – Coding, Identification and Marking*.	
The type and main external dimensions of the container shall be identified with codes and marked on the container. Only those freight containers which comply with both the ISO top-handling capability and structural stacking requirements set forth in ISO 1496 shall be marked with size and type codes in accordance ISO 6346, Section 4.2.1 and 4.2.2. **Note:** The size and type codes, when displayed on the container, shall be used as a whole, i.e., the information must not be broken into its component parts.		
Size Code	The container size (i.e., external dimensions) shall be indicated by two characters as follows: First character: numeric or alphabetic character representing length. Second character: numeric or alphabetic character representing the width and the length. **Note:** The two characters shall be selected in accordance with ISO 6346, ANNEX D	22

Type Code	The container type and main characteristics shall be indicated by two characters as follows: First character: alphabetic character representing container type. Second Character: Numeric character representing main characteristics related to the container type. **Note:** The two characters shall be selected in accordance with ISO 6346, ANNEX E.	G1

Outside of the reference number on the CSC plate identified in section 4.4.1 of this document the number that can be used to trace the freight container back to its original owner is the owners code and the six-digit serial number.

ISO 6346 also requires other markings the DOE contractor may find useful. The maximum gross and tare weights in both kilograms and pounds, air/surface symbols, warning of overhead electrical dangers, or height marking for container higher than 8-feet 6-inches. The DOE contractor, if they choose to paint the freight container, may have these markings either removed or painted over, but it is recommended they keep as a minimum the owners code, freight container serial number, and check digit for traceability and the maximum gross and tare weights in kilogram and pounds for operational use..

When a DOE contractor uses a freight container as a Type IP-2 or Type IP-3, there are regulatory marking requirements that are required to be placed on the freight container. These can be found in 49 CFR 172.310. The following markings shall be placed on a freight container with letters at least 13mm in height on the outside of the container. A package which does not conform to Type IP-2 and Type IP-3 requirements may not be so marked.

For a Type IP-2, the markings shall read, "Type IP-2, USA."

For a Type IP-3, the markings shall read, "Type IP-3, USA."

6.5 Pre-Shipment Inspection

Once you have completed the loading process and the shipment is properly blocked and braced verify that the freight container is securely loaded and ensure the container is still level. If not, work to ensure it is level. A level freight container ensures proper closure. Prior to closing the doors, visually inspect the door gasket to ensure that it has not been damaged during the loading process and, if so, repair as needed.

Appendix I provides a sample pre-shipment inspection checklist that a shipper/offeror may choose to use as is or use as a model to develop one of their own.

6.6 Freight Container Maintenance

When using a freight container for inter-modal shipments (i.e., internationally), the container must be maintained accordance with 49 CFR Parts 450-453. This includes each time a container undergoes a major repair, refurbishment, or on-hire/off-hire interchange. Most of the freight containers that a DOE contractor will use do not need to meet those requirements. If they do, it is recommended they either hire

or employ trained, tested, and qualified personnel who meet the Institute of International Container Lessors (IICL) requirements.

Even though a freight container may not need to be in a maintenance program, a DOE contractor may still need to have access to trained and qualified personnel who can evaluate modifications or evaluate damage to a freight container to ensure compliance with ISO 1496-1.

A DOE contractor needs to know that when a change is made or damage occurs to a freight container, an evaluation must take place (using a graded approach) to ensure it still meets the requirements of ISO 1496-1.

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APPENDIX A: Definitions

Approved Test A proposed test plan submitted to the Third Party Approval Agency with the application for a new design as to how each of the tests in ISO 1496-1 will be conducted. When approved by the Third Party Approval Agency, their surveyor when witnessing the ISO 1496-1 tests, ensure these tests are performed as planned.

Carrier (49 CFR 171.8): A person who transports passengers or property in commerce by railcar, aircraft, motor vehicle, or vessel.

Closure: Those mating parts of a packaging system designed to be opened and closed and all associated devices needed to hold those components securely closed during transport, including any gaskets or sealants designed to prevent loss or dispersal of the contents.

Competent authority (49 CFR 171.8): A national agency responsible under national law for the control or regulation of a particular aspect of the transportation of hazardous materials (dangerous goods). The term "appropriate authority," as used in the International Civil Aviation Organization (ICAO) Technical Instructions (incorporated by reference; see 49 CFR 171.7), has the same meaning as "competent authority." For purposes of the hazardous materials regulations, the Associate Administrator for Hazardous Materials Safety of the DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) is the competent authority for the United States.

Consignee: Any person, organization, or government that receives a consignment.

Container Test Report: A document that records the actual tests and their results of each test performed as required in the approved test plan.

Containment system: The components of the packaging (when assembled) intended to retain the radioactive contents during transportation.

Design (49 CFR 173.403): A description of the packaging that may include specifications, engineering drawings, reports showing compliance with regulatory requirements, gross weight, materials of construction, materials used as shielding, external dimensions and cavity size, internal and external structures, valves, sampling ports, means of heat dissipation, lifting and tie-down devices, amount of shielding, closures, and means of containment. The containment and shielding components should be clearly identified. Overall and cutaway sketches of the package should be included as part of the design description, as well as drawings that clearly detail the safety features considered in the analysis, including material lists, dimensions, valves, and fasteners. Drawings should specify the requirements for all packaging weld joints; joints for gaskets should be sufficiently detailed to show the surface finish and flatness requirements of the closure surfaces; the gasket specification; and, if appropriate, the method of gasket retention.

Designer: The person or organization that develops the design by selecting the assembly of components and materials to be used for the packaging of particular radioactive material contents. The designer should have a working knowledge of the proposed radioactive contents, packaging engineering concepts, DOT Type A design and performance requirements, and use or functionality of the packaging. The designer applies this knowledge to determine the components of the packaging; ensures that the design

demonstrates the capability to fulfill all design requirements; and specifies the criteria for which the packaging is to be fabricated, tested, and closed. In some instances the designer may also be the fabricator and/or the shipper/offeror.

Dispersible radioactive material: For the purpose of this document, dispersible materials are radioactive materials that could become released or leaked from the packaging due to conditions normal to transport (i.e., vibrations, accelerations, temperature, pressure). Examples of dispersible contents include unpackaged low level waste, piping or components with exterior contamination, or oxide contents, fines, powders in containers that cannot be shown to withstand routine vibrations or accelerations (e.g., badly deteriorated drums or boxes).

Engineering analysis: Engineering analysis of a package design involves separating the design into components to demonstrate that containment, shielding, and thermal performance of the overall package are maintained under the testing and performance conditions specified in the regulations. Analysis methods include comparison, hand or computer calculations, and reasoned analysis.

Fabricator: The person or organization that fabricates or assembles the packaging components of a specific design, as specified by a customer. In some instances the fabricator may also be the designer and/or the shipper/offeror.

Freight container (IAEA Safety Standards TS-R-1, 2005-223): An article of transport equipment that is designed to facilitate the transport of goods, either packaged or unpackaged, by one or more modes of transport without intermediate reloading which is 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 m3. Any other freight container is considered to be a large freight container.

Freight container (49 CFR 173.403): A reusable container having a volume of 1.81 cubic meters (64 cubic feet) or more, designed and constructed to permit it being lifted with its contents intact and intended primarily for containment of packages in unit form during transportation. A small freight container' is one, which has either one outer dimension less than 1.5 m (4.9 feet) or an internal volume of not more than 3.0 cubic meters (106 cubic feet). All other freight containers are designated as large freight containers.

Freight container (also see "Standard Freight Container" below)

Freight container modifications affecting original certification: Modifications that affect the previous approved design of the container by the competent authority (e.g., U.S. Coast Guard) or their designee (e.g., American Bureau of Shipping). In most cases, any modification that affects the structural integrity of the container and for which the competent authority can require new testing to be performed.

Freight Container Modifications that do not affect its original certification: Modifications that do not affect the certification of the container by the competent authority or their designee. In most cases, these are modifications that affect the structural integrity of the container.

Inner Containment: An inner receptacle or container that acts as a containment boundary of the contents, but is not capable of meeting all the requirements of the regulations. The inner containment must be placed in an outer packaging to meet all transportation requirements.

Low Specific Activity (LSA) material (49 CFR 173.403): Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limits set forth below. Shielding material surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups LSA-1, LSA-2, or LSA-3.

Modified Freight Container: Containers that have been modified from their original design. The modifications that have been made may or may not violate the original certification of the container.

Non-Dispersible radioactive material: Contents consist of solid radioactive materials of a sufficiently large (particle) size so as not to leak from the freight container. Non-dispersible contents include solid activated materials that will not break down or disintegrate into fines during transport, flanged hardware components with internal contamination, piping with wrapped ends with internal contamination, or bagged homogeneous/non-puncturing waste. Non-dispersible radioactive materials must either be of a form that is 1) robust enough to remain as a solid unit without disintegration; or 2) be confined in inner packaging (bagging, drums, and boxes) that can be shown to withstand routine conditions of transport.

Non-fixed radioactive contamination: Radioactive contamination that can be readily removed from a surface by wiping with an absorbent material. Non-fixed (removable) radioactive contamination is not significant if it does not exceed the limits specified in 49 CFR 173.443.

Normal conditions of transport: A term used in both the DOT and IAEA regulations to encompass rough handling and minor mishaps during transportation. Type A packages are required to demonstrate that they can withstand normal conditions of transport by meeting the performance and containment requirements of 49 CFR 173.412, 465, and 466.

Off-the-shelf Freight Container: Containers that available for sale or lease, comply with their original design, and have not been modified.

Offeror or person who offers (49 CFR 171.8): Any person who does either or both of the following.

- Performs, or is responsible for performing, any pre-transportation function required under this [CFR] subchapter for transportation of the hazardous material in commerce.
- Tenders or makes the hazardous material available to a carrier for transportation in commerce.

A carrier is not an offeror when it performs a function required by this [CFR] subchapter as a condition of acceptance of a hazardous material for transportation in commerce (e.g., reviewing shipping papers, examining packages to ensure that they are in conformance with this subchapter, or preparing shipping

documentation for its own use) or when it transfers a hazardous material to another carrier for continued transportation in commerce without performing a pre-transportation function.

Package (49 CFR 173.403): The packaging together with its radioactive contents as presented for transport.

(1) **Excepted package** means a packaging together with its excepted Class 7 (radioactive) materials as specified in Sec. Section 173.421-173.426 and 173.428.

(2) **Industrial package** means a packaging that, together with its low specific activity (LSA) material or surface contaminated object (SCO) contents, meets the requirements of Sections 173.410 and 173.411. Industrial packages are categorized in Section 173.411 as either:
   (i) "Industrial package Type 1 (IP-1)";
   (ii) "Industrial package Type 2 (IP-2)"; or
   (iii) "Industrial package Type 3 (IP-3)".

Packaging (49 CFR 173.403): The assembly of components necessary to ensure compliance with the packaging requirements in 49 CFR 173, Subpart I. It may consist of one or more receptacles; absorbent materials; spacing structures; thermal insulation; radiation shielding; service equipment for filling, emptying, venting, and pressure relief; and devices for cooling or absorbing mechanical shocks. The conveyance, tie-down system, and auxiliary equipment may sometimes be designated as part of the packaging.

Person (49 CFR 107.1 and 171.8): An individual, firm, co-partnership, corporation, company, association, or joint-stock association (including any trustee, receiver, assignee, or similar representative) or a government or Indian tribe (or an agency or instrumentality of any government or Indian tribe) that transports a hazardous material to further a commercial enterprise or offers a hazardous material for transportation in commerce. The term "person" does not include the following.

1. The US Postal Service.
2. Any agency or instrumentality of the federal government, for the purposes of 49 U.S.C. 5123 (civil penalties) and 5124 (criminal penalties).
3. Any government or Indian tribe (or an agency or instrumentality of any government or Indian tribe) that transports hazardous material for a governmental purpose.

Pre-transportation function (49 CFR 171.8): At least one of the pre-transportation functions specified in the definition section of 49 CFR 171.8 that are required to ensure the safe transportation of a hazardous material, including radioactive material.

Production Certificate: A document that is issued by the Third Party Approval Agency upon the satisfactory conclusion of container plan review, prototype approval, the production tests required by the approved test plan, the acceptance of the manufacturer's quality control procedures and the survey of each container. These units, when considered acceptable to the Third Party Approval Agency, will be certified and Production Certificate issued. The Production Certificate when issued will list the serial numbers for each container.

Prototype Test Certificate: A document that is issued by the Third Party Approval Agency when they have verified all designs, calculations supporting the design and methods of construction for the freight container meeting the design considerations and the performance tests as required in the Agency's Rules of Certification. Prior to this document being issued the surveyor will witness the construction of each freight container, verify the materials of construction are as designated in the design drawings, verify fabrication techniques, such as. welding, and witness each test that is required in their Rules of Certification. This document is issued by the Third Party Approval Agency when a prototype container meets the requirements of the Rules of Certification based on the surveyor's observations and it has been determined that the prototype has passed the required tests.

Quality assurance (49 CFR 173.403): A systematic program of controls and inspections applied by each person involved in the transport of radioactive material that provides confidence that a prescribed standard of safety is achieved in practice.

Radiation level (49 CFR 173.403): The radiation dose-equivalent rate expressed in millisieverts per hour or mSv/h (millirems per hour or mrem/h). Neutron flux densities may be converted into radiation levels according to Table 1 in 49 CFR173.403 (definitions).

Radiation shield: Material incorporated in packaging to reduce the intensity of radiation from the package. The radiation shield surrounds the contents and may or may not qualify as a containment system.

Routine conditions of transport: Routine conditions of transport are incident free with no mishaps. Type A packages are required to demonstrate that they can withstand routine conditions of transport by meeting the requirements of 49 CFR 173.24, 24a, 24b, and 173.410.

Routine Conditions of Transport (RTC): RCT are quantitatively defined in the international regulations (TS-R-1, *Regulations for the Safe Transport of Radioactive Material*, and TS-G-1.1, *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material*). The Federal Motor Carrier Safety Administration (FMCSA) in 49 CFR 393 provides requirements and associated acceleration factors that can be applied for domestic NCT considerations.

RCT International: The Regulations for the Safe Transport of Radioactive Materials (e.g., TS-R-1 and TS-G-1.1) define routine conditions of transport (RCT) as follows:

- Incident free transport conditions (TS-R-1, 106);
- Accelerations, vibration or vibration resonance (TS-R-1, 612); and Acceleration factors for package retention for RCT from TS-G-1.1 Appendix IV, Table IV are listed in the table below.

	Acceleration Factors		
Transport Mode	**Longitudinal**	**Lateral**	**Vertical**
Highway	2g	1g	2g up, 3g down
Rail	5g	2g	2g up, 2g down
Sea	2g	2g	2g up, 2g down

Appendix V of TS-G-1.1 discusses conveyance package retention. The following are excerpts from TS-G-1.1, Appendix V:

- Package retention systems only have to be designed to meet the demands of routine conditions of transport. Therefore, in normal or accident conditions of transport, the package is permitted, and may be required as part of the design, to separate from the conveyance by the breakage or designed release of its restraint in order to preserve the package integrity.
- The methods of retention should not cause the package to be damaged, or even stress components of the package or its retention system beyond yield, during routine conditions of transport.
- The requirement that the integrity of the package should not be impaired by overstressing in normal or accident transport conditions can be satisfied by the designer incorporating quantifiable weak links in either the package attachment points or in the tie-downs specified for restraint. See Figure 3.6 for freight container attachment points.
- The forces imposed on the package may be determined by multiplying the acceleration factors by the mass of the package. For vertical accelerations, the factors are those experienced by the package, not allowing for gravity.

RCT Domestic: For domestic transport the Cargo Securement Rules of the Federal Motor Carrier Safety Administration (FMCSA) provides relevant package securement requirements. Excerpts (in italics) from the FMCSA (49 CFR 393) are provided below.

- FMCSA has adopted new performance requirements concerning deceleration in the forward direction, and acceleration in the rearward and lateral directions, those cargo securement systems must withstand. Deceleration is the rate at which the speed of the vehicle decreases when the brakes are applied, and acceleration is the rate at which the speed of the vehicle increases in the lateral direction or sideways (while the vehicle is turning), or in the rearward direction (when the vehicle is being driven in reverse and makes contact with a loading dock).
- FMCSA requires that cargo securement systems be capable of withstanding the forces associated with following three deceleration/accelerations, applied separately:

  – 0.8 g deceleration in the forward direction,
  – 0.5 g acceleration in the rearward direction, and
  – 0.5 g acceleration in a lateral direction.
  – 0.2 g acceleration in a vertical direction

  These values were chosen based on researchers' analysis of studies concerning commercial motor vehicle performance.

The Shipper has the responsibility for evaluating the securement of packages or components within the Freight Container. Packages and components need to remain in place, without changing position, and not incur damage under the routine conditions of transport.

Rules of Certification: A document that is produced by a Third Party Approval Agency that is used by those organization who wish to have a freight container (cargo Container) approved by that agency who represents the Competent Authority of the country they represent. This document may have varying titles as described in the table below.

Third Party Approval Agency	Title of their "Rules of Certification"
American Bureau of Shipping	Rules of Certification of Cargo Containers
Bureau of Veritas	Rules for the Classification and Certification of Freight Containers
Lloyds Register	EMEA Container Certification Scheme
DET Norske Veritas	Rules of Certification of Freight Containers
Germanischer Lloyd	Rules for Classification and Construction

Shall and should: For the purposes of this document, the word "shall" or "must" is used to denote a requirement; the word "should," denotes a recommendation; and the word "may," denotes permission (neither a requirement nor a recommendation).

Shipment/Consignment: Any package, packages, or load of radioactive material presented by a consignor for transport.

Shipper/Consignor: Any person, organization, or government that prepares a consignment for transport and is named as consignor in the transport documents.

Standard Freight Container: A freight container complying with ISO 1496-1, Series 1 *freight containers-Specification and testing*-Part 1*: General cargo containers for general purposes*, Edition 1990, as identified in 49 CFR 173.411(b)(6) and for purposes of this document. (Also see ISO 668 – Series 1 *Freight container - Classification, dimensions and ratings*.)

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APPENDIX B: Historical Background

During the 1960s, the rapid increase in the use of freight containers for the consignment of goods by sea and the development of specialized container ships caused the International Maritime Organization (IMO) to undertake a study of the safety of containerization in marine transport in 1967. The container itself emerged as the most important aspect to be considered. In 1972, a conference was held to consider a draft convention prepared by the IMO in cooperation with the Economic Commission for Europe. The conference was jointly convened by the United Nations and the IMO. The 1972 Convention for Safe Containers had two goals. One was to maintain a high level of safety of human life in the transport and handling of containers by providing generally acceptable test procedures and related strength requirements that would prove adequate over years of use. The other was to facilitate the international transport of containers by providing uniform international safety regulations, equally applicable to all modes of surface transport. In this way, proliferation of divergent national safety regulations could be avoided.

The requirements of the Convention apply to the great majority of freight containers used internationally, except those designed specifically for carriage by air. As it was not intended that all containers, vans, or reusable packing boxes should be affected, the scope of the Convention was limited to containers of a prescribed minimum size having corner fittings—devices that permit handling, securing, or stacking. The Convention established procedures whereby containers used in international transport will be safety approved by an administration of a contracting state or by the organization acting on its behalf. The administration or its authorized representative will authorize the manufacturer to affix a safety approval plate containing the relevant technical data to approved containers. The approval, evidenced by the safety approval plate granted by one contracting state, should be recognized by other contracting states. This principle of reciprocal acceptance of safety-approved containers is the cornerstone of the Convention; and once approved and plated, it is expected that containers will move in international transport with the minimum of safety control formalities.

The United States accepted the Convention requirements and adopted them on January 3, 1978. The United States designated the U.S. Coast Guard as the responsible organization to ensure compliance with the International Convention for Safe Containers (CSC) (See appendix A). This was adopted by law and incorporated into 49 CFR Parts 450–453. The U.S. Coast Guard may elect to authorize other organizations to ensure compliance with the International Convention for Safe Containers (CSC) requirements, e.g., American Bureau of Shipping (ABS).

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APPENDIX C: Commercial Process for Freight Container Certification

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The American Bureau of Shipping (ABS) has been designated as an authorized entity by the US Coast Guard (per 49 CFR 450, Subpart B) to ensure compliance with the International Convention for Safe Containers (CSC) requirements for the United States. Therefore, their process for freight container certification (i.e., ABS Rules for Certification for Cargo Containers) will be outlined in this section. Certification includes freight container design, design review, prototype and production testing, manufacturing controls and inspections, marking, and certification by the authorized authority. Periodic inspections and re-inspections (following repair or maintenance) required for continued CSC approval, in accordance with 49 CFR 452, will also be discussed.

C.1 FREIGHT CONTAINER CERTIFICATION PROCESS

The certification process consists of a) the development of rules, guides, standards and other criteria for the design, construction and quality assurance of containers, materials, and equipment; b) the review of the design and survey during and after construction to verify compliance; and c) the issuance of certificates when such compliance has been verified. The rules, guides, and standards are developed by the specific bureau (e.g., ABS) and approved by committees made up of users, manufacturers, engineers, materials experts, operations and other technical/scientific personnel. The certification process is comprehensive and carried out by qualified personnel in accordance with the federal regulations. As such, the certification documentation should be fully adequate to demonstrate compliance to DOT requirements. Containers certified to the ABS rules of certification meet the CSC and ISO-1496-1 requirements.

C.1.1 Conditions of Certification

The requirements for freight container certification are determine by bureaus and approved by committees made up of experienced container manufacturers, users, marine/railroad/structural/materials engineers, ship builders, steel makers and other relevant technical experts. The conditions for certification consist of, but are not limited to, completion of the following:

- Compliance with specified rules, guides, standards, and other criteria for the design, testing and construction (e.g., CSC, ISO 1496-1);
- Review of container design, drawings and calculations;
- Use of appropriate materials of construction and equipment;
- Review of container plans for prototype design and performance testing;

- Review of quality programs, testing plans, procedures, and manufacturing facilities;
- Surveillance of prototype testing and production manufacturing (by bureau authorized inspectors); and
- Completion of reports documenting prototype testing and production fabrication.

Certification is granted when a bureau, through its reviews and surveillance, concludes that the conditions for certification have been satisfactorily met. Certification is a representation by the Bureau as to the structural fitness for the particular use or service in accordance with its Rules, guides and standards. Placement of a round ABS emblem (representing general service) signifies the container complies with the ABS Rules for Certification, which includes the CSC and ISO 1496-1 requirements.

C.1.2 Design Review

For new or modified freight container designs, a manufacturer is required to submit comprehensive information to the bureau for review. The submittal is to include a statement that the containers:

- will be built in conformance to the "Rules of Certification for Cargo Containers",
- will be manufactured under a quality control program acceptable to the bureau,
- will be available for inspection during manufacture and testing, and
- will be tested in accordance with prescribed procedures.

Additionally any changes in design, materials, or fabrication methods will not be made without written approval.

The information submitted varies depending on whether a new design series is being requested or whether additional units of an approved design or changes to an existing design are desired. These required documents are identified in Table C- 1 below.

Table C-1. Documents to submit to bureau for design review

New Design Series*	Approved Design Series*	Changes to existing Designs*
Application of each new design series is to include the following plans and data.	Application of additional units to be certified to an approved design series is to include the following.	When changes are being made to an application or to an approved design series, include the following.
Application Form	Container Data Form	Container Data Form
Container Data Form	Data Form Supplement for Thermal Containers if applicable	Data Form Supplement for Thermal Containers if applicable

Material identification form		Design Comparison Table
Following drawings ▪ General arrangement ▪ Sub-assemblies ▪ Detail of components ▪ Markings, including data plates		Following Drawings ▪ Marking drawing – If owner has changed ▪ General Assembly ▪ Subassembly ▪ Detail drawing as appropriate showing any revision from original design ▪
Prototype Test Agenda		All changes will be reviewed and if the modifications are deemed significant retesting of those parts of the container affected by the modification may be required.
Quality Control Procedures – Required for each facility		
When the application includes a request for certification to governmental requirements, international conventions, or other standards, the submittal is to include the necessary information required for the reviews.		

**Information in Table C-1 was extracted from the ABS Rules of Certification for Cargo Containers 1998*

Upon receipt of the documents identified under "New Design Series", the bureau will perform a thorough design review of drawings, calculations, test agenda, and quality control procedures provided by the manufacturer. Upon completion of the design review, which is based primarily upon the container meeting the design considerations in Section C.1.5, the performance tests in Section C.1.6 will be performed. The bureau will then allow the manufacturer to fabricate the freight containers that will be used for the performance tests in Section C.1.6. During the manufacturing of these units, the bureau's surveyor inspects the use of materials of construction along with verifies welding processes, quality assurance program, and the testing of units.

C.1.3 Materials and Fabrication

Materials and fabrication details are included in the documentation required by the shipper of IP-2 and IP-3 radioactive material packages per 49 CFR 173.411(c). The bureau's freight container certification process specifically addresses materials and fabrication in Section 3 (ref). All structural materials must conform to an established specification or recognized national standard. Since the majority of freight containers are fabricated in countries outside the US, due notice is given to practices in the specific country.

The bureau verifies the acceptability of materials and the welding processes. Welding is to be carried out in accordance with recognized standards by qualified welders. The bureau's rules go into significant detail on welding details, qualifications, and tests. Bureau surveillance personnel review all weld procedures and perform surveillance during manufacture. Since freight containers are primarily all-welded construction (except for doors, etc.) the acceptability of materials and welding practices and procedures is given attention during reviews, testing and surveillance. (Joint types, orientations, and acceptance criteria)

C.1.4 Quality Control

The Bureau will approve all prototype and production manufacturing and testing facilities and carry out periodic audits. The principal freight container manufacturers submit quality control manuals to the Bureau which gives in detail those inspections and controls to be followed to assure the quality of the production units are comparable to that of the prototype. The required quality elements are listed below. The manufacturer must submit its QC manual to the Bureau for review in order that compliance may be verified with QC requirements of the ABS Rules for Certification. The manufacturing facility is subject to audit by the ABS surveillance personnel to confirm compliance with the QC procedures specified in the submitted manual. All changes or revisions to the QC manual including any procedural changes are to be submitted to the bureau for review.

The QC manual is to include the following elements:

- Description of Organization: Manufacturer's organization including management, purchasing, production, and QC functions.
- Materials Identification: methods are to be in place to control and identify all materials, including methods for welding electrode identification.
- Workmanship Quality: methods are to be in place to ensure consistently acceptable quality (e.g., jigs, fixtures).
- Control Records: procedures for maintaining records are to be adequate to assure identification of material and checks on workmanship.
- Fabrication QC Methods: welding procedures and inspection techniques used in fabrication are to be acceptable to the Bureau surveillance personnel. Special attention is given to ensuring adequacy of corner fittings and their attachment to the structural members.

C.1.5 Design Considerations

Freight containers are designed to be structurally sound and weather tight under multi-modal (highway, rail, marine) loading, transport and handling conditions. The main frame, corner fittings, sides and ends are to have sufficient structural strength to withstand, without significant permanent deformation, the static and dynamic loads imposed by lifting, stacking, impact, vibration, and racking loads encountered under normal service conditions as well as protect the cargo from the environment. The floor structure must be strong enough to support the payload under dynamic loading and concentrated forklift truck axle loads. The design considers the loads from each transport mode and terminal handling, expressed as accelerations. Marine transport imposes significant transverse loads on the containers due to the sway of the ship and the high stacking heights. Rail transport imposes significant longitudinal loads due to coupling and humping loads. Handling equipment that loads and unloads containers imposes significant vertical accelerations on the container. Overall the freight container is designed to withstand the

maximum normal loads from all modes of transport and handling. This results in a robust structure that remains serviceable and does not undergo elastic deformation under normal service.

The freight container design features include four top and four bottom corner fittings which defines a rectangular box. The corner fittings are welded to the top, bottom, and end rails to form the frame of the FC. The corner fittings are to protrude slightly above the highest point of the roof and the bottom corner fittings protrude slightly below the plane of the bottom, so that when stacked the load can be fully supported at the corners. Other design features include forklift pockets and special lifting and cargo securing devices.

The design loads that must be met by Freight Containers take into account the normal service conditions outlined above. The design loads required by the ABS Rules (include CSC and ISO-1496-1 considerations) are summarized below. Note – the design loads are statically applied to prototype containers as discussed in Section C.1.6. For the bulleted items below: R = Gross Weight, P = Maximum Payload, T = Tare Weight.

- Corner Structure Loads – Stacking – to simulate stacking on a ship that is pitching and heaving: the corner structure is to have sufficient strength to allow stacking when transported by ship. Design load factor (static + dynamic) is 1.8 x 8 R (stacking 9 high) distributed among the four corner structures.
- Lifting Loads – to ensure top and bottom corner fittings and associated structures are capable of suspending a loaded container: Total weight of 2R, a) lifting vertically from top with each corner to carry ¼ the design load, b) lifting from 4 bottom corners at 45o angles to horizontal (for 20' container), and c) lifting from fork-lift pockets in vertical upward direction.
- Floor Loads – to ensure floor is capable of carrying loads imposed by loading vehicles and cargo: a) wheel: floor is to withstand concentrated loads imposed by lift truck front axle (two wheels) loading of 12,000 lbs. over an area not greater than 22 in2/wheel, and b) cargo: 2P uniformly distributed from side to side over any 10' of length.
- Floor and Rear Panel Loads – to ensure front and end panels can withstand cargo load forces resulting from rail coupling impacts or highway breaking: a) load of 0.4P uniformly distributed outward over the front and rear end panels, and b) transverse racking load of 33,700 lbs. applied at top of front and rear panel corners with bottom corners fixed.
- Side Panel Loads – to ensure side panels can withstand cargo load forces resulting from ship rolling or highway cornering: a) a load of 0.6P uniformly distributed over side walls in transverse direction (outward), and b) longitudinal racking load of 16,850 lbs. applied at each top corner of side wall with bottom corners fixed.
- Lashing – to simulate external forces transmitted to the corner fittings: concentrated loads applied individually or simultaneously to the corner fittings in the longitudinal, transverse and vertical directions.
- Roof Load – simulates two 220 lbs. workers on roof: a load of 440 lbs. uniformly distributed over a 2' x 1' area in a downward direction.

- Base Structure Loads – ensures base structure can withstand forces resulting from rail impacts: a load of 2R applied in a longitudinal direction through bottom apertures of the bottom corner fittings to simulate acceleration during rail car impact.
- Cargo Securing Devices (where provided) – to ensure anchor or lashing points can withstand inertial forces imposed by cargo in transit: concentrated load applied away from cargo securing device located inside FC, a) 2200 lbs. for anchor point in base structure, b) 1100 lbs. for lashing point in any other part of container (other than base).

C.1.6 Testing

C.1.6.1 Prototype tests

Full-sized prototype containers, manufactured to the same QC requirements as production containers, are tested to verify design adequacy. The test loads are primarily static to provide comparable and repeatable test data at reasonable costs. The test loads (described in C.1.6.2) take into account the combined static and dynamic loads anticipated in service. Bureau surveillance personnel witness prototype tests. Dimensional measurements are taken before testing and retaken, along with weather tightness, upon completion of all structural tests.

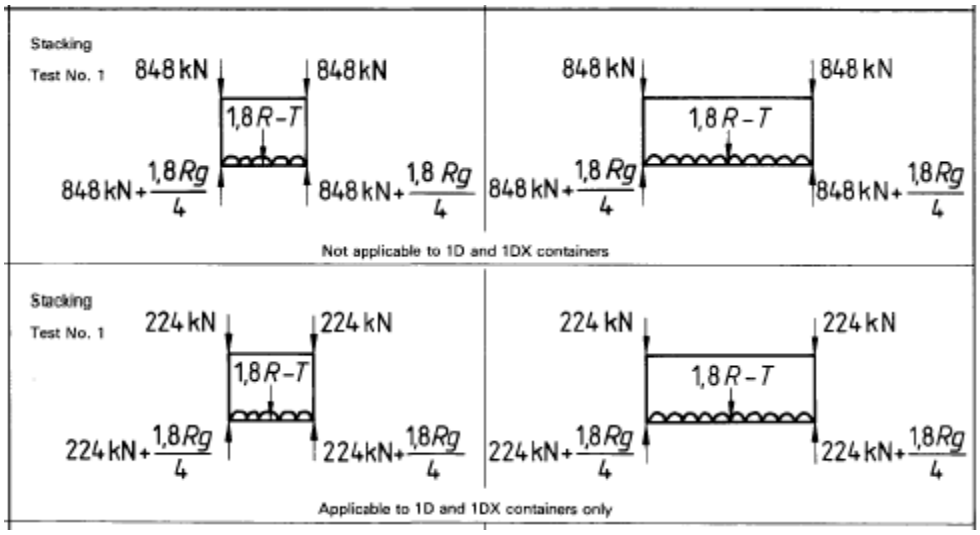
Testing acceptance criteria: a) when the prescribed load is applied the container is not to exhibit significant permanent deformation or weakening; and b) after removal of the load the dimensions are to return to the original values within allowable tolerances and the unit is to be fully suitable for service.

C.1.6.2 ISO-1496-1 tests

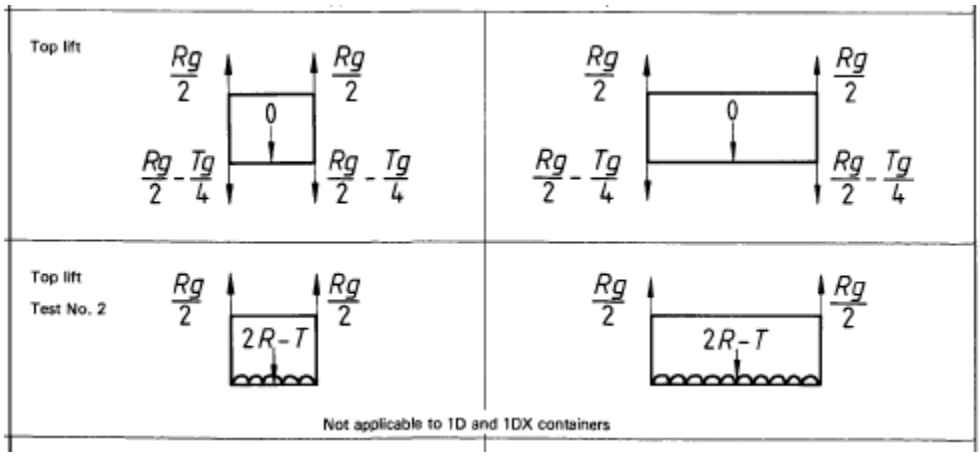
The ISO 1496-1 prototype tests are briefly paraphrased below. Compliance with these tests will generally satisfy the Design Requirements discussed in Section 4.4.1, meeting the ISO 1496-1, and are specifically the tests referred to in DOT 49 CFR 173.411(b)(6). It is noted that the CSC also contains testing requirements but they are slightly different than the ISO 1496 tests. A comparison of the differences between the ISO 1496-1 and CSC testing details is given in Appendix M. Note – for additional details on tests, see ISO 1496-1 Section 7. The first sentence of each test (except for test #12) provides the rational for structural test criteria excerpted from ISO TR 15070, Series 1 Freight Containers – Rationale for Structural Test Criteria.

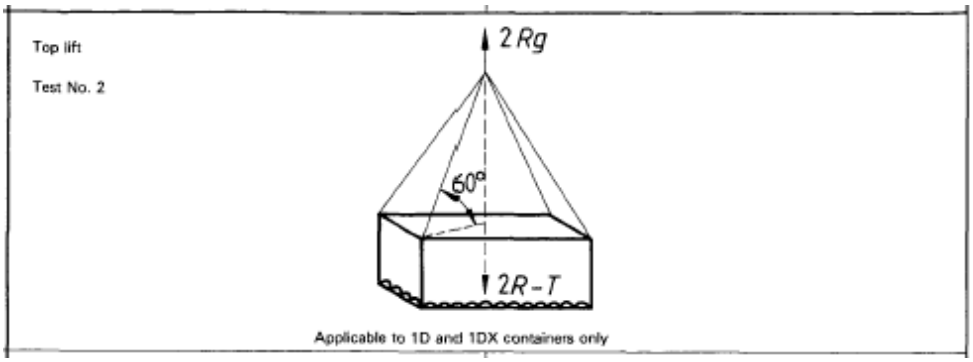
1. Stacking – The test is carried out to prove the ability of a fully loaded container to support a superimposed mass of containers, taking into account the conditions aboard ships at sea. The container shall be placed on four level pads, one under each bottom corner fitting and be floor of the container shall be uniformly loaded to a weight of 1.8R. The container shall be subjected to vertical force of 762,550 lbs. (nine-high stacking), applied to all four corner fittings simultaneously, or 381,275 lbs. to each pair of end fittings. Upon completion of the test, the container shall show neither permanent deformation nor any abnormality which will render it unsuitable for use.

Figure Definitions: R = Gross Weight, P = Maximum Payload, T = Tare Weight

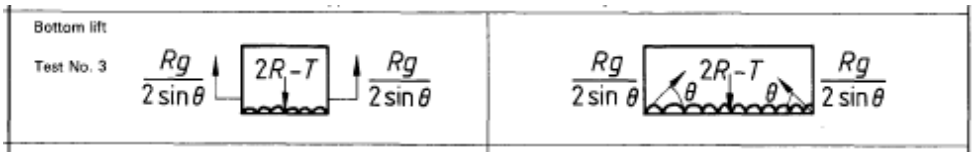


2. Lifting from the Four Top Corner Fittings – This test is carried out to prove the ability of a container, whether in a loaded or empty condition, to withstand being lifted vertically using its top corner fittings. It demonstrates the lifting capability not only of the top frame but also of the entire container frame and floor structure of the container. The container shall have a load uniformly distributed over the floor such that the combined weight of the container and payload is 2R and shall be lifted vertically from all top corners such that no significant acceleration or deceleration forces are applied. The container shall be suspended for 5 min. and then lowered to the ground. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.

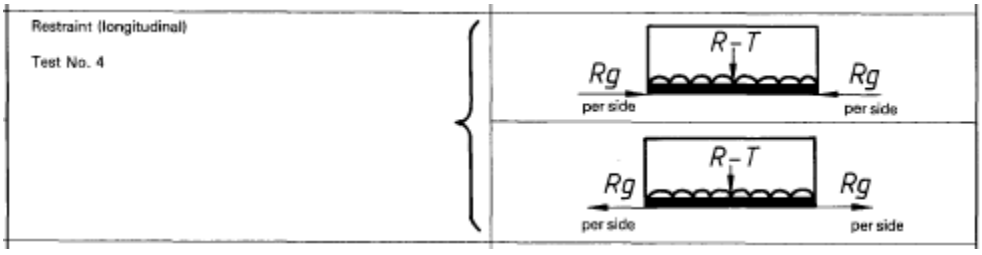




3. Lifting from Bottom Corners – This test is carried out to prove the ability of a container, whether in a loaded or empty condition, to withstand being lifted using the bottom corner fittings, in accordance with ISO 1161, Series 1 Freight Containers – Corner Fittings - Specifications, via slings which transmit the lifting force from the bottom corner fittings obliquely to a single transverse spreader beam. The container shall have a load uniformly distributed over the floor such that the combined weight of the container and payload is 2R and shall be lifted from the side apertures of all four-corner fittings in such a way that no significant acceleration or deceleration forces are applied. Lifting forces shall be applied at 45° to horizontal for a 20' container. The container shall be suspended for 5 min. and then lowered to the ground. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.



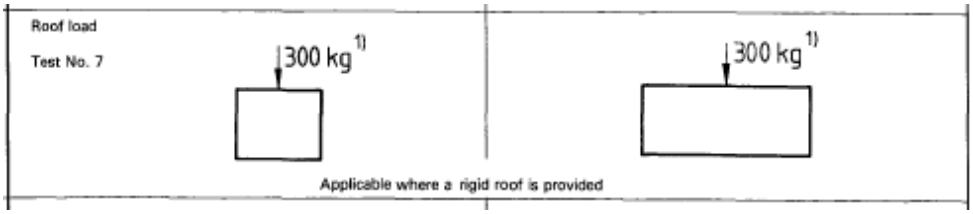
4. Restraint (longitudinal) – This test is carried out to prove the ability of a container to withstand longitudinal external restraint under dynamic conditions of railway operations. The container shall have a load uniformly distributed over the floor such that the combined weight of the container and payload is R, and be secured to anchor points through the bottom apertures of the bottom corner fittings at one end of the container. A force of 2R shall be applied horizontally to the container through the bottom apertures of the other bottom corner fittings, first towards and then away from the anchor points. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.



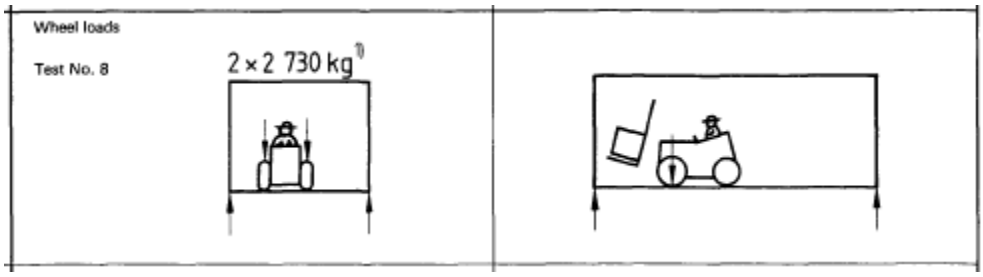
5. Strength of End Walls – This test is carried out to prove the ability of the end walls of a container to withstand the forces caused by the cargo under the dynamic conditions of railway operations. The container shall be subjected to an internal loading of 0.4P uniformly distributed over the wall. Both the blind end and door ends shall be tested. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.

6. Strength of Side Walls – This test is carried out to prove the ability of the sidewalls of a container to withstand the forces caused by cargo under dynamic conditions of ship movement. Each side of the container shall be subjected to a uniformly distributed loading of 0.6P. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.

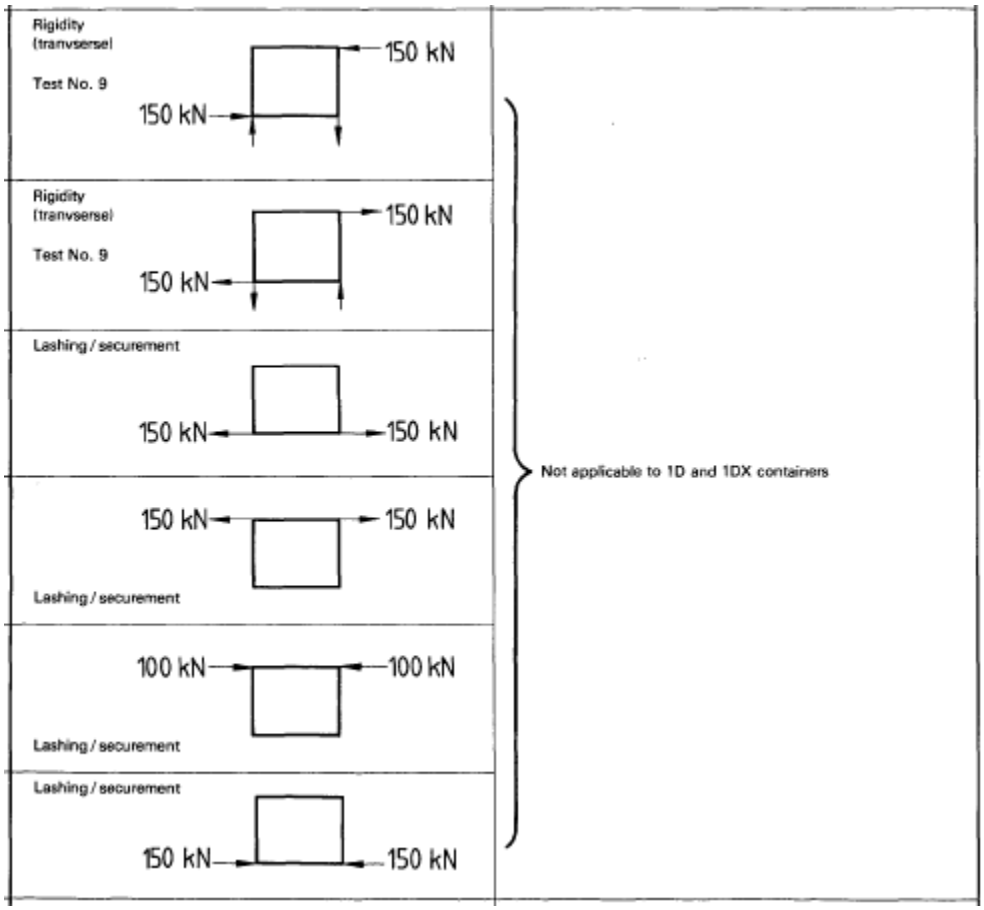
7. Strength of Roof – This test is carried out to prove the ability of the rigid roof of a container, where fitted, to withstand loads imposed by persons walking on it. A load of 440 lbs. shall be distributed over an area of 1' x 2' located at the weakest area of the rigid roof of the container. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.



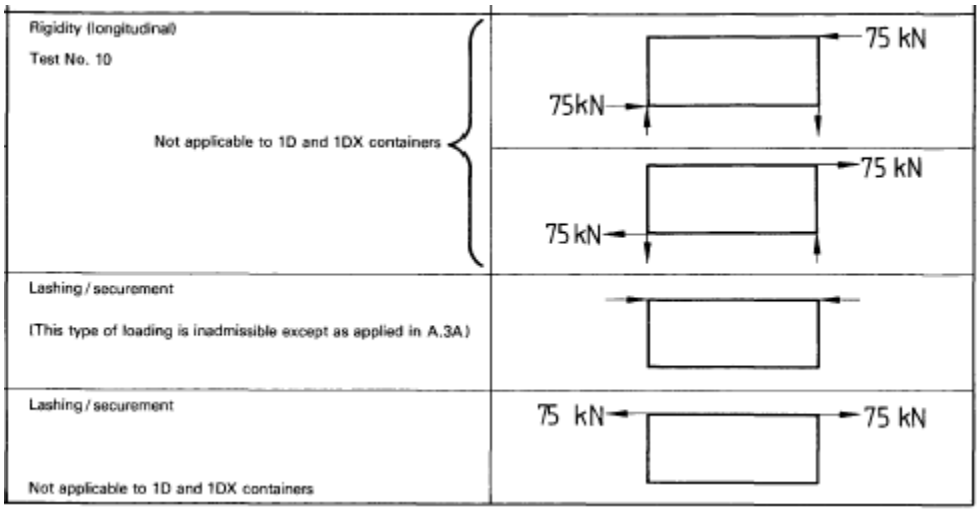
8. Floor Strength – This test is carried out to prove the ability of the floor of a fixed container to withstand concentrated dynamic forces imposed by wheeled vehicles placing and removing cargo. The test shall be performed using a test vehicle equipped with tires with an axle load of 12,000 lbs. (6,000 lbs. on each of two tires). The footprint (area) shall be no more than 22 in^2 per tire. The test shall be made with the container resting of four level supports under its four bottom corner fittings, with its base structure free to deflect. The test vehicle shall be driven over the entire floor area. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.



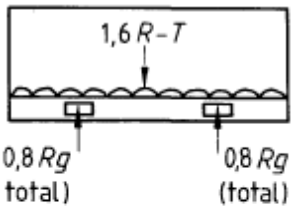
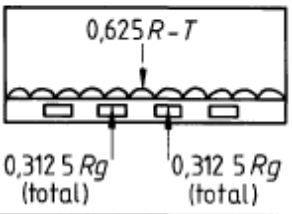
9. Rigidity (transverse) – This test is carried out to prove the ability of a container to withstand transverse racking forces resulting from ship movement. An empty container shall be placed on four level supports, one under each corner fitting and be restrained against lateral and vertical movement by anchor devices acting through the bottom apertures of the bottom corner fittings. Lateral restraint shall be provided only at a bottom corner fitting diagonally opposite to and in the same end frame as a top corner fitting to which the force is applied. A force (at right angles to long axis) of 33,700 lbs. shall be applied to each of the top corner fittings on one side of the container parallel both to the base and in the planes of the ends of the container. The forces shall be applied first towards and then away from the top corner fittings. The sideways deflection of the top of the container under full transverse loading shall not cause the sum of the changes in length of the two diagonals to exceed 2 3/8 inches. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.



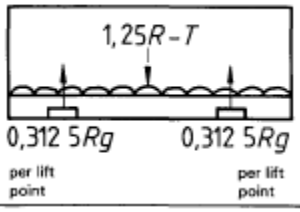
10. Rigidity (longitudinal) – This test is carried out to prove the ability of a container to withstand longitudinal racking forces resulting from ship movement. An empty container shall be placed on four level supports, one under each corner fitting and be restrained against lateral and vertical movement by anchor devices acting through the bottom apertures of the bottom corner fittings. Longitudinal restraint shall be provided only at a bottom corner fitting diagonally opposite to and in the same side frame as the top corner fitting to which the force is applied. A force of 16,850 lbs. shall be applied to each of the top corner fittings on one end of the container in lines parallel both to the base of the container and to the planes of the sides of the container. The forces shall be applied first towards and then away from the top corner fitting. The longitudinal deflection of the top of the container with respect to the bottom of the container, under full test load shall not exceed 1 inch. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.



1. Lifting from Fork-Lift Pockets (where fitted) – This test is carried out on any container which is fitted with forklift pockets to demonstrate its ability to be lifted by forklift equipment (40-ft freight containers may not have forklift pockets). The container shall have a load uniformly distributed over the floor in such a way that the combined weight of the container and payload is 1.6R and it shall be supported on two horizontal bars each 8 inches wide, projecting 72 inches into the forklift pockets. The container shall be supported for 5 minutes and then lowered to the ground. A second test shall be applied to the (additional) inner pockets, except that the combined weight of the container and payload shall be 0.625R and the bars shall be placed in the inner pockets. Upon completion the container shall show neither permanent deformation nor any abnormality, which will render it unsuitable for use, and the dimensional requirements shall be met.

Fork-lift pockets Test No. 11 Applicable to 1CC, 1C, 1CX, 1D and 1DX containers when fitted with one set of fork-lift pockets	
Fork-lift pockets Test No. 11 Applicable to 1CC, 1C and 1CX containers when fitted with a second set of fork-lift pockets	

2. Lifting from the Base at Grappler Arm Positions (where fitted) – Grappler arms are infrequently used today. See ISO-1496-1 for details of tests.

Grappler lift Test No. 12 Applicable to all sizes when fitted with grappler arm lift positions	

3. Weatherproofness – This test is carried out to prove the ability of a container to remain watertight after a stream of water has been applied on all external joints. A stream of water shall be applied on all exterior joints and seams of the container. The nozzle shall be held at a distance of 5 feet from the container and be moved at a speed of 4 inches per second. Upon completion of the test, no water shall have leaked into the container.

C.1.6.3 Production tests

Each freight container that is manufactured for use is dimensionally and weather tight tested by the manufacturer. A pull test is also performed on each corner post assembly. If inspection personnel deem quality control procedures adequate, the pull test may be performed on one container from each lot of fifty (50) containers. The Bureau surveillance personnel witness representative production tests during manufacturing.

C.1.7 Marking

Each container (approved by ABS) is permanently marked by the manufacturer with the following information:

- Manufacturer's name and address,

- Manufacturer's serial number,
- Month and year of manufacture,
- American Bureau of Shipping emblem (or other third party emblem as applicable),
- Maximum gross weight,
- Tare,
- Payload, and
- Design type number

The International Convention for Safe Containers (CSC) plate is required for international shipment in accordance with 49 CFR 450.1. Note: the CSC plate and associated periodic inspections, are not required for domestic use of freight containers nor are they required for use of freight containers as Type IP-2 or Type IP-3 packagings in accordance with 49 CFR 411(b)(6). The CSC plate contains the following information:

- Country of Approval Reference,
- Date (month and year) of manufacture,
- Manufacturer's identification number of the container,
- Maximum operating gross weight (kg and lb),
- Allowable Stacking Weight for 1.8g (kg and lb),
- Transverse Racking Test Load Value (kg and lb),
- End wall strength (only if end walls are designed to withstand a load of less than 0.4 times maximum permissible payload (i.e., 0.4P),
- Side wall strength (only if side walls are designed to withstand a load of less than or greater than 0.6 times maximum permissible payload (i.e., 0.6P), and
- First maintenance examination date (month and year) for new containers and subsequent maintenance examination dates (month and year) if plate is used for this purpose.

C.2 PERIODIC EXAMINATION PER 49 CFR 452.1 (REQUIRED FOR INTERNATIONAL USE)

Except if under an approved continuous examination program (ACEP), each owner of an approved container subject to this part shall examine the container or have it examined in accordance with the procedures prescribed in §452.3 at intervals of not more than 30 months, except that for containers approved as new containers, the interval from the date of manufacture to the date of the first examination must not exceed five years. Note: the purpose of the "Examinations" is to ensure the FCs remain safe for use.

C.2.1 Elements of Periodic Examinations 49 CFR 452.3

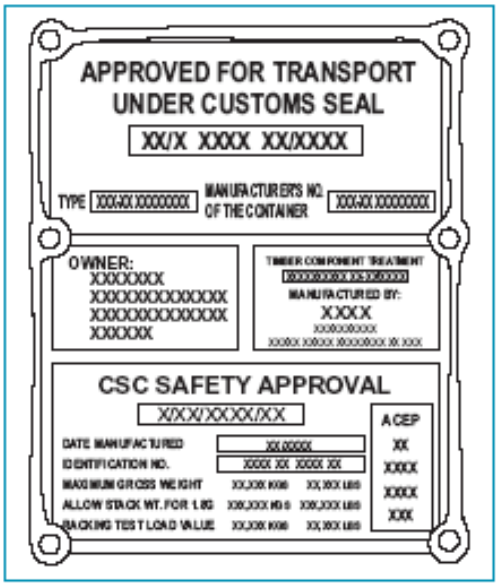
Periodic examinations required by §452.1 for maintaining CSC compliance are detailed in 49 CFR 452.3. A summary of the examination requirements are given below.

1. Each examination must include a detailed visual inspection for defects such as cracks, failures, corrosion, missing or deteriorated fasteners, and any other safety related deficiency or damage which could place any person in danger. Any such deficiencies disclosed by the examination must be corrected by the owner before the container is continued in service.
2. Each examination must be performed by qualified personnel, trained and experienced in the detection of container structural damage per §453.3(a)(3).
3. Examinations must be documented, and the records retained by the owner until the next examination is completed and recorded. The records must be maintained in an office under the control of the owner and be made available for inspection by the Coast Guard upon demand.

C.2.2 Continuous Examination Program 49 CFR 452.7

1. In lieu of a periodic examination under §452.1, each owner of an approved container meeting §450.5 may examine the container or have it examined using an approved continuous examination program. An owner must submit the continuous examination program for approval to the Commandant (G-MSO), United States Coast Guard, 2100 Second Street, SW., Washington, DC 20593. When submitting a continuous examination program for approval, the owner must show the continuous examination complies with §452.9.
2. The owner must mark the container with the letters "ACEP/USA/(year continuous examination program is approved)" to indicate the container is being periodically examined under an approved continuous examination program. This marking must be as close as practicable to the safety approval plate. This marking must be on all containers covered by a continuous examination program by January 1, 1987.

[1]CSC Plate with ACEP marking



[1]CSC Plate with current examination marking

[1] "Uranium Concentrates Industry Good Practices for ISO Containers in Multimodal Transports, Revision 0," World Nuclear Transport Institute www.wnti.co.uk.

C.2.3 Elements of Continuous Examination Program 49 CFR 452.9

Examinations required by §452.7 must conform to the following minimum requirements (excerpts from §452.9):

1. A thorough examination that must include a detailed visual inspection for defects such as cracks, failures, corrosion, missing or deteriorated fasteners, and any other safety related deficiency or damage that could place any person in danger. Any such deficiencies disclosed by the examination must be corrected by the owner before the container is continued in service. A thorough examination must be done each time a container undergoes a major repair, refurbishment or on-hire/off-hire interchange. In no case is the time period between thorough examinations to exceed 30 months.

2. Each thorough examination must be performed by qualified personnel, trained and experienced in the detection of container structural damage.

3. Thorough examinations must be documented, and the records retained by the owner, until the next examination is completed and recorded. The records must include, in addition to identification of the container, a record of the date of last examination and a means of identifying the examiner. The records must be maintained in an office under the control of the owner and be made available for inspection by the Coast Guard upon demand.

C.3 FREIGHT CONTAINER MAINTENANCE AND CSC CIRCULAR 134

Freight container maintenance and repair is required when damage or wear renders the container unsafe or unsatisfactory for use. Any repair that has the potential for affecting the structure of the FC must be reviewed and approved by an approval agency before the container is put back into use. If repairs are extensive the unit may require retesting. The FC industry has repair facilities that are certified by approval authorities to ensure that repairs are carried out in a quality manner. CSC Circular 134, "Guidance on Serious Structural Deficiencies in Containers", was written to enable approval authorities to assess the integrity of structurally sensitive components of containers and to help them decide if a container is safe to continue in transportation.

Structurally sensitive components (shown in Figure C.1 below) are those that enable the container to safely be used in transportation. Examples of structurally sensitive components are:

- Top and Bottom rails,
- Headers and Sills,
- Corner Posts,
- Corner Fittings, and
- Understructure and Locking Rod Assemblies.

Damage or alteration to any of the above components must be repaired before the container is put back into service.

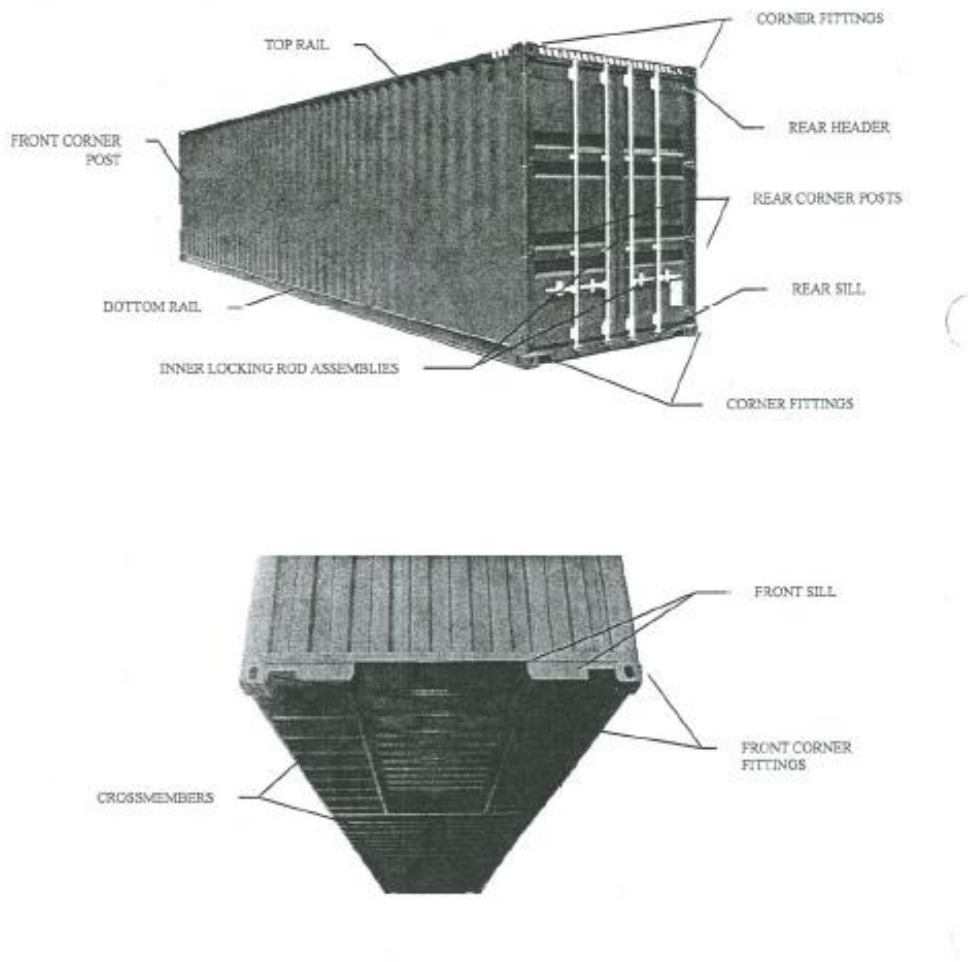


Figure C-1. Structurally sensitive components of a general-purpose freight container

APPENDIX D: Regulatory Guidance

49 CFR Ref. October 1, 2009	49 CFR Requirement	Acceptance Criteria/Comments
Introduction to 49 CFR 172.310 and 49 CFR 172.310(a)	In addition to any other markings required by this subpart, each package containing Class 7 (radioactive) materials must be marked as follows: Each package with a gross mass greater than 50 kg (110 lb) must have its gross mass including the unit of measurement (which may be abbreviated) marked on the outside of the package.	**Comment:** The shipper/offeror shall comply with the regulation.
49 CFR 172.310(b)	Each industrial, Type A, Type B(U), or Type B(M) package must be legibly and durably marked on the outside of the packaging, in letters at least 13 mm (0.5 in) high, with the words "TYPE IP-1," "TYPE IP-2," "TYPE IP-3," "TYPE A," "TYPE B(U)" or "TYPE B(M)," as appropriate. A package which does not conform to Type IP-1, Type IP-2, Type IP-3, Type A, Type B(U) or Type B(M) requirements may not be so marked.	**Comment:** The shipper/offeror shall comply with the regulation.
49 CFR 172.310(c)	Each package which conforms to an IP-1, IP-2, IP-3 or a Type A package design must be legibly and durably marked on the outside of the packaging with the international vehicle registration code of the country of origin of the design. The international vehicle registration code for packages designed by a United States company or agency is the symbol "USA."	**Comment:** The shipper/offeror shall comply with the regulation.

49 CFR Ref.	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.24(a)	Applicability. Except as otherwise provided in this subchapter, the provisions of this section apply to— (1) Bulk and non-bulk packagings; (2) New packagings and packagings which are reused; and (3) Specification and non-specification packagings.	**Comment:** Documentation of consideration during the packaging selection process is required and can be a one-time or reusable packaging.
49 CFR 173.24(b)	Each package used for the shipment of hazardous materials under this subchapter shall be designed, constructed, maintained, filled, its contents so limited, and closed, so that under conditions normally incident to transportation— (1) Except as otherwise provided in this subchapter, there will be no identifiable (without the use of instruments) release of hazardous materials to the environment; (2) The effectiveness of the package will not be substantially reduced; for example, impact resistance, strength, packaging compatibility, etc. must be maintained for the minimum and maximum temperatures, changes in humidity and pressure, and shocks, loadings and vibrations, normally encountered during transportation; (3) There will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, significantly reduce the effectiveness of the packaging; (4) There will be no hazardous material residue adhering to the outside of the package during transport.	**Comment:** The shipper/offeror shall comply with the regulation.
49 CFR 173.24(c)	Authorized packagings. A packaging is authorized for a hazardous material only if— (1) The packaging is prescribed or permitted for the hazardous material in a packaging section specified for that material in Column 8 of the Sec. 172.101 table and conforms to applicable requirements in the special provisions of Column 7 of the Sec. 172.101 table and, for specification packagings (but not including UN standard packagings manufactured outside the United States), the specification requirements in parts 178 and 179 of this subchapter; or (2) The packaging is permitted under, and conforms to, provisions contained in subparts B or C of part 171 of this subchapter or Sections 173.3, 173.4, 173.4a, 173.4b, 173.5, 173.5a, 173.6, 173.7, 173.8, 173.27, or Section 176.11 of this subchapter.	**Comments:** This standard provides guidance on Industrial Packaging. The shipper/offeror has the responsibility to ensure that the content is properly classified and appropriate for the package.
49 CFR 173.24(d)	Specification packagings and UN standard packagings manufactured outside the U.S.— (1) Specification packagings. A specification packaging, including a UN standard packaging manufactured in the United States, must conform in all details to the applicable specification or standard in part 178 or part 179 of this subchapter. (2) UN standard packagings manufactured outside the United States. A UN standard packaging manufactured outside the United States, in accordance with national or international regulations based on the UN Recommendations (IBR, see Sec. 171.7 of this subchapter), may be imported and used and is considered to be an authorized packaging under the provisions of paragraph (c)(1) of this section, subject to the following conditions and limitations: (i) The packaging fully conforms to applicable provisions in the UN Recommendations and the requirements of this subpart, including reuse provisions; (ii) The packaging is capable of passing the prescribed tests in part 178 of this subchapter applicable to that standard; and (iii) The competent authority of the country of manufacture provides reciprocal treatment for UN standard packagings manufactured in the U.S.	**Comment:** The shipper/offeror shall comply with the regulation.

49 CFR Ref.	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.24(e)	Compatibility. (1) Even though certain packagings are specified in this part, it is, nevertheless, the responsibility of the person offering a hazardous material for transportation to ensure that such packagings are compatible with their lading. This particularly applies to corrosivity, permeability, softening, premature aging and embrittlement. (2) Packaging materials and contents must be such that there will be no significant chemical or galvanic reaction between the materials and contents of the package. (3) Plastic packagings and receptacles. (i) Plastic used in packagings and receptacles must be of a type compatible with the lading and may not be permeable to an extent that a hazardous condition is likely to occur during transportation, handling or refilling. (ii) Each plastic packaging or receptacle which is used for liquid hazardous materials must be capable of withstanding without failure the procedure specified in appendix B of this part ("Procedure for Testing Chemical Compatibility and Rate of Permeation in Plastic Packagings and Receptacles"). The procedure specified in appendix B of this part must be performed on each plastic packaging or receptacle used for Packing Group I materials. The maximum rate of permeation of hazardous lading through or into the plastic packaging or receptacles may not exceed 0.5 percent for materials meeting the definition of a Division 6.1 material according to Sec. 173.132 and 2.0 percent for other hazardous materials, when subjected to a temperature no lower than— (A) 18°C (64°F) for 180 days in accordance with Test Method 1 in appendix B of this part; (B) 50°C (122°F) for 28 days in accordance with Test Method 2 in appendix B of this part; or (C) 60°C (140°F) for 14 days in accordance with Test Method 3 in appendix B of this part. (iii) Alternative procedures or rates of permeation are permitted if they yield a level of safety equivalent to or greater than that provided by paragraph (e)(3)(ii) of this section and are specifically approved by the Associate Administrator. (4) Mixed contents. Hazardous materials may not be packed or mixed together in the same outer packaging with other hazardous or nonhazardous materials if such materials are capable of reacting dangerously with each other and causing— (i) Combustion or dangerous evolution of heat; (ii) Evolution of flammable, poisonous, or asphyxiant gases; or (iii) Formation of unstable or corrosive materials. (5) Packagings used for solids, which may become liquid at temperatures likely to be encountered during transportation, must be capable of containing the hazardous material in the liquid state.	**Comments:** Emphasis here is on the compatibility between the radioactive materials and packaging components. Secondary hazards need to also be considered.
49 CFR 173.24(f)	Closures. (1) Closures on packagings shall be so designed and closed that under conditions (including the effects of temperature, pressure and vibration) normally incident to transportation— (i) Except as provided in paragraph (g) of this section, there is no identifiable release of hazardous materials to the environment from the opening to which the closure is applied; and (ii) The closure is leakproof and secured against loosening. For air transport, stoppers, corks or other such friction closures must be held in place by positive means. (2) Except as otherwise provided in this subchapter, a closure (including gaskets or other closure components, if any) used on a specification packaging must conform to all applicable requirements of the specification and must be closed in accordance with information, as applicable, provided by the manufacturer's notification required by Section 178.2 of this subchapter.	**Acceptance Criteria:** The closure of a Industrial Package shall meet the design and performance requirements of 49 CFR 173.410 and 173.411 (b)(6). **Comment:** A "manufacturer" as identified here does not apply to Industrial Packaging. This role is fulfilled by the shipper/offeror, which has all the required information to certify that the Industrial Package meets all the applicable requirements.

49 CFR Ref.	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.24(g)	Venting. Venting of packagings, to reduce internal pressure which may develop by the evolution of gas from the contents, is permitted only when— (1) Except for shipments of cryogenic liquids as specified in Section 173.320(c) and of carbon dioxide, solid (dry ice), transportation by aircraft is not involved; (2) Except as otherwise provided in this subchapter, the evolved gases are not poisonous, likely to create a flammable mixture with air or be an asphyxiant under normal conditions of transportation; (3) The packaging is designed so as to preclude an unintentional release of hazardous materials from the receptacle; (4) For bulk packagings, other than IBCs, venting is authorized for the specific hazardous material by a special provision in the Section 172.101 table or by the applicable bulk packaging specification in part 178 of this subchapter; and (5) Intermediate bulk packagings (IBCs) may be vented when required to reduce internal pressure that may develop by the evolution of gas subject to the requirements of paragraphs (g)(1) through (g)(3) of this section. The IBC must be of a type that has successfully passed (with the vent in place) the applicable design qualification tests with no release of hazardous material.	**Comments:** Venting of Industrial Packagings is acceptable. Venting is a consideration to deal with gas generation resulting from chemical reactions, biological decay, and radiolysis. Venting may not permit release of radioactive contents (e.g., Venting in combination with a particulate filter is acceptable). Packaging designed for transport by aircraft shall not be vented.
49 CFR 173.24(h)	Outage and filling limits— (1) General. When filling packagings and receptacles for liquids, sufficient ullage (outage) must be left to ensure that neither leakage nor permanent distortion of the packaging or receptacle will occur as a result of an expansion of the liquid caused by temperatures likely to be encountered during transportation. Requirements for outage and filling limits for non-bulk and bulk packagings are specified in Section 173.24a(d) and 173.24b(a), respectively. (2) Compressed gases and cryogenic liquids. Filling limits for compressed gases and cryogenic liquids are specified in Sec. Section 173.301 through 173.306 for cylinders and Section 173.314 through 173.319 for bulk packagings. (i) Air transportation. Except as provided in subpart C of part 171 of this subchapter, packages offered or intended for transportation by aircraft must conform to the general requirements for transportation by aircraft in Section 173.27.	**Comments:** Consider temperature and pressure changes as well as volume changes due to phase change. Room within the packaging shall be allowed for expansion and contraction of the payload.
49 CFR 173.24a(a)	Packaging design. Except as provided in Section 172.312 of this subchapter: (1) Inner packaging closures. A combination packaging containing liquid hazardous materials must be packed so that closures on inner packagings are upright. (2) Friction. The nature and thickness of the outer packaging must be such that friction during transportation is not likely to generate an amount of heat sufficient to alter dangerously the chemical stability of the contents. (3) Securing and cushioning. Inner packagings of combination packagings must be so packed, secured and cushioned to prevent their breakage or leakage and to control their shifting within the outer packaging under conditions normally incident to transportation. Cushioning material must not be capable of reacting dangerously with the contents of the inner packagings or having its protective properties significantly weakened in the event of leakage. (4) Metallic devices. Nails, staples and other metallic devices shall not protrude into the interior of the outer packaging in such a manner as to be likely to damage inner packagings or receptacles. (5) Vibration. Each non-bulk package must be capable of withstanding, without rupture or leakage, the vibration test procedure specified in Section 178.608 of this subchapter.	**Comment:** The shipper/offeror shall comply with the regulation.

49 CFR Reference	49 CFR Requirement	Acceptance Criteria/Comments
49 CFR 173.24a(b)	Non-bulk packaging filling limits. (1) A single or composite non-bulk packaging may be filled with a liquid hazardous material only when the specific gravity of the material does not exceed that marked on the packaging, or a specific gravity of 1.2 if not marked, except as follows: (i) A Packing Group I packaging may be used for a Packing Group II material with a specific gravity not exceeding the greater of 1.8, or 1.5 times the specific gravity marked on the packaging, provided all the performance criteria can still be met with the higher specific gravity material; (ii) A Packing Group I packaging may be used for a Packing Group III material with a specific gravity not exceeding the greater of 2.7, or 2.25 times the specific gravity marked on the packaging, provided all the performance criteria can still be met with the higher specific gravity material; and (iii) A Packing Group II packaging may be used for a Packing Group III material with a specific gravity not exceeding the greater of 1.8, or 1.5 times the specific gravity marked on the packaging, provided all the performance criteria can still be met with the higher specific gravity material. (2) Except as otherwise provided in this section, a non-bulk packaging may not be filled with a hazardous material to a gross mass greater than the maximum gross mass marked on the packaging. (3) A single or composite non-bulk packaging which is tested and marked for liquid hazardous materials may be filled with a solid hazardous material to a gross mass, in kilograms, not exceeding the rated capacity of the packaging in liters, multiplied by the specific gravity marked on the packaging, or 1.2 if not marked. In addition: (i) A single or composite non-bulk packaging which is tested and marked for Packing Group I liquid hazardous materials may be filled with a solid Packing Group II hazardous material to a gross mass, in kilograms, not exceeding the rated capacity of the packaging in liters, multiplied by 1.5, multiplied by the specific gravity marked on the packaging, or 1.2 if not marked. (ii) A single or composite non-bulk packaging which is tested and marked for Packing Group I liquid hazardous materials may be filled with a solid Packing Group III hazardous material to a gross mass, in kilograms, not exceeding the rated capacity of the packaging in liters, multiplied by 2.25, multiplied by the specific gravity marked on the packaging, or 1.2 if not marked. (iii) A single or composite non-bulk packaging which is tested and marked for Packing Group II liquid hazardous materials may be filled with a solid Packing Group III hazardous material to a gross mass, in kilograms, not exceeding the rated capacity of the packaging in liters, multiplied by 1.5, multiplied by the specific gravity marked on the packaging, or 1.2 if not marked.	**Comment:** This requirement is not applicable for Industrial Packages.

49 CFR Ref.	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.24a(b) Continued	(4) Packagings tested as prescribed in Sec. 178.605 of this subchapter and marked with the hydrostatic test pressure as prescribed in Sec. 178.503(a)(5) of this subchapter may be used for liquids only when the vapor pressure of the liquid conforms to one of the following: (i) The vapor pressure must be such that the total pressure in the packaging (i.e., the vapor pressure of the liquid plus the partial pressure of air or other inert gases, less 100 kPa (15 psia)) at 55°C (131°F), determined on the basis of a maximum degree of filling in accordance with paragraph (d) of this section and a filling temperature of 15°C (59°F)), will not exceed two-thirds of the marked test pressure; (ii) The vapor pressure at 50°C (122°F) must be less than four-sevenths of the sum of the marked test pressure plus 100 kPa (15 psia); or (iii) The vapor pressure at 55°C (131°F) must be less than two-thirds of the sum of the marked test pressure plus 100 kPa (15 psia). (5) No hazardous material may remain on the outside of a package after filling.	**Comment:** This requirement is not applicable for Industrial Packages.
49 CFR 173.24a(c)	Mixed contents. (1) An outer non-bulk packaging may contain more than one hazardous material only when— (i) The inner and outer packagings used for each hazardous material conform to the relevant packaging sections of this part applicable to that hazardous material; (ii) The package as prepared for shipment meets the performance tests prescribed in part 178 of this subchapter for the packing group indicating the highest order of hazard for the hazardous materials contained in the package; (iii) Corrosive materials (except ORM-D) in bottles are further packed in securely closed inner receptacles before packing in outer packagings; and (iv) For transportation by aircraft, the total net quantity does not exceed the lowest permitted maximum net quantity per package as shown in Column 9a or 9b, as appropriate, of the Sec. 172.101 table. The permitted maximum net quantity must be calculated in kilograms if a package contains both a liquid and a solid. (2) A packaging containing inner packagings of Division 6.2 materials may not contain other hazardous materials except— (i) Refrigerants, such as dry ice or liquid nitrogen, as authorized under the HMR; (ii) Anticoagulants used to stabilize blood or plasma; or (iii) Small quantities of Class 3, Class 8, Class 9, or other materials in Packing Groups II or III used to stabilize or prevent degradation of the sample, provided the quantity of such materials does not exceed 30 mL (1 ounce) or 30 g (1 ounce) in each inner packaging. The maximum quantity in an outer package, including a hazardous material used to preserve or stabilize a sample, may not exceed 4 L (1 gallon) or 4 kg (8.8 pounds). Such preservatives are not subject to the requirements of this subchapter.	**Not Applicable**
49 CFR 173.24a(d)	Liquids must not completely fill a receptacle at a temperature of 55°C (131°F) or less.	**Comment:** The shipper/offeror shall comply with the regulation.

49 CFR Ref.	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.24b(a)	Outage and filling limits. (1) Except as otherwise provided in this subchapter, liquids and liquefied gases must be so loaded that the outage is at least five percent for materials poisonous by inhalation, or at least one percent for all other materials, of the total capacity of a cargo tank, portable tank, tank car (including dome capacity), multi-unit tank car tank, or any compartment thereof, at the following reference temperatures— (i) 46°C (115°F) for a non-insulated tank; (ii) 43°C (110°F) for a tank car having a thermal protection system, incorporating a metal jacket that provides an overall thermal conductance at 15.5°C (60°F) of no more than 10.22 kilojoules per hour per square meter per degree Celsius (0.5 Btu per hour/per square foot/ per degree Fahrenheit) temperature differential; or (iii) 41°C (105°F) for an insulated tank. (2) Hazardous materials may not be loaded into the dome of a tank car. If the dome of the tank car does not provide sufficient outage, vacant space must be left in the shell to provide the required outage.	**Not Applicable**
49 CFR 173.24b(b)	(b) Equivalent steel. For the purposes of this section, the reference stainless steel is stainless steel with a guaranteed minimum tensile strength of 51.7 dekanewtons per square millimeter (75,000 psi) and a guaranteed elongation of 40 percent or greater. Where the regulations permit steel other than stainless steel to be used in place of a specified stainless steel (for example, as in Sec. 172.102 of this subchapter, special provision B30), the minimum thickness for the steel must be obtained from one of the following formulas, as appropriate: Formula for metric units $e_1 = (12.74e_0) / (Rm_1 A_1)(1/3)$ Formula for non-metric units $e_1 = (144.2e_0) / (Rm_1 A_1)(1/3)$ Where: e_0 = Required thickness of the reference stainless steel in mm or inches respectively; e_1= Equivalent thickness of the steel used in mm or inches respectively; Rm_1 = Specified minimum tensile strength of the steel used in dekanewtons per square millimeter or pounds per square inch respectively; and A_1 = Specified minimum percentage elongation of the steel used multiplied by 100 (for example, 20 percent times 100 equals 20). Elongation values used must be determined from a 50 mm or 2 inch test specimen.	**Comment:** This requirement is not applicable to Industrial packagings as no specific materials of construction are identified for Industrial Packaging.
49 CFR 173.24b(c)	Air pressure in excess of ambient atmospheric pressure may not be used to load or unload any lading which may create an air-enriched mixture within the flammability range of the lading in the vapor space of the tank.	**Not Applicable**
49 CFR 173.24b(d)	A bulk packaging may not be loaded with a hazardous material that: (1) Is at a temperature outside of the packaging's design temperature range; or (2) Except as otherwise provided in this subchapter, exceeds the maximum weight of lading marked on the specification plate.	**Comment:** The shipper/offeror shall comply with the regulation.
49 CFR 173.24b(e)	Stacking of IBCs and Large Packagings. (1) IBCs and Large Packagings not designed and tested to be stacked. No packages or freight (hazardous or otherwise) may be stacked upon an IBC or a Large Packaging that was not designed and tested to be stacked upon. (2) IBCs and Large Packagings designed and tested to be stacked. The superimposed weight placed upon an IBC or a Large Packaging designed to be stacked may not exceed the maximum permissible stacking test mass marked on the packaging.	**Not Applicable**

49 CFR Ref.	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.24b(f)	UN portable tanks. (1) A UN portable tank manufactured in the United States must conform in all details to the applicable requirements in parts 172, 173, 178 and 180 of this subchapter. (2) UN portable tanks manufactured outside the United States. A UN portable tank manufactured outside the United States, in accordance with national or international regulations based on the UN Recommendations (IBR, see Sec. 171.7 of this subchapter), which is an authorized packaging under Section 173.24 of this subchapter, may be filled, offered and transported in the United States, if the Section 172.101 Table of this subchapter authorizes the hazardous material for transportation in the UN portable tank and it conforms to the applicable T codes, and tank provision codes, or other special provisions assigned to the hazardous material in Column (7) of the Table. In addition, the portable tank must— (i) Conform to applicable provisions in the UN Recommendations (IBR, see Sec. 171.7 of this subchapter) and the requirements of this subpart; (ii) Be capable of passing the prescribed tests and inspections in part 180 of this subchapter applicable to the UN portable tank specification; (iii) Be designed and manufactured according to the ASME Code (IBR, see Section 171.7 of this subchapter) or a pressure vessel design code approved by the Associate Administrator; (iv) Be approved by the Associate Administrator when the portable tank is designed and constructed under the provisions of an alternative arrangement (see Section 178.274(a)(2) of this subchapter); and (v) The competent authority of the country of manufacture must provide reciprocal treatment for UN portable tanks manufactured in the United States.	**Not Applicable**
Introduction to 49 CFR 173.410 and 49 CFR 173.410(a)	In addition to the requirements of subparts A and B of this part, each package used for the shipment of Class 7 (radioactive) materials must be designed so that— (a) The package can be easily handled and properly secured in or on a conveyance during transport.	**Comment:** The shipper/offeror should be able to easily handle and secure the package in the conveyance through the use of standard handling and securing devices.
49 CFR 173.410(b)	Each lifting attachment that is a structural part of the package must be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and it must be designed so that failure of any lifting attachment under excessive load would not impair the ability of the package to meet other requirements of this subpart. Any other structural part of the package which could be used to lift the package must be capable of being rendered inoperable for lifting the package during transport or must be designed with strength equivalent to that required for lifting attachments.	**Acceptance Criteria:** By calculation the designer will use the yield point of the material to determine that the lifting attachment meets the minimum safety factor of three against yield. Also by calculation and design the designer will make sure that if a lifting attachment does fail it will not impact the ability of the package to perform its proper function (i.e., the attachment would fail but would not tear out of the packaging and therefore containment and shielding would be maintained). **Comment:** The use of a marking (e.g., "DO NOT LIFT") on the structural part of the package which could be used to lift the package is not sufficient to render that part inoperable for lifting.
49 CFR 173.410(c)	The external surface, as far as practicable, will be free from protruding features and will be easily decontaminated.	**Comment:** The shipper/offeror shall comply with the regulation.
49 CFR 173.410(d)	The outer layer of packaging will avoid, as far as practicable, pockets or crevices where water might collect.	**Comment:** The shipper/offeror shall comply with the regulation.
49 CFR 173.410(e)	Each feature that is added to the package will not reduce the safety of the package.	**Comment:** The shipper/offeror shall comply with the regulation.

49 CFR Ref	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.410(f)	The package will be capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use (See Sections 173.24, 173.24a, and 173.24b).	**Acceptance Criteria:** No visible leakage at the conclusion of either the test performed or through an engineering evaluation. Additionally, if structural damage occurs during the vibration test/engineering evaluation, this would indicate an unacceptable design. Showing the package can meet the vibration requirements identified in 49 CFR 178.608 is an acceptable method for demonstrating compliance.
49 CFR 173.410(g)	The materials of construction of the packaging and any components or structure will be physically and chemically compatible with each other and with the package contents. The behavior of the packaging and the package contents under irradiation will be taken into account.	**Comment:** When designing a Industrial Packaging, the designer will document that the packaging will not suffer any significant chemical or galvanic reactions. This requirement is also identified in 49 CFR 173.24(e)(2). For Industrial Packages, the evaluation should include the effects that irradiation may have on materials. Documentation should include discussion of the reactions between materials of construction and the radioactive payload.
49 CFR 173.410(h)	All valves through which the package contents could escape will be protected against unauthorized operation.	**Comment:** The designer should document the features of the packaging that ensure all valves are protected from unauthorized operation.
49 CFR 173.410(i)(1)	For transport by air— (1) The temperature of the accessible surfaces of the package will not exceed 50°C (122°F) at an ambient temperature of 38°C (100°F) with no account taken for insulation;	**Comment:** A thermal evaluation should be carried out with the package immersed in an ambient temperature of 38°C (100°F) with maximum payload wattage. The evaluation is to show that no accessible surface will exceed 50°C (122°F). Screens and barriers may be used to restrict access from package surfaces that may exceed 50°C (122°F).
49 CFR 173.410(i)(2)	The integrity of containment will not be impaired if the package is exposed to ambient temperatures ranging from -40°C (−40°F) to +55°C (131°F); and	**Comment:** The designer shall evaluate the containment system to ensure that it will not significantly degrade under the conditions of (a) maximum or minimum payload wattage and (b) high or low temperatures. Low temperatures can embrittle materials and high temperatures can soften materials such that containment can be impaired.
49 CFR 173.410(i)(3)	Packages containing liquid contents will be capable of withstanding, without leakage, an internal pressure that produces a pressure differential of not less than 95 kPa (13.8 lb/in^2).	**Not Applicable**

49 CFR Ref.	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.411 (a)	General. Each industrial packaging must comply with the requirements of this section which specifies packaging tests, and record retention applicable to Industrial Packaging Type 1 (IP-1), Industrial Packaging Type 2 (IP-2), and Industrial Packaging Type 3 (IP-3).	Shipper/Offeror must meet all requirements
49 CFR 173.411 (b)(1)	Each IP-1 must meet the general design requirements prescribed in Section 173.410.	Shipper/Offeror must meet all requirements
49 CFR 173.411 (b)(2)	Each IP-2 must meet the general design requirements prescribed in Section 173.410 and when subjected to the tests specified in Section 173.465(c) and (d) or evaluated against these tests by any of the methods authorized by Section 173.461(a), must prevent: ▪ Loss or dispersal of the radioactive contents; and ▪ A significant increase in the radiation levels recorded or calculated at the external surfaces for the condition before the test.	Shipper/Offeror when meeting the requirements of 49 CFR 173.411 (b)(6) are not required to perform the tests required in Section 173.465(c) and (d), but are required to meet all the requirements in 49 CFR 173.410
49 CFR 173.411 (b)(3)	Each IP-3 packaging must meet the requirements for an IP-1 and an IP-2, and must meet the requirements specified in Section 173.412(a) through (j).	Shipper/Offeror when meeting the requirements of 49 CFR 173.411 (b)(6) are not required to perform the tests required in Section 173.412 (j), but are required to meet all the requirements in 49 CFR 173.410
49 CFR 173.411 (b)(4)	Tank containers may be used as Industrial package Types 2 or 3 (Type IP-2 or Type IP-3) provided that: ▪ They satisfy the requirements for Type IP-1 specified in paragraph (b)(1); ▪ They are designed to conform to the standards prescribed in Chapter 6.7, of the United Nations Recommendations on the Transport of Dangerous Goods, (IBR, see Sec. 171.7 of this subchapter), "Requirements for the Design, Construction, Inspection and Testing of Portable Tanks and Multiple-Element Gas Containers (MEGCs)," or other requirements at least equivalent to those standards; ▪ They are capable of withstanding a test pressure of 265 kPa (37.1 psig); and ▪ They are designed so that any additional shielding which is provided shall be capable of withstanding the static and dynamic stresses resulting from handling and routine conditions of transport and of preventing a loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the tank containers.	**Not Applicable**
49 CFR 173.411 (b)(5)	Tanks, other than tank containers, including DOT Specification IM 101 or IM 102 steel portable tanks, may be used as Industrial package Types 2 or 3 (Type IP-2) or (Type IP-3) for transporting LSA-I and LSA-II liquids and gases as prescribed in Table 6, provided that they conform to standards at least equivalent to those prescribed in paragraph (b)(4) of this section.	**Not Applicable**

49 CFR Ref.	49 CFR Req.	Acceptance Criteria/Comments
49 CFR 173.411 (b)(6)	Freight containers may be used as Industrial packages Types 2 or 3 (Type IP-2) or (Type IP-3) provided that: ▪ The radioactive contents are restricted to solid materials; ▪ They satisfy the requirements for Type IP-1 specified in paragraph (b)(1); and (iii) 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 (IBR, see Sec. 171.7 of this subchapter)." 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: o Loss or dispersal of the radioactive contents; and o 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.	Shipper/Offeror must meet all requirements
49 CFR 173.411 (b)(7)	Metal intermediate bulk containers may also be used as Industrial package Type 2 or 3 (Type IP-2 or Type IP-3), provided that: ▪ They satisfy the requirements for Type IP-1 specified in paragraph (b)(1); and ▪ They are designed to conform to the standards prescribed in Chapter 6.5 of the United Nations Recommendations on the Transport of Dangerous Goods, (IBR, see Sec. 171.7 of this subchapter), ``Requirements for the Construction and Testing of Intermediate Bulk Containers," for Packing Group I or II, and if they were subjected to the tests prescribed in that document, but with the drop test conducted in the most damaging orientation, they would prevent: o Loss or dispersal of the radioactive contents; and o Loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the intermediate bulk containers.	**Not Applicable**
49 CFR 173.411 (c)	Except for IP-1 packagings, each offeror of an industrial package must maintain on file for at least one year after the latest shipment, and shall provide to the Associate Administrator on request, complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that specification.	Shipper/Offeror must meet all requirements

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APPENDIX E: Example of a New or Like New Freight Container Procurement Specification

Sample Procurement Specification for ISO 1CC Type Steel Dry Cargo Containers Having Dimensions of 20'x8'x8'-6"

Scope

This specification covers the procurement of new or like new ISO 1CC Type Steel dry cargo containers, with 3 or 4 door lock rods and having a dimension of 20'x8'x8'-6".

Operational Environment

The container is to be designed and manufactured for the transportation of general cargo by marine, highway, and rail throughout the world. All Materials used in construction will be able to withstand extreme temperatures ranging from-40°C (-40°F) to 70°C (158°F) without effect on the strength of the basic structure and weatherproofness of the cargo container.

Standards and Regulations

The seller shall ensure that the containers comply with the following requirements and regulations in their latest edition:

ISO/TC-104 freight containers publications:

- 668 - *Series 1 freight containers – Classification, dimensions, and ratings*
- 1496-1 - *Series 1 freight containers – Specifications And testing – Part 1: General cargo containers for general purposes*
- 1496-1 - Amendment 1, Series 1 freight *Containers – Specifications and Testing – Part 1: General Cargo Containers for General Purposes*. Amendment 1: *1AAA and 1BBB Containers*
- 1161 – *Series I freight containers – Corner Fittings – Specification*
- 6346 - *Freight Containers – Coding, identification, and marking*
- 830 – *Freight containers – Vocabulary*
- 6359 – *Freight container – Consolidated Data plate*

2. The International Union of Railway (UIC) code 592 OR
3. The Customs Convention on the International Transport Goods (TIR)
4. The International Convention for Safe Containers (CSC)
5. Transport Cargo Containers and Unit Loads Quarantine Aspects and Procedures by Commonwealth of Australia Department of Health (TCT)
6. 49 CFR Parts 450 – 453

Approval and Certificate Documents Requested

The seller shall ensure that each container purchased under this specification shall have the following documentation:

- The seller shall obtain a copy of the manufacturers "Technical Specification," which will have a set of drawings attached. 20'x8'x8'6" ISO Type, Dry Cargo Steel Container. This is to be reviewed by organization who issued the purchase order to ensure that it meets the regulatory requirements in 49 CFR 173.411 (c).
- All the containers shall be certified for design type and individually inspected by Classification Society. The seller shall provide a copy of the prototype certificate that was issued for the design type showing it met the applicable Standards and Regulations identified above.
- The Production Certificate of series containers to be issued by the Classification Society. The seller shall ensure that the Society's seal is applied to the container and that the production certificate covers the serial numbers of the containers purchased.
- All the containers will be certified and comply with the requirements of the International Convention for Safe Containers. The seller shall ensure that a CSC plate is affixed to the container ensure the container meets the requirements International Convention for Safe Containers.

Handling

The seller shall ensure that the container is be capable of being handled without any permanent deformation which will render it unsuitable for use or any other abnormality during the following conditions:

- Lifting, full or empty, at the top corner fittings vertically by means of spreaders fitted with hooks, shackles or twist locks.
- Lifting, full or empty, at the bottom corner fittings using slings with appropriate terminal fittings at slings angle of forty five (45°) degrees to horizontal.
- Lifting, fully or empty, at two fork pocket by fork lift truck. Moving or stationary.
- Side lifting from two top corner fittings when fully laden. (The reaction force will be supported by the corner posts only).

Transportation

The seller shall ensure that the container will be constructed suitable for transportation by marine, road, and rail without any permanent deformation which will render the container unsuitable to use or any other abnormality.

Dimensions and Ratings

The seller shall ensure that the container meets the applicable requirements in ISO 668, *Series 1 freight containers – Classification, dimensions, and ratings*

Construction

The seller will ensure the container is constructed with steel frame, fully vertically corrugated steel side and end walls, die-stamped corrugated steel roof, wooden flooring, corrugated double hinged doors and ISO corner fittings at eight corners.

All steelwork will be built up by means of automatic and semi-automatic CO_2 gas arc welding or an equitable process. All exterior welds including that on base structure will be continuous to insure water-tightness, all the welds, even spots, will have full penetration without undercutting or porosity. All material identified in the construction of the container will meet their applicable standards or codes.

Markings

All sellers shall ensure the containers are marked in accordance with the following requirements:

- ISO 6346 - *Freight Containers – Coding, identification, and marking*
- 49 CFR Part 172, Subpart D-*Marking*, Section 310 *Class 7 (radioactive) materials*
- Additional markings that may be required in the purchase order

Quality Assurance Requirements

The requesting organization does not require that the Seller or broker have a fully documented QA program as they purchase them from an owner who purchases the containers from a manufacturer. Only when the order is large enough (i.e., lot of 200), will the seller be able to purchase directly from the manufacturer.

The seller will be required to provide the appropriate documentation identified in this specification and where applicable the seller may be requested to seal the vents and paint the inside and outside of the cargo container. Because of the minor work performed on the cargo container we require the seller to meet the following QA requirements:

- Criteria 5, *Work Processes* - This is to ensure that the seller will perform the necessary work required by this specification in a consistent and safe manner.
- Criteria 7, *Procurement* - This is to ensure that the seller will procure the items in accordance with this specification.
- Criteria 8, *Inspection and Acceptance Testing* – This is to ensure that the seller performs the required inspections as identified in this specification.

Inspection Checklist

The seller shall complete the visual inspection checklist to verify that the cargo container is in a new or like new condition prior to delivery. If repairs need to be made prior to delivery, the seller shall contact

the requesting organization to discuss the repairs. The last page of the Visual Inspection Checklist is where the seller shall enter the information shown on the customs seal and CSC plate.

By completing, signing and dating the Visual Inspection checklist, the seller certifies compliance with requirements stated in this specification.

Visual Inspection Checklist
Container Specific Inspection Requirements

Cargo Container Serial Number(s): _____

(Company) Release or PO Number: _____

Indicate compliance by checking each box below: √

General Requirements

Verify that the certifying seals from approval agency (e.g., ABS, Bureau of Veritas) are applied and can be seen.	
Has the cargo container been painted? If so, was it painted with one coat of mercury free, lead free, enamel paint?	
Cargo container has the following information or markings on the right door ▪ Purchase order number, ▪ Date of purchase (month – day – Year), ▪ Tare and maximum gross weight, ▪ Cargo container serial number plus check digit CSC plate must be readable and shows that the cargo container is with its first year of a 5 year certification.	
Prior to delivery the seller shall re-enter the cargo container with the doors closed and verify that the container was inspected for any light entering the container through holes or non-sealing door gaskets.	

Visual Inspection Checklist
Container Specific Inspection Requirements

The supplier will visually inspect each component of the cargo container using the checklist below. The supplier will show compliance by √ each box below.

Container Corner Post	
Shall not have any cracks, splits or missing welds	
Shall not have any tears or fractures	
Shall not have any dents	
Shall not have any rust	

Container Corner Fitting	
Shall be fully square	
Shall not have any pieces broken away	
Shall not be fractured or cracked	
Shall not be mis-aligned with the corner post	
Shall not have any missing or cracked welds	
Shall not have any rust	

Container Rear End Frame	
Shall not have any missing or cracked welds	
Door header shall have no splices	
Shall not have any dents or bends	
Shall not be cut or torn	
Door sill shall not have any splices	
Shall not have any rust	
Rain gutter shall not be damaged	

Container Top and Bottom Side Rails	
Shall not have any cracked or missing welds	
Shall not have splices in the rails	
Shall not have any dents or bends	
Shall not have any cuts, tears or fractures	
Shall not have any rust	

Container Front End Frame	
Shall not have any cracks, fractures or tears	
Shall have no splices in the top or bottom end rails	
Shall not have any dents or bends	
Shall not have any cracked or missing welds	
Shall not have any rust	

Visual Inspection Checklist
Container Specific Inspection Requirements

Container Side Walls	
Shall not have any cracks, fractures or tears	
Shall not have any inward or outward dents or bulges	
Shall not have any cracked or missing welds	
Shall not have any rust	

Container Roof Exterior	
Shall not have any cracks, fractures or tears	
Shall not have cracked roof reinforcement plate	
Shall not have any cracked or missing welds	
Shall not have any rust	

Container Roof Interior	
Shall not have any broken roof bows or welds	
Shall not have any missing, cracked or bent roof bows	
Shall not have any missing rivets or bolts	

Container Floor - Exterior Undercarriage	
Shall not have any cracked or missing welds on any connected steel member	
Cross members shall not be fractured, torn, twisted or disconnected from the side rail	
Shall have no splices	
Forklift pockets shall be no less than 4-1/2" high by 14" wide	
Shall not have any rust	

Container Floor - Inside	
Shall not be fractured or warped	
Shall have all required fasteners	
Shall not have any debris inside the container	
Shall be capable of supporting a forklift or small tractor	

Visual Inspection Checklist
Container Specific Inspection Requirements

Container Doors	
Shall not have torn or damaged door seals	
Each door shall have two locking bars	
Shall not have any broken, bent or inoperative door locking bars	
Hinges shall not be broken or unfastened	
Shall not have any holes or tears in door panels	
Shall not have any broken or loose cam handles	
Door locking handle shall not be broken or inoperative	
Shall not have any rust	
Locking bar mounting brackets shall not be broken or unfastened	
Shall not have any cracked or missing welds	
Door gaskets shall not have any tears, holes, cracks, patches or overlapping corner tabs	

Supplier Quality Assurance Representative

Date

Visual Inspection Checklist
Container Specific Inspection Requirements

Cargo Container Custom Seal Plate and CSC Plate

Record the following information found on the cargo container Custom Seal Plate and Container Safety Approval Plate (CSC). These two plates may be combined into one plate and usually are found on one of the doors.

Purchase Order Number _____

Cargo Container Number Plus Check Digit _____

Approved for Transport Under Customs Seal		
Type	Manufactures number of The Container	
Owner Information	Timber Component Treatment	
	Manufactured by Information	
CSC Safety Approval Plate		
Date Manufactured		First Maintenance Examination Due
Identification Number		
	Kilograms	Pounds
Maximum Gross Weight		
Allowable Stacking Weight for 1.8g		
Racking Test Load Value		

_____ Receipt Inspector

_____ Date

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APPENDIX F: Sample 3:1 Margin of Safety Against Yielding

3:1 Safety Margin Discussion

Purpose

This document provides a template for evaluation of the ISO-1161[1] fittings for loads imposed during lifting of the bulkhead freight containers.

Discussion

The following analysis template is intended to provide a standard model for evaluation of the bulkhead freight container corner fittings. The top and bottom fittings are evaluated for lift loads when lifted using standard lift attachments, using the methodology shown below.

Stress Analysis of Fittings (49CFR Part 173.410(b))

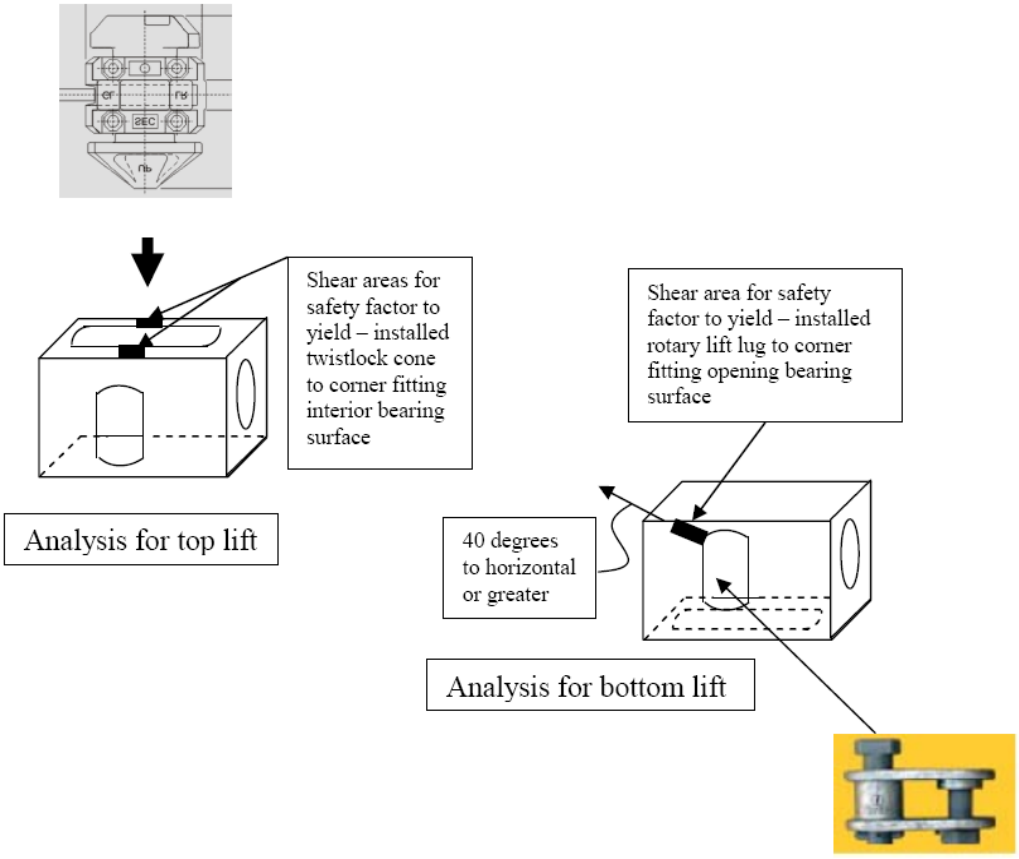


Figure F-1. Corner Fitting Loads and Analysis Model

Stress Analysis of Top Fitting, Lifted with Twistlock Lifting Device

The top fitting is loaded in shear by the twistlock lift device, and has a shear area as depicted in Figure 1. Refer to Figures F-2 and F- 4 for the top corner fitting and twistlock connector configuration.

Shear Stress at Top of Fitting

Applied load = Total supported weight (W) / 4 fittings = W/4 lbs. per fitting, for vertical lift at top fittings

Shear stress $S_s = \frac{P}{A_s} = \frac{W}{4 \cdot A_s}$

For pure shear, the maximum equivalent tensile stress is equal to twice the shear stress = $2S_s$.

The factor to yield (S_y) is:

Shear Stress Factor = $\frac{S_y}{2 \cdot S_s}$

The shear stress factor must be greater than or equal to 3.

Example, using the dimensions provided in ISO 1161, Annex B (twistlock) and Figure F- 2 (top corner fitting):

Width of slot in fitting: 2.5 in

Twistlock head dimensions: 3 7/8 x 1 3/16 in

Overlap per side = (3.875 – 2.5) / 2 = .6875 in

Wall thickness of top of fitting = 1.125 - .0625 = 1.0625 in

Shear area (adjusted for 5/16" chamfers) A_s = 1.0625 * (2*(.6875)+1.188) – (.3125)*(.3125) = 2.63 in^2 per side (= 5.25 in^2 total)

Assume the container has a weight of 67,200 lbs. The shear stress is:

$$S_s = \frac{W}{4 \cdot A_s} = \frac{67{,}200 \text{ lb}}{4 \cdot \left(5.25 \text{ in}^2\right)} = 3200 \text{ psi}$$

Assume the corner fitting has yield strength of 39,000 psi. The shear stress factor is:

$$\text{Factor} = \frac{S_y}{2 \cdot S_s} = \frac{39{,}000\ \text{psi}}{2 \cdot (3200\ \text{psi})} = 6.1 > 3$$

Bearing stress between the twistlock and upper fitting:

Bearing area = 2*(.6875)*(1.188) = 1.64 in^2

$$\text{Bearing stress} = \frac{16{,}800\ \text{lb}}{1.64\ \text{in}^2} = 10{,}250\ \text{psi}$$

The bearing stress is evaluated per the requirements of ASME BTH-1[2], Equation 3-38, which provides an allowable bearing stress equal to 1.5 * S_y / (Design Factor).

$$\text{Factor to Yield: } F = \frac{39{,}000\ \text{psi}}{10{,}250\ \text{psi}} = 3.8 > 3$$

Top Fitting to Corner Post / Side Rail Weld Stresses

The top fitting is welded to the adjacent corner post and side rail(s) using fillet welds. Lift loads are transmitted through the welds, loading the post in tension and the side rails in shear. It is assumed that the side rails at open ends of the container do not react to the lift loads due to their comparatively low stiffness. All welds are assumed to be loaded in shear. It is assumed that the line of action of the lift loads acts through the center of the weld group consisting of the post and side rail welds. Based on this assumption, no net bending or torsional loads act on the weld group, which attaches the fitting to the post and side rails.

From the geometry of the attached post and side rails, the total length of weld, L_w, can be determined. Assume all welds are of the same material (S_y) and weld size (t_w). The stress in the weld is:

$$S_{weld} = \frac{\text{Load}}{.707 \cdot t_w \cdot L_w}$$

Since the welds are assumed to be loaded in shear, the allowable stress is S_y / 2. The factor to yield is calculated as:

$$\text{Factor} = \frac{S_y}{2 \cdot S_{weld}} \geq 3$$

Base Metal at Top Fitting to Corner Post / Side Rail Weld

The base metal at the welded connections must be checked to ensure sufficient margin exists. The minimum material yield strength of the fitting, post, and side rails should be used for this calculation. The effective area is the same as the weld area, except the full weld thickness, t_w is applicable. It is conservatively assumed that the base metal at the welds is loaded in shear. The relations are:

$$S_{Base} = \frac{Load}{t_w \cdot L_w}$$

$$Factor = \frac{S_y}{2 \cdot S_{Base}} \geq 3$$

Failure Mode Under Excessive Load Application

The factor to yield for the "Top Fitting to Corner Post / Side Rail Weld Stresses" evaluation shall be greater than that for the "Shear Stress at Top of Fitting" evaluation. This is accomplished by ensuring the weld size and length which attaches the corner fitting to the post and rails is sufficient to provide the required margin to yield. Therefore, if an excessive load were applied to the lifting attachments during a lift using the top corner fittings, the failure mode would be shear through the ISO corner fitting. This would not impair the ability of the package to perform its intended function (e.g., containment of particles and radiation shielding).

Bottom Fitting, Lifted With Rotary Lug Lift Device

Lifts from the bottom fittings are commonly performed using a rotary lug lift device.[3] Refer to Figures F-3 and F-5a, -5b for the bottom corner fitting and rotary lug lift device configuration. The rotary lug lift device fits into the long container side slot for lifting, and the lug is turned 90 degrees after installation to lock it in place. When loaded, the lug bears against the upper inside surface of the bottom fitting, and the pin bears against the upper edges of the side slot (see Figure F-1). The bottom fitting is not evaluated for shear loads, as no shear failure plane exists for this lift configuration. However, the lug bears against the free edge of the slot in the bottom fitting, and bearing stresses are evaluated below.

For a minimum sling angle of θ from horizontal, the lift load is resolved into components below:

Lifted load per fitting = Vertical load = F_v

Horizontal component: $F_H = \frac{F_V}{\tan\theta}$

The rotary lug lift device has a turned down section which bears against the side and top edges of the slot, and a t-head which bears against the inner top surface of the fitting. The configuration of the lift device is such that the t-head is subjected to most of the vertical load component, and the turned down section of the lug is subjected to most of the lateral load component. Bearing stresses are determined for both regions of the fitting.

Inside edge of slot:

$$A_{b\_slot} = D \cdot t$$

Where D is the pin diameter and t is the thickness of the fitting.

$$S_{b\_slot} = \frac{F_H}{A_{b\_slot}}$$

The bearing stress is evaluated per the requirements of ASME BTH-1, Equation 3-38, which provides an allowable bearing stress equal to 1.5 * S_y / (Design Factor). Solving in terms of the design factor gives:

$$DF_{slot} = \frac{1.5 \cdot S_Y}{S_{b\_slot}} > 3$$

Upper inside surface of fitting:

$$A_{b\_upper} = w \cdot h$$

$$S_{b\_upper} = \frac{F_V}{A_{b\_upper}}$$

The design factor is calculated the same as above for the slot:

$$DF_{upper} = \frac{1.5 \cdot S_Y}{S_{b\_upper}} > 3$$

Bottom Fitting to Corner Post / Side Rail Weld Stresses

See discussion in Section 2.1.1, under "Top Fitting to Corner Post / Side Rail Weld Stresses."

Base Metal at Bottom Fitting to Corner Post / Side Rail Weld

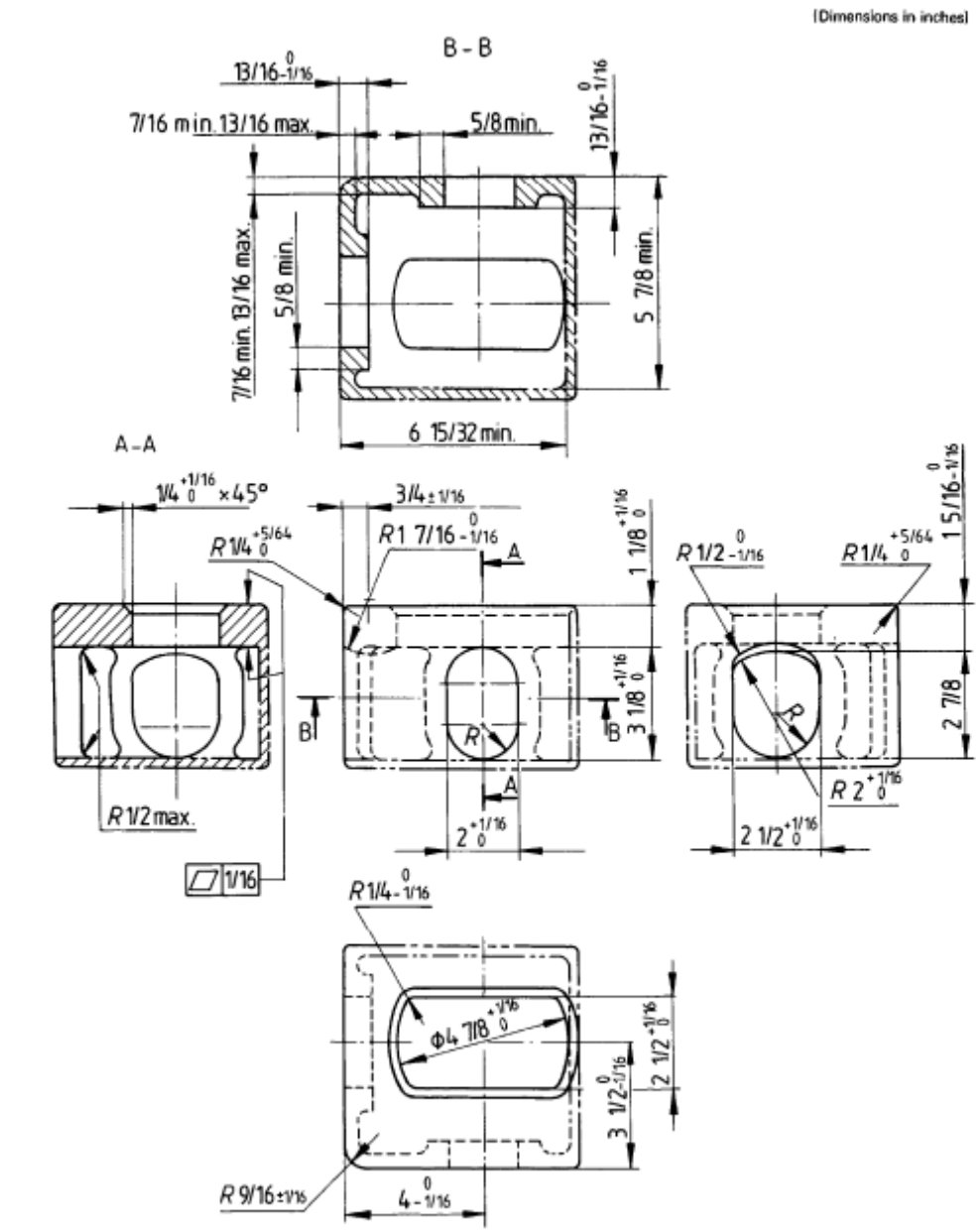
See discussion in Section 2.1.1, under "Base Metal at Top Fitting to Corner Post / Side Rail Weld."

Failure Mode Under Excessive Load Application

If an excessive load were applied to the lifting attachments during a lift using the bottom corner fittings, the failure mode is indeterminate. It is shown through calculations that the bottom corner fittings and their attachment welds are robust and can withstand lift loads with significant margin. If significant overload occurred, some deformation of the fitting wall would occur, and possible disengagement of the rotary lift device from the fitting could result. In addition, buckling of the container frame is expected at significant overload conditions. Analysis to determine the magnitude of load required for these failure modes is beyond the scope of this document.

References:

1. ISO 1161, *Series 1 Freight Containers – Corner Fittings – Specification*, 1984
2. "*Design of Below-the-Hook Lifting Devices*", ASME BTH-1-2005
3. Tandemloc catalog, Replacement Rotary Lug, Final Assembly (416000B-LTZ). http://www.tandemlock.com

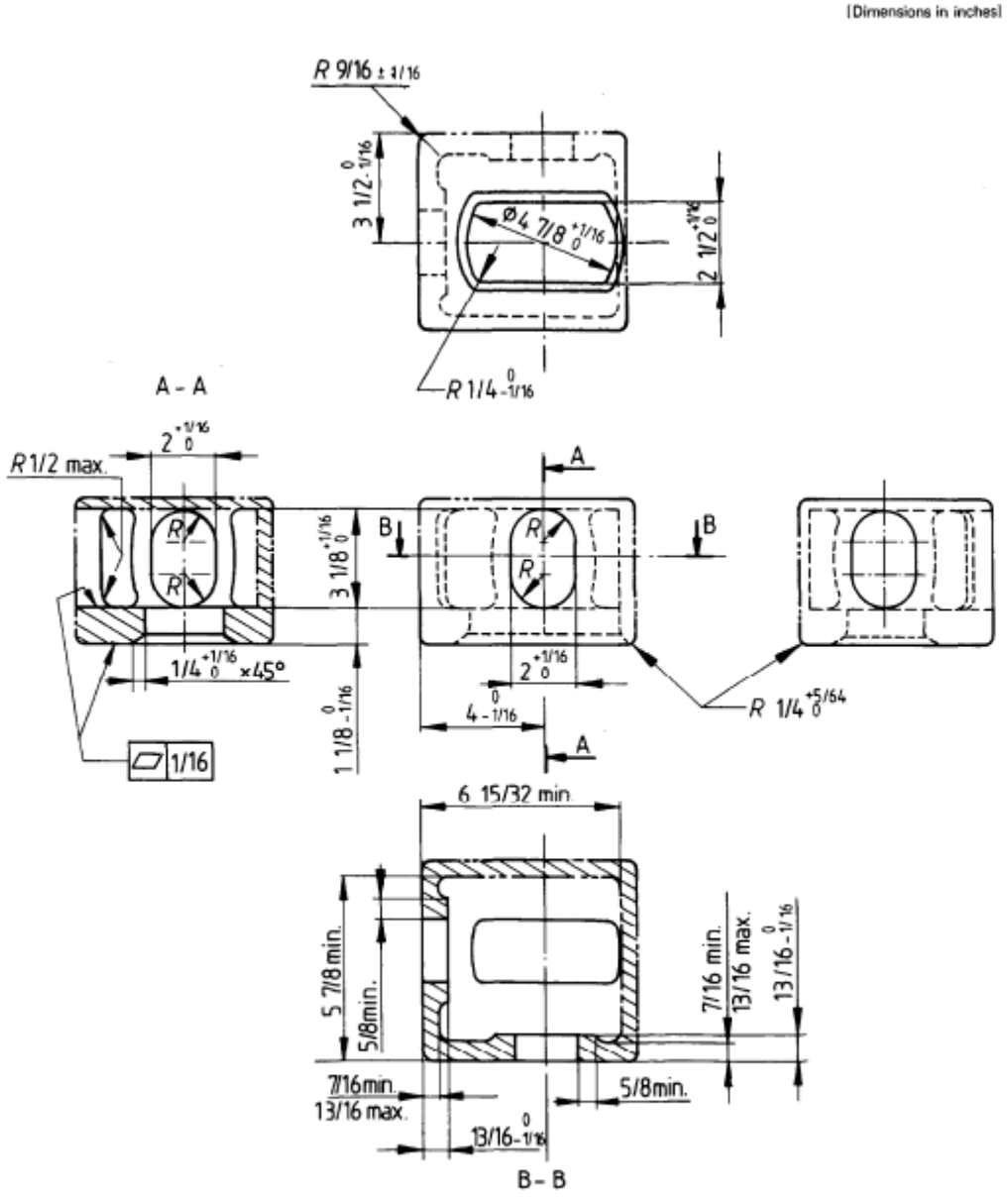


NOTES

1 Solid and broken lines (— and ---) show surfaces and contours which shall be physically duplicated in the fitting.

2 Phantom lines (— · — · —) show optional walls, which may be used to develop a box-shaped fitting.

Figure F-2. Top Corner Fitting (From ISO 1161)



NOTES

1 Solid and broken lines (— and ---) show surfaces and contours which shall be physically duplicated in the fitting.

2 Phantom lines (— · — · —) show optional walls, which may be used to develop a box-shaped fitting.

Figure F-3. Bottom Corner Fitting (From ISO 1161

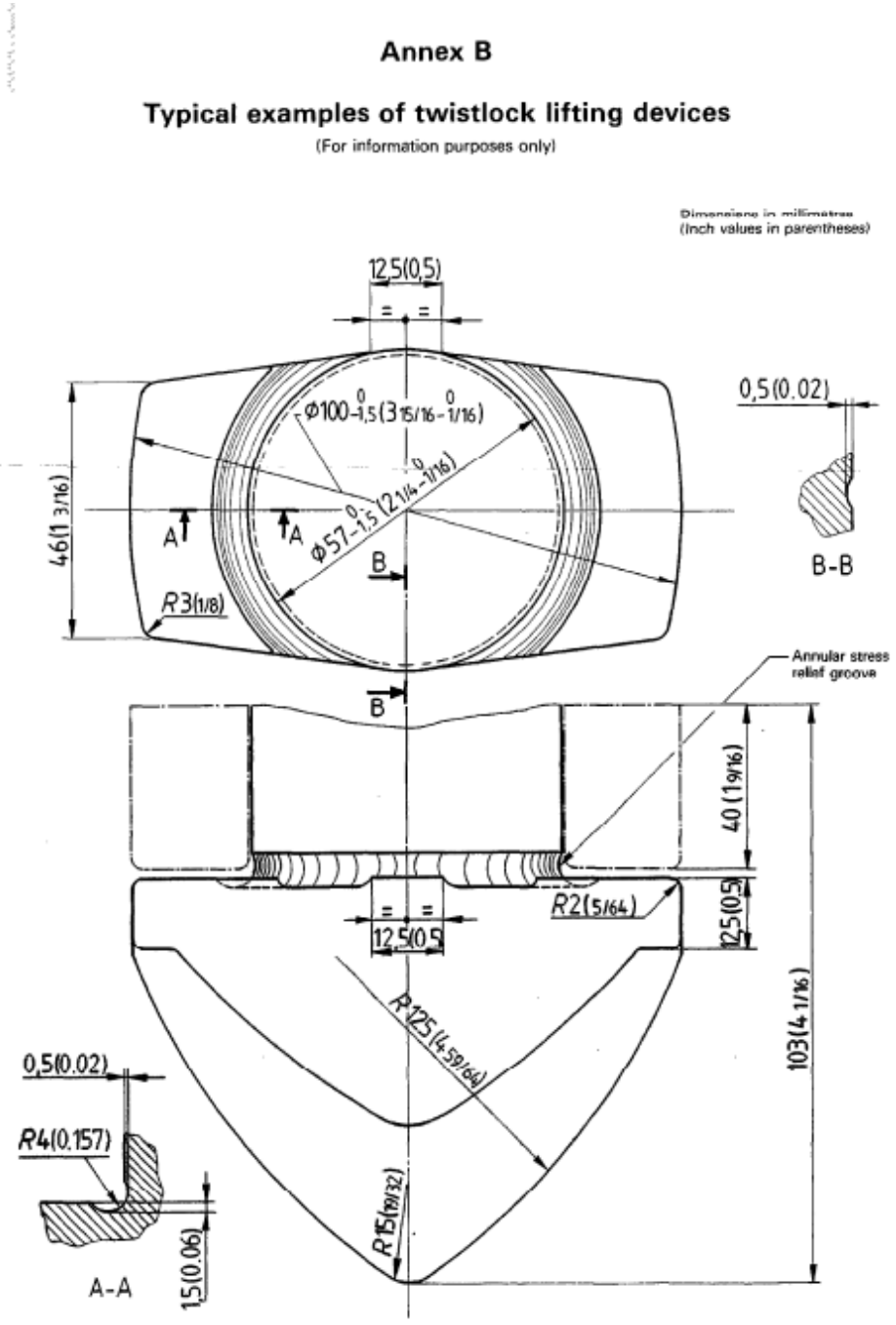
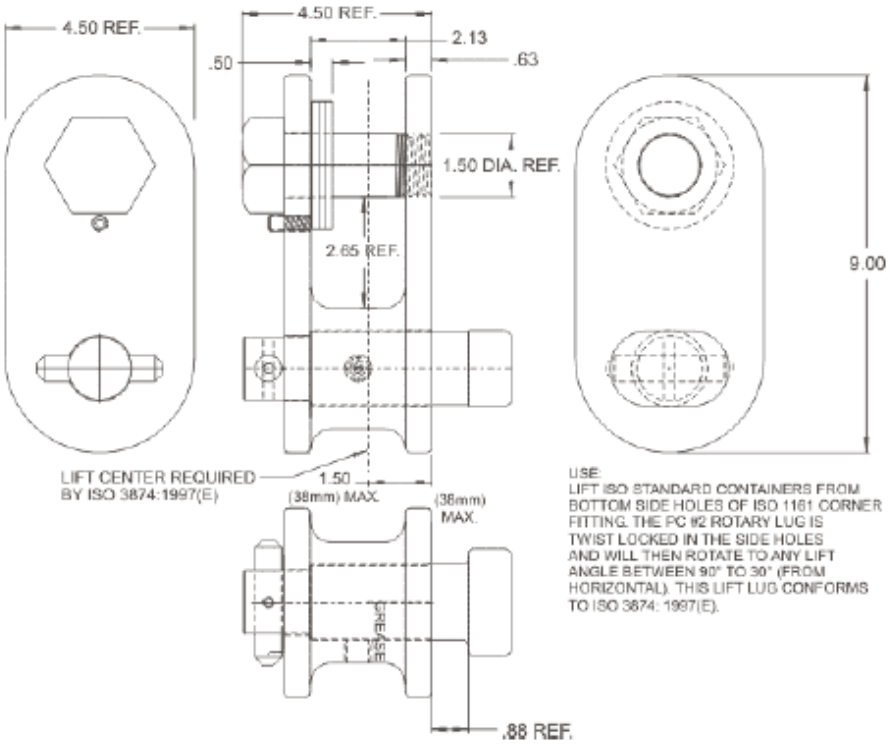


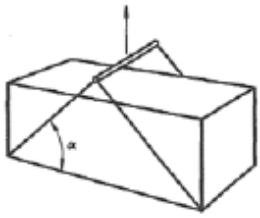
Figure F-4. Twistlock Lifting Device (From ISO 1161)

Figure F-5a. Rotary Lift Lug (From Tandemloc Catalog)



ISO 3874 Bottom Lift Standards

1. The container is lifted from side apertures of four bottom corner fittings by means of slings. The bottom sling attachment shall bear on the corner fittings only and should be such to exert lifting forces not more than 38mm away from the outer face of the corner fittings. (See figure 2.)
2. Lifting devices shall be properly engaged.



NOTE - See footnotes to table A.

Figure 1 - Lifting by means of a bottom lift sling (Dimensions in millimeters.)

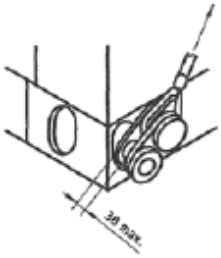


Figure 2 - Bottom sling attachment

3. The applicability of bottom lift slings is given in Table A below.
4. Folding platform-based containers (codes PL and PC; see ISO 6346), when empty and in the folded condition, may be handled in interlocked piles. The total mass of the pile shall not exceed the maximum gross mass (rating) according to ISO 668.

Figure F-5b. Rotary Lift Lug (From Tandemloc Catalog)

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APPENDIX G: Example of a Manufacturer's Technical Specifications

A sample of a manufacture's specification can be found on the "Magellan" web site:

http://www.magellan-maritime.de/en/home/home.html

Once you get to the home page of the Magellan web site look at the left hand column. Find the link to "Technology" and click on that link. This will take you to their container specifications. The container specification you are looking for is titled "20'GP, General Purpose Container." Click on that link and it will take you to the Magellan, "Technical Specification for a Typical Steel Dry Cargo Container, 20' x 8'x 8'6" ISO 1CC Type General Purpose" freight container.

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APPENDIX H: Discussion of the 20% Dose Rate Requirement

Proceedings of the 16th International Symposium on the Packaging and Transportation of Radioactive Materials
PATRAM 2010
October 3-8, 2010, London, England

RADIATION LEVEL CHANGES AT RAM PACKAGE SURFACES

Erich Opperman
Savannah River Nuclear Solutions
Aiken, South Carolina

Mark Hawk
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Ashok Kapoor
DOE EM-45 Office of Packaging and Transportation Safety
Washington DC

Ronald Natali
R.B. Natali Consulting, Inc.
Richmond, Utah

ABSTRACT
This paper will explore design considerations required to meet the regulations that limit radiation level variations at external surfaces of radioactive material (RAM) packages. The radiation level requirements at package surfaces (e.g. TS-R-1 paragraphs 531 and 646) invoke not only maximum radiation levels, but also strict limits on the allowable increase in the radiation level during transport. This paper will explore the regulatory requirements by quantifying the amount of near surface movement and/or payload shifting that results in a 20% increase in the radiation level at the package surface. Typical IP-2, IP-3, Type A and Type B packaging and source geometries will be illustrated. Variations in surface radiation levels are typically the result of changes in the geometry of the surface due to an impact, puncture or crush event, or shifting and settling of radioactive contents.

INTRODUCTION
Radiation level requirements at or near radioactive material package surfaces are governed not only by the maximum allowable values (e.g., 2 mSv/h) but also limitations in the amount of variation that is allowed (i.e., < 20%). This requires that packaging designs carefully couple the radioactive contents with the structure and geometry of the packaging design to ensure that relative motion between the content and packaging surfaces are minimized. The radioactive content is the source of the penetrating radiation that is present at the package surface. Movement or shifting of contents within the packaging, or settling due to vibration, will result in changes in the radiation levels at the package surface. Similarly a change in the geometry of the package surface due to a drop, impact or crush may also result in unacceptable changes in the radiation level at the deformed surface of the package. It is the responsibility of the package designer to ensure that the radioactive contents and packaging hardware configuration prevents unacceptable changes in the radiation levels.

This paper uses a number of representative examples commonly used in radioactive material package designs in an approach to explore the dose rate changes at package surfaces. Packages with small concentrated sources, waste boxes and drums with uniformly distributed homogeneous sources as well as more concentrated "point" sources will be examined. The radiation levels will be calculated near the package surfaces using a convenient to use, and commercially available, point kernel shielding code [Ref 1]. The radiation level gradients (mSv/h/cm) can then be used to determine the amount of movement required to produce a 20% increase in the external surface radiation level. Examples of surface deformation due to drop testing as well as radioactive material content movement will be discussed.

The scope of the evaluations and regulations considered are limited to surface transport of packages carrying solid RAM so as only to consider 0.3 to 1.2m drops. Additionally readers should use the cases presented in this paper as *order-of-magnitude* representations of the changes expected in dose rates at package surfaces. The variables in a RAM package are many and this evaluation considers only simplified cases.

REGULATORY REQUIREMENTS

The radiation level requirements in the *IAEA Safety Standards TS-R-1, 2009* [Ref 2] are used in this evaluation. The requirements governing the limits on changes in surface radiation levels will be cited for industrial packages (IP), Type A and Type B. The evaluations look only at the requirements governing radiation level changes at package surfaces, and not the maximum limits.

IP-2, IP-3 and Type A Packages. The applicable requirements for IP-2, IP-3 and Type A packages include the general requirements of para 606–616 and the applicable design and testing requirements specified in para 634–647. This includes the effects of accelerations and vibrations associated with routine conditions of transport, as well as the free drop tests specified in para 722. Under these conditions the package shall be "*designed to prevent more than a 20% increase in the maximum radiation level at any external surface of the package."*

Alternative IP-2 and IP-3 Requirements. There are alternative methods for meeting the IP requirements listed in para 624-628 that include satisfying the UN Packing Group I or II tests; meeting a minimum test pressure of 265 kPa for Tank containers; meeting the ISO 1496-1 design and testing standard for Freight containers; and meeting UN Packing Group I or II tests for metal Intermediate Bulk containers. In all of the above alternative approaches the packages must be designed so that when subject to the specified tests (and routine transport and handling as applicable) the "*design would prevent more than a 20% increase in the maximum radiation level at the external surface of the package.*"

Type B Packages. Type B packages are designed to meet the general requirements of para 606-616, the design and testing requirements of para 634-647 and additionally the Type B requirements in para 651-664. This includes the Type A requirement in para 646 that the "*design would prevent more than a 20% increase in the maximum radiation level at the external surface of the package*" when subjected to normal condition tests - that

includes the 0.3-1.2m free drop test. Under the Type B hypothetical accident tests the package "*would retain sufficient shielding to ensure that the radiation level at 1 m from the surface would not exceed 10 mSv/h.*"

All of the regulations sited above have one common theme; the design of the package shall prevent more than a *20% increase in the maximum radiation level at the external surface of the package*. The design, which consists of the radioactive material content and packaging hardware, is to prevent the increase under the routine conditions of transport that include vibrations and accelerations as well as the drop conditions associated with normal handling.

APPROACH

The radiation level or "dose rate" gradients resulting from hypothetical Cs-137 RAM source materials within content will be calculated near typical package surfaces (e.g., drums, boxes) and the amount of movement (of RAM content or the external surface) required to produce a 20% increase will be explored. The following case examples will explore the surface radiation level increase for a -

- 205 liter drum uniformly compressed down 15 cm from top,
- point source in a 205 liter drum
- 2550 liter waste box with uniformly distributed RAM contents
- small special form source package
- settling of RAM contents due to drop testing or vibration

Based on drop test results, actual packaging surface deformation values will be compared to the calculated movements required for a 20% increase in dose rate. There are three areas of consideration 1) deformation of the outer surface of the package due to drops, 2) internal movement or shifting of the RAM content, and 3) settling of uniformly distributed RAM content due to routine transport vibrations.

CASE EXAMPLES

Case 1. Drum with uniform RAM content and crushed from top (axially). The first case explores a 205 L drum filled with zero density and 1 g/cc uniformly distributed RAM content that hypothetically drops and is uniformly compressed 15 cm as shown in Figure 1. The deformation results in a more concentrated RAM content (e.g. radiation source) with increased density (1 to 1.22 g/cc). A 0.04 TBq source of Cs-137 is uniformly distributed within the drum. The zero density RAM content case simulated a very light weight payload and the 1 g/cc case simulates a heavy weight payload (220 kg).

Results. When the drum and contents are compressed down 15 cm in the simulated drop, the radiation levels at the top surface of the light and heavy content drums increase by approximately 19% and 8% respectively. The radiation level of the light weight drum increases more because the source becomes concentrated without a corresponding significant increase in source density. As the radiation escapes from the volume of the contents, the content itself provides shielding. This "self-shielding" becomes increasingly important as content density increases. Hence the radiation level changes

due to surface deformation will be smaller for high density heavy content weight drums than for light weight low density content.

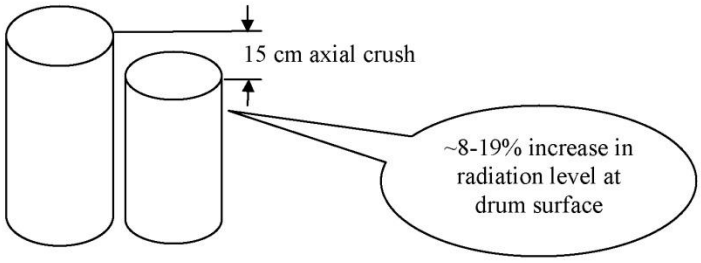

Figure 1. Case 1 depicts the drum with uniformly distributed content compressed in the axial direction 15 cm.

Figure 2 shows the dose rates versus distance from the top of the drum for the light and heavy content cases. Figure 3 shows the change in the radiation level at the drum surface as a function of crush depth. Deformations in excess of 15 cm for low density content is required before the radiation level at the package surface exceed the regulatory 20% limit. In reality actual drum deformations due to normal condition drops are more on the order of 2-8 cm and localized at the edge of the drum as shown in Figure 4. In conclusion for uniform RAM contents in 205 L drums (that remains uniformly distributed), drop deformation should not result in 20% increases surface radiation levels.

Case 2. Point source in a 205 liter drum. A 0.04 TBQ point Source of Cs-137 is centered in a 205 L drum as shown in Figure 7. The source is surrounded by dunnage having a 1 g/cc density. The dose rate gradient is calculated near the surface of the drum to determine the movement necessary to produce a 20% increase in dose rate. Two cases are considered; one with a shielded drum and one without.

Results. Based on the calculated dose rate gradients shown in Figure 5 it requires ~3 cm of surface movement to result in a 20 % change in the dose rate. This means that surface deformation toward the source of greater than 3 cm would result in a 20% increase in the radiation level. Similarly if the source shifts during transportation within the drum greater than 3 cm the radiation level at the surface would increase by more than 20%. Figure 6 is a plot of the movement required to produce a 20% increase in radiation level versus distance from the point source. As shown in Case 1, drums experience local deformations of approximately 2-8 cm in center of gravity (CG) over corner drops. It is therefore feasible that radiation levels could increase by 20% for a point source secured in a drum. Sources should be secure within the drum so they do not shift and drum content weight and wall thickness should be designed so that deformation will not exceed ~3 cm.

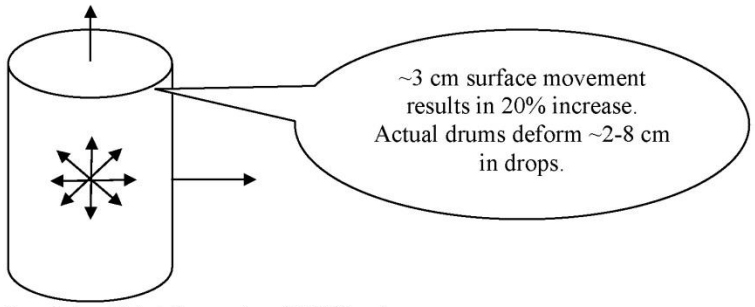

Figure 7. Case 2 is a Point Source in a 205 liter drum.

Case 3. 2550 liter waste box with uniformly distributed RAM content. Case 3 explores a 2550 L waste box filled with a uniformly distributed 1 g/cc content (2550 kg) as shown in Figure 12. The dose rate gradients are calculated normal to the side wall and at a diagonal away from the corner in line with CG over corner. A source of 0.04 TBq of Cs-137 is uniformly distributed within the box. The dose rate gradients are evaluated to determine the motion required to produce a 20% dose rate increase.

Results. Due to the relatively large waste box source volume the dose rate gradients are more gradual near the surface as shown in Figure 8. The radiation levels are lower along the diagonal as compared to the side wall because the corner is farther away from the centroid of the source volume. Movements on the order of ~10 cm are required to increase the radiation level by 20% as shown in Figure 9. Corner deformation in testing is a function of payload weight and physical form, and box stiffness. A stout reinforced corner may deform only a few cm, whereas lower strength boxes may deform well beyond 10 cm. See Figures 10 & 11. To prevent surface dose rates from increasing beyond 20% at waste box corners designers should ensure that corners are sufficiently stiff and that payload shifting will be minimal. The latter is problematic as loose payload is often carried in low level waste boxes.

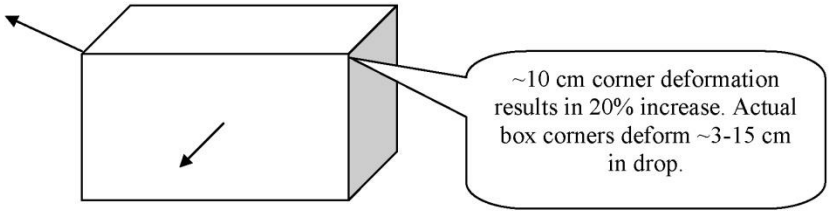

Figure 12. Case 3 is a uniform source in 2550 liter waste box (2550 kg content weight).

Case 4. Small special form source package. Case 4 explores a 5 cm dia. uniform source within a shielded package having an outer diameter of 40 cm as shown in Figure 13. This case simulates a typical Type A special form source package. The dose rate gradients are

calculated near the external package surface to determine the amount of movement that results in a 20% dose rate increase.

Results. Based on the calculated dose rate gradients shown in Figure 14 an approximate 2 cm of surface movement is required to result in a 20 % change in the dose rate. As shown in Figure 15 only ~2 cm movement is required to produce a 20% change in dose rate, source packagings must be designed to be robust with tight tolerances and to securely house the radioactive source capsule.

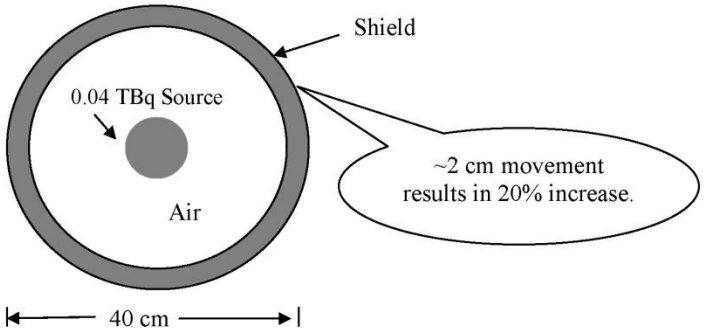

Figure 13. Case 4 is a small special form source package.

Case 5. Settling of RAM contents due to drops or vibrations. Case 5 explores the settling of loosely packed RAM content in a waste box as shown in Figure 16. This simulates content settling that may occur during transportation due to drops or vibrations. As the payload settles the source term becomes more concentrated and its density increases. The dose rate gradients are calculated near the side wall of the package at locations of maximum dose rate. A uniformly distributed 0.05 TBq source is uniformly distributed through out the content volume. The dose rate gradients are calculated near the external package surface to determine the amount of movement that results in a 20% dose rate increase. The waste boxes are modeled as 2550 liter boxes with 0.5 and 0.1 g/cc content densities which represent typical "heavy" and "light weight" payload weights of 1250 and 255 Kg respectively.

Results. As the RAM contents settle for the heavy payload case the maximum dose rate at the side was changed only slightly. However, for the light weight content cases, the dose rate increases significantly. For the light weight case the maximum dose rate increases ~15% when the payload settles to 75% , and increases 30% when the payload settles to 50% of the original volume. Figure 17 show the dose rate gradients near the side wall for the two payload densities. These results are similar to Case 1 for the compressed drum. When contents are sufficiently dense, external dose rate increases are minimal because increases in self-shielding due to payload compression off-set the higher radioactive source density. For lower density contents the self-shielding factor is less important. It can be concluded that significant payload settling will increase surface dose

rates by more than 20%. It is emphasized that these are simplistic calculations for hypothetical cases. In reality radioactive source material is seldom truly uniformly distributed in solid payloads.

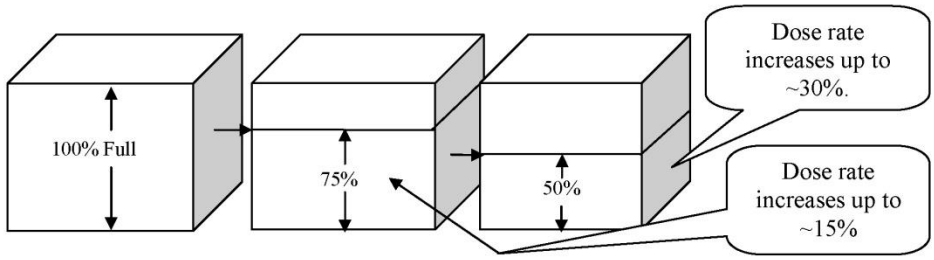

Figure 16. Case 5 depicts radioactive payload settling due to transportation drops or vibrations.

CONCLUSIONS

Surface radiation level increases in excess of 20% may occur in radioactive material packages due to shifting contents or outer packaging wall deformations. Smaller RAM packages with concentrated RAM sources (e.g., capsules) have relatively steep dose rate gradients at the package surface so these packaging designs must ensure that the source is well secured against internal movement (e.g., < 2cm) and that the outer packaging is robust to minimize surface deformation in drop considerations. Larger volume packages such as drums or boxes carrying uniformly distributed RAM (e.g., low level waste) have smaller surface dose rate gradients due to the physically large source volume. For these packages surface deformations on the order of ~10 cm are required to produce radiation level increases of 20%. In practice, drums typically do not deform in excess of 10 cm, however waste boxes dropped CG over corner may well exceed deformations of 10 cm. Additionally drop tests will result in the payload shifting in the direction of the impact which can also increase surface radiation level.

Payload settling may also result in surface radiation level increases in excess of 20%. For the idealized cases looked at in this paper, if a light weight content settles to 50% of its original volume, the maximum surface dose rate will increase ~30%. This clearly exceeds the required 20%. As payloads increase in weight the effect of settling is much less pronounced due to the increase in self-shielding within the content volume. The cases in this paper consider only idealized content and source distributions. In reality the distribution of RAM within a package is often non-homogeneous. There are often "hot spots" or zones of higher dose rates present. In these cases the package designer along with the shipper must carefully consider the methods for payload securement so RAM content movement is minimized during handling and transit.

The package designer is responsible for ensuring that the packaging and associated RAM contents are well engineered to minimize relative movement within the packaging during transport. The shipper is very important as it is the shipper's responsibility to ensure that not only the packaging is properly loaded and that the RAM contents are adequately

blocked, braced and secured against movement but the entire package assembly is properly secured to the conveyance.

ACKNOWLEDGMENTS
The authors gratefully acknowledge review comments provided by Steven J. Nathan and Teresa M. Davis of Savannah River Nuclear Solutions, LLC, and Angela McGee of UT-Battelle, LLC, Oak Ridge National Laboratory.

REFERENCES

1. MicroShield ® 7, Grove Software, Inc. 147 Mill Ridge Road, Lynchburg, VA 24502, www.radiationsoftware.com.
2. TS-R-1, *Regulations for the Safe Transport of Radioactive Material,* International Atomic Energy Agency (IAEA), 2009 Edition.

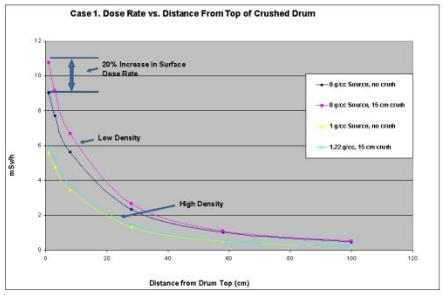

Figure 2. Dose rate vs. distance from drum top for low and high content density.

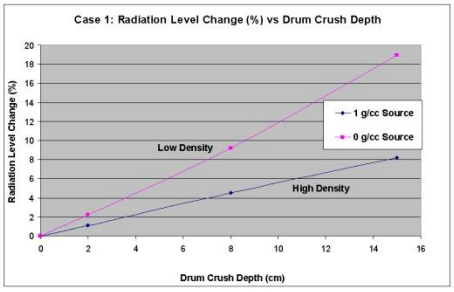

Figure 3. Percent change in dose rate vs. drum crush depth (cm).

Figure 4. Actual drum deformation from 1.2m drop with 430 kg content.

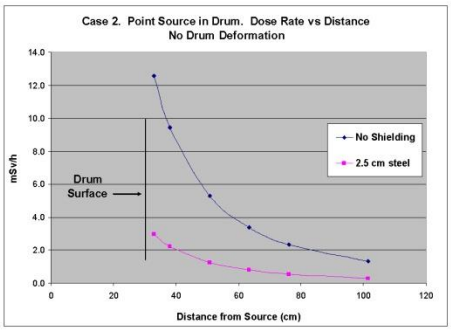

Figure 5. Dose rate gradients vs. distance from drum surface.

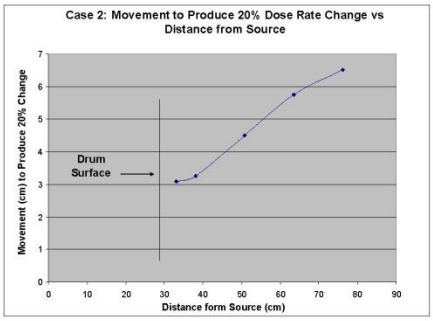

Figure 6. Movement (cm) to produce 20% dose rate change vs. distance from drum.

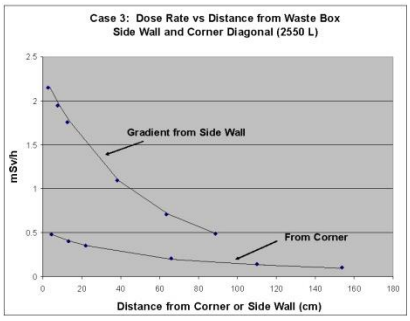

Figure 8. Dose rate vs. distance from box side wall and corner.

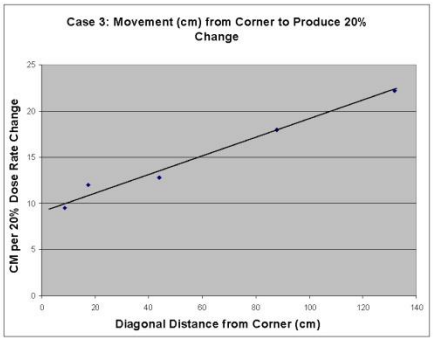

Figure 9. Movement from corner to produce 20% dose rate change.

Figure 10. Deformation in waste box after CG/corner 1.2 m drop (major deformation).

Figure 11. Deformation in waste box after CG/corner 1.2 m drop (minor deformation).

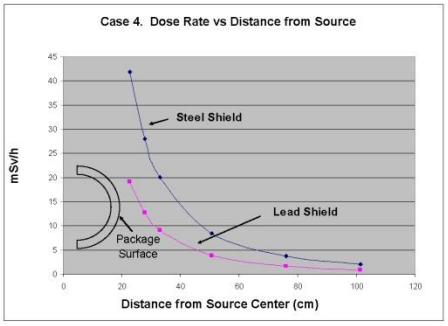

Figure 14. Dose rate vs. distance from source package.

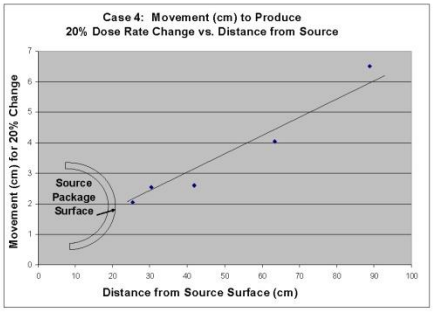

Figure 15. Movement to produce 20% change vs. distance from source.

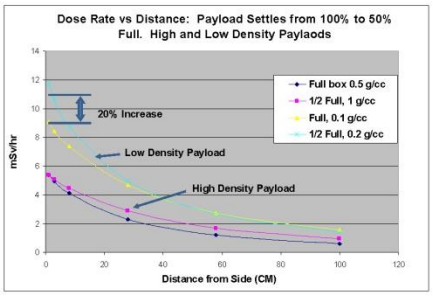

Figure 17. Dose rate vs. distance from side of box as payload settles.

APPENDIX I: Examples of Checklists

Sample Receipt Inspection Checklist

Upon receipt of freight containers each one will be visually inspected using the checklist below. The Inspector will show compliance by checking each box and signing the document that the inspection took place. Any requirement that does not pass this visual inspection will be segregated and marked and a non-conformance report issued.

Cargo Container Serial Number(s): _____

(Company) Release or PO Number: _____

Indicate compliance by checking each box below √

General Requirements

Verify that Approval Agency seals (e.g., ABS, BV, GL, LR), are on the container(s) and in good condition.	
When the freight container is required to be painted. Did the shipper/offeror require a specific type of paint to be used? For example, Paint the freight container with one coat of mercury and lead free enamel paint.	
Freight container may require additional markings other than those required by ISO standards. These additional markings may include, but not limited to the following: ▪ Purchase Order number, ▪ Date of purchase (month – day – Year), ▪ Tare and maximum gross weight, ▪ Cargo container serial number plus check digit CSC plate must be readable and shows that the cargo container is with its first two years of a 5-year certification.	
Upon delivery and after the visual inspection is completed the shipper/offeror shall re-enter the freight container and with the doors closed verify that the freight container is light tight by inspecting for any light entering the container through holes or non-sealing door gaskets.	
Documentation Package. Documents requested in the purchase order may include, but not limited to, Prototype and/or Production Certificate, Manufacturers Technical Specification, design or fabrication drawings, and any certificates of conformances.	

Visually inspect the following

Container Corner Post	
Shall not have any cracks, splits or missing welds	
Shall not have any tears or fractures	
Shall not have any dents	
Shall not have any rust	

Container Corner Fitting	
Shall be fully square	
Shall not have any pieces broken away	
Shall not be fractured or cracked	
Shall not be miss-aligned with the corner post	
Shall not have any missing or cracked welds	
Shall not have any rust	

Container Rear End Frame	
Shall not have any missing or cracked welds	
Door header shall have no splices	
Shall not have any dents or bends	
Shall not be cut or torn	
Door sill shall not have any splices	
Shall not have any rust	
Rain gutter shall not be damaged	

Container Top and Bottom Side Rails	
Shall not have any cracked or missing welds	
Shall not have splices in the rails	
Shall not have any dents or bends	
Shall not have any cuts, tears or fractures	
Shall not have any rust	

Container Front End Frame	
Shall not have any cracks, fractures or tears	
Shall have no splices in the top or bottom end rails	
Shall not have any dents or bends	
Shall not have any cracked or missing welds	
Shall not have any rust	

Container Side Walls	
Shall not have any cracks, fractures or tears	
Shall not have any inward or outward dents or bulges	
Shall not have any cracked or missing welds	
Shall not have any rust	

Container Roof Exterior	
Shall not have any cracks, fractures or tears	
Shall not have cracked roof reinforcement plate	
Shall not have any cracked or missing welds	
Shall not have any rust	

Container Roof Interior	
Shall not have any broken roof bows or welds	
Shall not have any missing, cracked or bent roof bows	
Shall not have any missing rivets or bolts	

Container Floor - Exterior Undercarriage	
Shall not have any cracked or missing welds on any connected steel member	
Cross members shall not be fractured, torn, twisted or disconnected from the side rail	
Shall have no splices	
Forklift pockets shall be no less than 4-1/2" high by 14" wide	
Shall not have any rust	

Container Floor - Inside	
Shall not be fractured or warped	
Shall have all required fasteners	
Shall not have any debris inside the container	
Shall be capable of supporting a forklift or small tractor	

Container Doors	
Shall not have torn or damaged door seals	
Each door shall have two locking bars	
Shall not have any broken, bent or inoperative door locking bars	
Hinges shall not be broken or unfastened	
Shall not have any holes or tears in door panels	
Shall not have any broken or loose cam handles	
Door locking handle shall not be broken or inoperative	
Shall not have any rust	
Locking bar mounting brackets shall not be broken or unfastened	
Shall not have any cracked or missing welds	
Door gaskets shall not have any tears, holes, cracks, patches or overlapping corner tabs	

Receipt Inspector's Signature

Date

Pre-Use Inspection Checklist[1]

The purpose of this checklist is to ensure the container is acceptable just prior to loading.

Item	Inspection Requirement	Signature
1	When staging a freight container for loading purposes, please make sure it is on solid ground and level. Freight containers that are not level may not seal properly and not allow doors to close properly.	
2	When available have on hand the documentation that was used to perform the receipt inspection.	
3	Verify that the packaging is proper for the contents to be shipped.	
4	Examination of the main framework (corner posts, corner fittings, bottom and top side rails, bottom and top end rails, door sill and header) – no major defects: ▪ Dents or bends in structural members (including under floor cross members) greater than 19 mm in depth, regardless of length; ▪ Cracks or breaks in structural members (including under floor cross members); ▪ More than one splice or an improper splice (e.g., a lapped splice) in top or bottom end rails or door headers or more than two splices in any one top or bottom side rail or any splice in a door sill or corner post; ▪ Door hinges and hardware that are seized, twisted, broken, ▪ Missing or otherwise inoperative; ▪ Non-closing gaskets and seals; ▪ Any distortion of the overall configuration sufficient to undermine proper alignment of handling equipment, mounting and securing on a chassis or vehicle	
5	Examination of the doors: they shall work properly and be capable of being securely locked and sealed in the closed position, and properly secured in the open position; gaskets shall be in good condition and be tight when doors are closed.	
6	Examination of the marking and labeling: irrelevant markings, labels, placards, orange panels, signs and marine pollutant marks shall be removed or masked.	

[1] "Uranium Concentrates Industry Good Practices for ISO Containers in Multimodal Transports, Revision 0," World Nuclear Transport Institute www.wnti.co.uk

Pre-Use Inspection Checklist (continued)

Item	Inspection Requirement	Signature
7	Examination of the CSC plate: ▪ Correct fixation (cannot be removed easily); ▪ Approval number; ▪ Date of manufacture; ▪ Identification number (shall be that of the container); ▪ Maximum gross weight; ▪ Allowed stacking weight for 1.8 G; ▪ Racking testing load value; Either last dates of examination (valid for 5 years for less 5 year old containers, valid for 30 months for more than 5 year old containers) or confirmed Approved Continuous Examination Program (ACEP) approval scheme from the owner.	
8	The interior surfaces shall be clean, dry and free of residue and persistent odors from previous cargo. Walls, roof and floor shall be exempt of rust.	
9	The floor shall be in good condition to facilitate its decontamination at consignee's place and to avoid any escape of uranium concentrate in case of failure of on or more packages during the voyage: no cracks, breaks, holes, protruding nails or screws.	
10	Examination of anchor points and lashing points: not seized, twisted, broken, missing or inoperative (irrelevant if not used for stowage of the cargo).	
11	Check the waterproof of the container: Potential point of leakage can be detected by observing if any light enters the closed container.	
12	Verify that the vents are in working order. ▪ If vents are required to be sealed verify the work has been done to seal the vents. ▪ If vents are to be replaced with a special vent, e.g., NucFil Vent, verify that the applicable vents is in place and installed properly.	
13	Verify that when applicable any special instructions for loading, blocking and bracing, tie-downs, closing, and preparation of the freight container are available at the time of loading the freight container.	
Containment System		
14	Verify that each closure, valve or other opening of the containment system through which the radioactive content might escape is properly closed and sealed.	
15	Verify that the internal pressure of the containment system will not exceed the design pressure during transportation.	

[1]Pre-Shipment Checklist for a Freight Container

The purpose of this checklist is to ensure the safe and contamination free handling and transport of containers packed with class 7, radioactive materials. The containers may be loaded on to either road or rail conveyances depending on the modes of transportation being deployed.

Item	Inspection Requirement	Signature
1	When loading is complete verify that the freight container is still level. If not work to the best possible efforts to get the freight container level. A level container ensures ease of proper closure.	
2	Verify that prior to closing the doors the door gasket is in good condition and has not been damaged in the loading process. If so replace the damaged sections to the door gasket as a whole.	
3	When available have on hand the documentation that was used to perform the receipt and pre-use inspections. Verify that the freight container is still in the same condition as inspected.	
4	After the container is packed it will be visually inspected for secure loading.	
5	Close the freight container per the closure instructions provided by the shipper/offeror or the manufacture. After closure the container will be sealed with a tamper indicating device (TID), if numbered records TID number:	
6	Visually check external container markings to ensure the appropriate DOT marking is on the container and when required verify that any labeling required is still intact and has not been damaged.	
7	Prior to shipment ensure that container is clean on sides, top and bottom and if necessary with high pressure cleaner or appropriate equipment. Dirt and sand shall be removed from the container bottom seams prior to shipment.	
8	Check the outside surfaces of the container for non-fixed contamination (wipe sampling) and record the measured values.	
9	Measure and record maximum dose rates and units of measurement (e.g., mSv): ▪ Container surface contact ▪ One (1) meter away from the container **Note:** The one (1) meter value is used to calculate the transport index for the container.	
10	When applicable place the appropriate placards the freight container.	
11	Record the freight container number that will be used for tracking.	

APPENDIX J: Department of Transportation Letters of Interpretation

DOT Reference Number	Company Requesting Interpretation	Date of Letter
02-0221	Alloy Products Corporation	December 4, 2002
05-0228	Regulatory Resources Inc.	November 8, 2005
06-0063	Logistical Solutions	June 16, 2006
07-0115	Mr. Philip Brandt	February 12, 2008
08-0055 (Training)	Ella McNeil	June 6, 2008

Boothe
§178.601
Testing
02-022 1

ALLOY PRODUCTS CORP.
Stainless Steel Craftsmen Since 1929

1045 Perkins Avenue
P.O. Box 529
Waukesha, WI 53187-0529
(414) 542-6603
Fax (414) 542-5421

Friday, August 16, 2002

Department of Transportation
Office of Hazardous Material and Technology
400 7th Street Southwest
Room # 8430
Washington, D.C., District of Columbia

Reference : Bureau of Explosives, Tariff # BOE-6000

Attention : Mr. Thomas G. Allen

Dear Mr. Allen

During the design qualification testing per Subpart M , we perform all test required in section 178.601,c,1. In addition , we perform the vibration test as per section 176.608.

Question :

During periodic testing per section 178.601,c,2 , are we required to perform the vibration test as well ?

My interpretation is that the vibration test is required for the design qualification testing only and it does not apply to the periodic testing. Am I correct?

I am looking forward for your response. Thank you

Regards,

Peter El-Sabaaly

Peter El-Sabaaly
Director of Engineering

DOTvibration.peter

U.S. Department
of Transportation
**Research and
Special Programs
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

DEC 4 2002

Mr. Peter El-Sabaaly
Director of Engineering
Alloy Products Corporation
P.O. Box 529
Waukesha, WI 53187-0529

Ref. No. 02-0221

Dear Mr. El-Sabaaly:

This responds to your August 16, 2002 letter requesting clarification on package testing requirements under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180). Specifically, you ask if the vibration standard under § 178.608 is required for the design qualification testing only and not the periodic retesting of packagings.

Your understanding of vibration standard is that the vibration test is required for the design qualification testing only and does not apply to the periodic retesting. Your understanding is incorrect. All performance tests for design qualification testing and periodic retesting under §§ 178.603, 178.604, 178.605, 178.606, or 178.607, must be performed in accordance with provisions in § 178.601(c)(1) and (c)(2) at the frequency specified in 178.601(e). These performance tests are required to be performed and packages must successfully pass these tests before they can be certified as a UN performance packaging authorized to carry hazardous materials.

However, as specified in § 178.608, each non-bulk packaging must be capable of withstanding, without rupture or leakage, the vibration test procedure outlined in this section. This capability can be demonstrated through the packaging performance history using this type of packaging or by performing the vibration test. The vibration test is not required to be performed for non-bulk packagings. For certain bulk packagings, such as intermediate bulk containers, the vibration test must be conducted for both design qualification and periodic retesting.

I hope this answers your inquiry.

Sincerely,

Delmer F. Billings
Chief, Standards Development
Office of Hazardous Materials Standards

020221

178.601

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

400 Seventh Street, S.W.
Washington, D.C. 20590

NOV 8 2005

Mr. Wade A. Winters
Regulatory Resources, Inc.
240 Joshua Rd
Kennewick, WA 99338

Ref. No.: 05-0228

Dear Mr. Winters:

This is in response to your September 19, 2005 letter concerning Industrial Packagings (Type 2 and Type 3) under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180). Your questions are paraphrased and answered as follows:

Q1. Given that an ISO 1496-1 freight container in compliance with § 173.411(b)(6) is authorized for use as a Type IP-2 or Type IP-3, may the same ISO 1496-1 freight container be certified as a DOT-7A packaging if the water spray and puncture test are performed?

A1. No. To be certified as a Type A package, the design must meet all the requirements of § 178.350. Although compliance with § 173.411(b)(6) and successful completion of the water spray and puncture test would satisfy the requirements of §§ 173.410 and 173.465, the design must still meet the requirements of §§ 173.403 and 173.412. It must also be noted that certification of the design is restricted to the content or contents specified in the test report or the analysis conducted. Expansion of the certification to contents with different physical properties would require further analysis.

Q2. If the design and testing documentation is not available for a foreign ISO 1496-1 certified freight container manufacturer, may the shipper assume that the design and testing criteria have been met?

A2. No. Under § 173.411(c), each offeror of an Type IP-2 or Type IP-3 must have on file (and maintain on file for at least one year) complete documentation of test and

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173.411(b)(6)

engineering evaluation or comparative data for the industrial package. If the information is unavailable for an ISO 1496-1 freight container, it may not be used as a Type IP-2 or Type IP-3 package.

I hope this information is helpful. If you have further questions, please do not hesitate to contact this office.

Sincerely,

Hattie L. Mitchell

Hattie L. Mitchell
Chief, Regulatory Review and Reinvention
Office of Hazardous Materials Standards

Pollack
§173.411(b)(6).
Industrial Packagings
05-02.28

Regulatory Resources, Inc.
"The Source You Come Back To"

240 Joshua Road
Kennewick, WA 99338
voice: 509-628-1020
fax: 509-628-0972
wade@regulatoryresources.net
www.regulatoryresources.net

September 19, 2005

Ms. Susan Gorsky
Office of Hazardous Materials Standards
Pipeline and Hazardous Materials Safety Administration
U.S. Department of Transportation
PHH-10
400 Seventh Street, SW
Washington, DC 20590

Dear Ms. Gorsky,

Regulatory Resources, Inc. (RRI) is a consulting and training company serving clients subject to the Department of Transportation (DOT) Hazardous Materials Regulations (HMRs) and the Environmental Protection Agency (EPA) solid and hazardous waste management regulation. One of our specialty areas covers the regulations for the safe transport of radioactive materials. Various Class 7 packaging questions have been raised in recent training classes and I'm seeking PHMSA's clarification on these. This particular request for clarification concerns freight containers authorized as Industrial packagings in 49 CFR 173.411.

The first of two questions concerns 49 CFR 173.411(b)(6). In this paragraph it states that freight containers may be used as Industrial packages Types 2 or 3 (Type IP-2) or (Type IP-3) provided that...industrial packaging Type 2 (IP-2) require the package to pass specified criteria when subjected to, or evaluated against, drop and stacking tests for Type A packages intended to contain solids (§173.465(c) and (d)). Type IP-3 packages are to be evaluated after being subjected to all Type A package design and test criteria for solids.

The adoption of the IAEA TS-R-1 regulations in Docket HM-230, January 26, 2004, allow an ISO 1496-1: "Series 1 Freight Containers — Specifications and Testing — Part 1: General Cargo Containers"; excluding dimensions and ratings, to be used as Type IP-2 and Type IP-3 as long as two specific requirements are met. Obviously, DOT has determined that the ISO 1496-1 testing is the same as or equivalent to the Type A package drop and stacking tests when evaluated against:

(A) no loss or dispersal of the radioactive contents; and
(B) no loss of shielding integrity which would result in more than a 20% increase in the radiation level at any external surface of the freight container.

Given that an ISO 1496-1 freight container in compliance with §173.411(b)(6) is authorized for use as, and so marked per §172.310(b), a Type IP-2 or Type IP-3 packaging, can this same ISO 1496-1 freight container be certified as a Type A DOT-7A packaging with only the additional design and test evaluation/performance for the water spray and puncture test considerations?

RRI's second question concerns the same paragraph where it states that an ISO 1496-1 freight container is certified as such by the information presented on the freight container's Container Safety Certificate (CSC) plate put in place by the original manufacturer. Many of these type of freight containers are manufactured in countries other than the U.S. The Hazardous Materials Regulations (HMR) §173.411(b)(6) allow the ISO 1496-1 freight container to be certified, pending qualifying conditions, as a Type IP-2 and Type IP-3 (see question above).

Regulatory Resources, Inc.
240 Joshua Road
Kennewick, WA 99338

Voice: 509-628-1020
Fax: 509-628-0972
www.regulatoryresources.net

The requirements in §173.411(c) specify that the user of any Type IP-2 or Type IP-3 package must maintain on file for at least one year after the latest shipment complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and material of constructions comply with that specification.

Concerns continue to surface by both package manufacturers and users of foreign made ISO 1496-1 freight containers regarding the inability to acquire the necessary §173.411(c) documentation from these foreign manufacturers. In some instances it appears that the foreign manufacturer may not possess the records on the freight container, and yet, these freight containers are certified and marked as ISO 1496-1 certified.

If specific design and testing documentation is not available from the foreign ISO 1496-1 certified freight container manufacturer, can a U.S. manufacturer or shipper apply §173.22(a)(3)(i) in determining that the ISO 1496-1 design and testing criteria have been met by the presence of the freight container's CSC specification plate?

Thank you for your time in these matters. Please contact me if I can answer any questions.

For Regulatory Resources, Inc.,

Wade A. Winters, CET, CHMM
President

WAW/lom

U.S. Department
of Transportation
**Pipeline and
Hazardous Materials Safety
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

JUN 16 2006

Mr. Kurt Colborn
Director, Technical Services
Logistical Solutions
800 Cranberry Woods Drive, Suite 450
Cranberry Township, PA 16066

Ref. No. 06-0063

Dear Mr. Colborn:

This responds to your March 13, 2006 letter requesting clarification on §173.411(b)(6) to allow the use of freight containers as Industrial Packagings (IP) Type 2 or 3 containers under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180).

Section 173.411(b)(6) authorizes the use of freight containers as industrial packagings Types 2 or 3 (Type IP-2 or (Type IP-3) provided that:

(i) The radioactive contents are restricted to solid materials;

(ii) The freight containers satisfy the requirements for Type IP-1 as specified in §173.410; and

(iii) The freight containers 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 must be designed so that if subjected to the tests prescribed in that document and the accelerations occurring during routine conditions of transport they would prevent loss or dispersal of the radioactive contents and loss of shielding integrity that would result in more than a 20% increase in the radiation level at any external surface of the freight containers.

Your questions are paraphrased and answered below:

Q1. May packages meeting the IP-1 freight container and ISO 1496 standards be used as IP-2 or IP-3 packages when used to consolidate small loads for shipment?

060063

173.411(b)(6)

A1. In accordance with § 173.411(b)(6), freight containers may be used as IP-2 or IP-3 packages, as long all of the following four conditions are met:

a) The freight container meets the requirements for an IP-1 package.

b) The freight container is designed to conform to the standards prescribed in: "Series 1 Freight Containers - Specifications and Testing - Part 1: General Cargo Containers for General Purposes; excluding dimensions and ratings. It should be noted that freight containers approved in accordance with the International Maritime Organization International Convention for Safe Containers are not necessarily equivalent to the testing prescribed by ISO 1496-1.

c) The freight container is designed such that if subjected to the tests prescribed in ISO 1496-1, as well as accelerations occurring during routine conditions of transport, there would be no loss or dispersal of the radioactive contents nor loss of shielding integrity which would result in more than a 20% increase in radiation levels on any external surface of the freight container. It should be noted that the test conditions of accelerations occurring during routine conditions of transport are in addition to the testing prescribed by ISO 1496-1 because the ISO Standard does not include dynamic tests.

d) The radioactive contents of the freight container are limited to solid materials. Additionally, radioactive contents that have not satisfied the requirements of § 173.411(b)(6) must not be transported in an IP-2 or IP-3 container.

Q2. What marking and labeling requirements apply to a freight container used as an IP-2 or IP-3 package? What marking and labeling requirements apply to internal containers?

A2. Freight containers used as an IP-2 or IP-3 package must be marked and labeled as such, in accordance with §§ 172.310 and 172.403. Inner containers are authorized provided they are specified in the IP-2 or IP-3 test and evaluation report. Inner containers must be marked in accordance with the specification specified in the test and evaluation report. For example, if the test and evaluation report specify the presence of inner IP-1 packages, the packages must be marked as such, in accordance with § 172.310. If the test report specifies inner containers (i.e. wooden boxes, bags, etc.) marking of the inner containers would not be required. Additionally, hazard communication markings and labels are not required for the inner containers.

Q3. May freight containers not meeting the IP-1 and ISO-1496-1 standards be used to transport loose bulk material if testing demonstrates the containers prevent the loss or dispersal of contents while subjected to the IS0-1496-1 test requirements?

A3. No. The freight container must meet all the requirements outlined in Answer 1.

Q4. Are the requirements in § 173.411(b)(6) intended to be used as an alternative means to certify packagings? If an IP-1 freight container is used an IP-2 or IP-3 package, how should the package be marked?

A4. The provisions of § 173.411(b)(6) are to be used as an alternative means of IP-2 and IP-3 packaging certification. Freight containers used as an IP-2 or IP-3 packaging must be marked accordingly.

I hope this answers your inquiry.

Sincerely,

John A. Gale
Chief, Standards Development
Office of Hazardous Materials Standards

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§ 173.411(b)(6)
Packages
06-0063

800 Cranberry Woods Drive, Suite 450, Cranberry Township, PA 16066 T 724.772.9800 F 724.772.9850 W www.mhfls.com

Mr. Edward Mazzullo
Director of Hazmat Standards
USDOT/PHMSA, Suite 8422
Office of Hazardous Materials Safety
400 7th Street, SW
Washington, DC 20590-3012

March 13, 2006

SUBJECT: Clarification of the use of Freight Containers as IP-2 and IP-3 Packages

Dear Mr. Mazzullo,

This letter is to request confirmation of our interpretation of the limits of the provision in 49 CFR 173.411(b)(6) to allow the use of IP-1 containers as IP-2 or IP-3 containers.

INTRODUCTION

We note that 49 CFR 173.411(b)(6) states:

Freight containers may be used as Industrial packages Types 2 or 3 (Type IP-2) or (Type IP-3) provided that:

(i) The radioactive contents are restricted to solid materials;
(ii) They satisfy the requirements for Type IP-1 specified in paragraph (b)(1); and
(iii) 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 (IBR, see Sec. 171.7 of this subchapter). They shall be designed such that if subjected to the tests prescribed in that document...they would prevent ...loss or dispersal of the radioactive contents...

DISCUSSION

The tests prescribed in ISO 1496 include transverse and longitudinal load testing for which the pass criterion is no permanent deformation. Temporary deflection of container walls of up to 60 mm (sufficient to temporarily unseat doors, lids, or other sealing surfaces) is entirely acceptable during the load test.

Since deflection can temporarily compromise container integrity, freight containers meeting ISO-1496 design and test requirements *will not necessarily prevent loss or dispersal of radioactive contents if used to ship loose bulk materials when subjected to the tests of that standard.* Therefore, it is not sufficient for a container to meet IP-1 and ISO-1496 requirements for it to be used as an IP-2 or IP-3 package. Such use [in accordance with 173.411(b)(6)] requires that the container *perform* as an IP-1, preventing loss or dispersal of its contents *while subjected* to the test conditions of ISO-1496.

The regulation itself provides for the use of an IP-1 package when a higher-rated package would otherwise be required. We understand the regulation as a shipping provision, not as an alternative means of package certification. Manufacturer certification of a packaging to meet IP-2, for example, still requires evaluation and testing in accordance with 173.411, 173.461, and 173.465. A shipper using the provision of 173.411(b)(6) should maintain the IP-1 marking on the freight container, and note the use of the shipping provision [i.e. "IP-1 used as an IP-2 in accordance with 173.411(b)(6)"] on the shipping documents.

INTERPRETATION REQUEST

We understand the shipping provision of 173.411(b)(6) to allow transport of multiple small containers of radioactive materials in freight containers when the activity of the internal containers would otherwise require a higher rated package. Freight containers carrying smaller containers of materials can meet the requirement to perform as an IP-1 *while subjected to* the transverse and longitudinal load tests of ISO-1496 (provided the internal containers prevent loss and dispersal during any temporary deflection of the freight container).

Please confirm that our interpretation of this regulation is correct, as follows:

1. Containers meeting IP-1 and ISO-1496 can be used as IP-2 or IP-3 packages when used to consolidate smaller containers for shipment.
2. The freight container can be marked and labeled as the package for shipment, but the internal containers form a necessary part of the package to prevent loss or dispersal of the radioactive contents (as during expected deflection).
3. Containers meeting IP-1 and ISO-1496 do not necessarily meet the requirements of 173.411(b)(6). Shipping loose bulk material in freight containers is not authorized in the absence of testing to demonstrate that the containers prevent the loss or dispersal of contents *while subjected to* the tests of the ISO-1496 standard.
4. 173.411(b)(6) is intended as a shipping provision, and must not be used as an alternative means of packaging certification by the manufacturer. IP-1 packagings used as IP-2 or IP-3 should be marked IP-1. IP-2 and IP-3 package markings are reserved for containers that actually meet the standards for those higher rated packagings.

Please feel free to call me at 724-772-9800, ext 5560 if you have any questions regarding this inquiry.

Respectfully submitted,

MHF Logistical Solutions

Kurt Colborn
Director of Technical Services

U.S. Department
of Transportation
Pipeline and Hazardous Materials Safety Administration

1200 New Jersey Avenue, SE
Washington, D.C. 20590

FEB 12 2008

Mr. Philip Brandt
124 Jim Town Road
Jonesborough, TN 37659

Ref. No. 07-0115

Dear Mr. Brandt:

This responds to your letter dated May 30, 2007, requesting clarification on the Pipeline and Hazardous Materials Safety Administration's (PHMSA) June 16, 2006 response to Mr. Kurt Colborn [Letter Reference No. 06-0063 enclosed] regarding the use of freight containers as Industrial Packagings (IP) Type 2 (IP-2) or Type 3 (IP-3) containers under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180). Specifically, you request additional clarification on our response A1(c) and A2 to Mr. Colborn.

Your questions are paraphrased and answered below:

Regarding PHMSA's Response A1(c):

Q1. Does the containment system (an ISO 1496-1 compliant freight container on a container chassis) described in my May 30, 2007 letter meet the requirements of §§ 173.410(f) and 173.411(b)(6) of the HMR?

A1. The described "containment system" does not meet all the cited requirements because it does not include a description of the radioactive contents. The ISO 1496/1 tests are permitted as an alternative to the tests normally required for IP-2 and IP-3 packages in § 173.411, but it must be shown that the particular radioactive contents will not be subject to loss or dispersal from the container, or loss of shielding integrity, as a result of those tests. The ISO tests allow some flexing of the freight container body which might be unacceptable for containment of the particular content. The potential for movement of the contents within the container must also be considered to evaluate compliance with the requirement for maintaining shielding integrity.

Q2. Can the requirements be satisfied by documenting the fact that a specified number of freight containers have been shipped on chassis under conditions of accelerations experienced during routine conditions of transport with no loss of containment?

A2. The container must be shown to meet either the IP-2, IP-3 or the alternative ISO 1496-1 tests along with preventing loss or dispersal of the particular radioactive contents being transported and loss of shielding under routine conditions of transport.

No specific tests beyond those in the ISO standard have been stipulated. The requirements can be met by testing, by engineering evaluations, or by comparative data, documented as required in § 173.411(c). The documentation should pertain to the entire package, including consideration of the properties of the particular radioactive contents.

Regarding PHMSA's Response A2:

Q3. May the freight containers meeting the requirements of §§ 173.411(b) and 173.411(c) of the HMR also serve as a waste disposal package when shipping LSA and/or SCO material? If yes, should the freight containers be marked as "TYPE IP-1", "TYPE IP-1", "TYPE IP-2", or "TYPE IP-3" as appropriate?

A3. The HMR do not regulate waste disposal packages. Radioactive material (RAM) waste disposal is regulated by the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA). The freight container should be marked with the appropriate IP Type marking.

Q4. Does the ISO 1496-1 requirement for the permanent attachment of the CSC Safety Approval Plate with the total gross mass (maximum allowable) of the package meet the requirements of § 172.310(a) for indicating the gross mass of the package or must the total actual gross mass of the shipment be marked on the freight container?

A4. The container must be marked with the total actual gross mass, unless, in accordance with § 173.427, it is being used to ship less than an A_2 quantity LSA or SCO material domestically in exclusive use, in which case it would be excepted from that marking requirement.

Q5. Is the international vehicle registration code required to be legibly marked on the freight container? If yes, does the information on the CSC Safety Approval Plate meet this requirement? If not, where/how is the international vehicle registration code obtained for a freight container?

A5. In accordance with §172.310(c), each package conforming to a Type IP-1, Type IP-2, Type IP-3 or Type A package design must be legibly and durably marked with the international vehicle registration code of the country of origin of the design, unless it is being used to ship less than an A_2 quantity LSA or SCO material domestically in exclusive use, in which case it would be excepted from that marking requirement.

The CSC Safety Approval Plate does not meet the international vehicle registration code marking requirement in § 172.310(c). The CSC plate indicates conformance with CSC requirements. It does not indicate conformance to Type IP-1, Type IP-2, Type IP-3, or Type A package design requirements.

Unless the container supplier has certified the container meets the requirements for the specified contents, the shipper must determine that the package meets the applicable requirements, and the shipper must apply the appropriate code. Note that the party certifying the design meets the requirements must comply with the documentation requirements specified in § 173.411(c).

Q6. Is it correct to assume that if the freight container is manufactured overseas then you would not mark the package with the "USA" marking?

A6. If a shipper in the United States is certifying that the freight container meets the applicable design requirements, the shipper is required to mark the package with "USA".

Q7. Would you mark the container with the country of origin (e.g., China)?

A7. It should be marked with the country of certification, not that of manufacture. This should be the country code of the party that holds the documentation required by § 173.411(c). This may not be the same as the country of origin of the freight container (see answer to #6).

Q8. Are the "Radioactive-LSA" or "Radioactive-SCO" markings, a "Class A Waste" label and the appropriate "IP" marking the only markings/labels required if the freight container is the waste package and the requirements of § 173.427 are met? (The labeling/marking requirements of §§ 172.310 and 172.403 do not apply).

A8. If the shipment is in compliance with § 173.427(a)(6)(vi) (less than an A_2 quantity, domestic exclusive use), the only required DOT marking is "RADIOACTIVE-LSA" or "RADIOACTIVE-SCO", as appropriate and the marking/labeling requirements specified in §§ 172.310 and 172.403 do not apply: The "IP" marking would not be required if the shipment is in compliance with § 173.427(a)(6)(vi). The "Class A Waste" label is not a DOT requirement.

Q9. Is there a requirement for performing testing and an evaluation report for a freight container that contains LSA and/or SCO waste if the freight container is the waste package and is marked as LSA or SCO-Radioactive and there is no loose radioactive material in the conveyance, no leakage of the radioactive material from the conveyance and the packaged and unpackaged waste in the freight container is braced so as to prevent shifting of lading under conditions normally incident to transportation?

A9. If the freight container is being used to transport unpackaged LSA-I or SCO-I material, or is being used as an excepted package of less than an A_2 quantity under exclusive use, in accordance with § 173.427(b)(4), then no documentation is required. If the freight container is being used as a Type IP-2 or Type IP-3 package, §173.411(c) requires the offeror to maintain complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction conform to that specification.

Q10. If all the requirements of § 173.411(b)(6) are met and there are no other test requirements, may LSA-II/III or SCO-II/III material be shipped in a freight container without further testing (e.g. the requirement in § 173.468(b) to conduct a seven day immersion test)?

A10. The referenced immersion test is to qualify material as LSA-III and is not a packaging requirement. Also, see "A9" above regarding requirements for documentation of tests and evaluations.

Q11. If the freight container is the LSA or SCO waste package, are the marking requirements discussed in PHMSA's June 16, 2006 "A2" response to Mr. Kurt Colborn [Letter Reference No. 06-0063] abrogated?

A11. Use of the container as a waste package has no impact on the DOT marking requirements. Freight containers used as a Type IP-2 or Type IP-3 package must be marked and labeled as such, except as provided for under § 173.427(a)(6)(vi) (less than an A_2 quantity, domestic exclusive use) (see "A8" above).

I hope this answers your inquiry.

Sincerely,

John A. Gale
Chief, Standards Development
Office of Hazardous Materials Standards

Enclosure

U.S. Department
of Transportation
**Pipeline and
Hazardous Materials Safety
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

JUN 16 2006

Mr. Kurt Colborn
Director, Technical Services
Logistical Solutions
800 Cranberry Woods Drive, Suite 450
Cranberry Township, PA 16066

Ref. No. 06-0063

Dear Mr. Colborn:

This responds to your March 13, 2006 letter requesting clarification on §173.411(b)(6) to allow the use of freight containers as Industrial Packagings (IP) Type 2 or 3 containers under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180).

Section 173.411(b)(6) authorizes the use of freight containers as industrial packagings Types 2 or 3 (Type IP-2 or (Type IP-3) provided that:

(i) The radioactive contents are restricted to solid materials;

(ii) The freight containers satisfy the requirements for Type IP-1 as specified in §173.410; and

(iii) The freight containers 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 must be designed so that if subjected to the tests prescribed in that document and the accelerations occurring during routine conditions of transport they would prevent loss or dispersal of the radioactive contents and loss of shielding integrity that would result in more than a 20% increase in the radiation level at any external surface of the freight containers.

Your questions are paraphrased and answered below:

Q1. May packages meeting the IP-1 freight container and ISO 1496 standards be used as IP-2 or IP-3 packages when used to consolidate small loads for shipment?

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173.411(b)(6)

A1. In accordance with § 173.411(b)(6), freight containers may be used as IP-2 or IP-3 packages, as long all of the following four conditions are met:

a) The freight container meets the requirements for an IP-1 package.

b) The freight container is designed to conform to the standards prescribed in: "Series 1 Freight Containers - Specifications and Testing - Part 1: General Cargo Containers for General Purposes; excluding dimensions and ratings. It should be noted that freight containers approved in accordance with the International Maritime Organization International Convention for Safe Containers are not necessarily equivalent to the testing prescribed by ISO 1496-1.

c) The freight container is designed such that if subjected to the tests prescribed in ISO 1496-1, as well as accelerations occurring during routine conditions of transport, there would be no loss or dispersal of the radioactive contents nor loss of shielding integrity which would result in more than a 20% increase in radiation levels on any external surface of the freight container. It should be noted that the test conditions of accelerations occurring during routine conditions of transport are in addition to the testing prescribed by ISO 1496-1 because the ISO Standard does not include dynamic tests.

d) The radioactive contents of the freight container are limited to solid materials. Additionally, radioactive contents that have not satisfied the requirements of § 173.411(b)(6) must not be transported in an IP-2 or IP-3 container.

Q2. What marking and labeling requirements apply to a freight container used as an IP-2 or IP-3 package? What marking and labeling requirements apply to internal containers?

A2. Freight containers used as an IP-2 or IP-3 package must be marked and labeled as such, in accordance with §§ 172.310 and 172.403. Inner containers are authorized provided they are specified in the IP-2 or IP-3 test and evaluation report. Inner containers must be marked in accordance with the specification specified in the test and evaluation report. For example, if the test and evaluation report specify the presence of inner IP-1 packages, the packages must be marked as such, in accordance with § 172.310. If the test report specifies inner containers (i.e. wooden boxes, bags, etc.) marking of the inner containers would not be required. Additionally, hazard communication markings and labels are not required for the inner containers.

Q3. May freight containers not meeting the IP-1 and ISO-1496-1 standards be used to transport loose bulk material if testing demonstrates the containers prevent the loss or dispersal of contents while subjected to the IS0-1496-1 test requirements?

A3. No. The freight container must meet all the requirements outlined in Answer 1.

Q4. Are the requirements in § 173.411(b)(6) intended to be used as an alternative means to certify packagings? If an IP-1 freight container is used an IP-2 or IP-3 package, how should the package be marked?

A4. The provisions of § 173.411(b)(6) are to be used as an alternative means of IP-2 and IP-3 packaging certification. Freight containers used as an IP-2 or IP-3 packaging must be marked accordingly.

I hope this answers your inquiry.

Sincerely,

John A. Gale
Chief, Standards Development
Office of Hazardous Materials Standards

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§ 173.411(b)(6)
Packages
07-0115

May 30, 2007

124 Jim Town Rd.
Jonesborough, TN 37659

Mr. John A. Gale
Chief, Standards Development
U.S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

Subj: Request for Clarification Document Ref. No. 06-0063

Dear Mr. Gale:

On June 16, 2006 you responded to questions posed by Mr. Kurt Colborn regarding the use of freight containers as Industrial Packages (IP) Type 2 or 3 containers under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180).

In your response (c) you stated, in part, that the test conditions of accelerations occurring during routine conditions of transport (49 CFR 173.410(f) General Design Requirements are in addition to the testing requirements prescribed by ISO 1496-1 because the ISO Standard does not include dynamic tests. The DOT acceleration test requirement in the regulations does not specify and/or provide a reference as to what constitutes acceptable testing.

For over the highway use a freight container is transported on a container chassis and as such meets the DOT definition of a containment system. Consequently, the requirement to perform acceleration tests during routine conditions of transport must be considered with a freight container mounted on a container chassis. Chassis built to American Bureau of Shipping requirements are designed to have sufficient structural strength to remain serviceable and withstand, without significant permanent deformation, the static and dynamic loads imposed by normal service in highway, railway, and shipboard service when loaded with a freight container to its GVWR of approximately 68,000 lbs. The twist locks that hold a maximally loaded (68,000 lbs. GVWR) freight container on the chassis must meet, in part, the design requirements to withstand a horizontal or longitudinal acceleration force of 3.5G where G represents the acceleration due to gravity. ISO 1496-1 includes as an appendix the Association of American Railroads Specification M-943-80 to assist manufacturers in the design of the chassis to meet this criterion. ISO 1496-1 also has under *Series 1 Freight Containers – Specification and Testing – Part 1: General Cargo Containers for General Purposes* under Section 6 *Testing* the requirements for testing and documenting that a freight container can withstand longitudinal external

restraint under dynamic conditions of railway operations, which implies an acceleration of 2 G. ISO 1496-1 also specifies the design and test requirements for the closure system on the freight containers during conditions of normal transport which is also part of the containment system.

The successful completion of the ISO 1496-1 test (Test No. 4) requires that the container shall, in part, show neither permanent deformation which will render it unsuitable for use nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchanges shall be satisfied. It should be noted that from a design standpoint that the maximum GVWR for the freight container on a chassis, when pulled by a tractor with a sleeper compartment (approximately 20,000 lbs.), is an estimated 60,000 lbs. or 10% lower than the rated design capacity and would yield an even higher G rating than discussed above.

Since the DOT requirements do not specify a required test does the containment system described above meet the requirements of 49 CFR 173.410(f) as well as 49 CFR 173.411(b)(6)? Can the requirements be satisfied by simply documenting the fact that a specified number of freight containers have been shipped on chassis under conditions of accelerations experienced during routine conditions of transport with no loss of containment? If neither of the above satisfies the referenced DOT requirements can the DOT provide references and/or guidance for the testing that does meet the specified requirements?

In your A2 response you state, in part, that freight containers used as IP-2 or IP-3 packages must be marked and labeled as such, in accordance with 49 CFR 172.310 and 172.403. 49 CFR 172.310 requires, in part, for non-Type B packages that weigh more than 50 kgs. that they be legibly and durably marked on the outside of the package in letters at least 13 mm high with the appropriate specified markings. Can the freight containers that meet the 49 CFR 411(b)(c) requirements also serve as the waste disposal package when shipping LSA and/or SCO material? If yes, should the freight containers used to ship the LSA or SCO materials be marked as TYPE IP-1, TYPE IP-2 or TYPE IP-3, as appropriate? Does the ISO 1496-1 requirement for the permanent attachment of the CSC Safety Approval Plate with the total gross mass (maximum allowable) of the package meet the requirement of 49 CFR 172.310(a) for indicating the gross mass of the package or must the total actual gross mass of the shipment be marked on the freight container? Is the subpart (c) requirement for the international vehicle registration code to be legibly marked on the freight container applicable? If yes, does the information on the CSC Safety Approval Plate meet this requirement? If not, where/how is the international vehicle registration code obtained for a freight container? Is it correct to assume that if the freight container is manufactured overseas then you would not mark the package with the USA label or marking? Would you mark the container with the country of origin e.g. China?

Are the Radioactive – LSA or Radioactive – SCO, a Class A Waste label and the appropriate IP label the only labels required if the freight container is the waste package and the requirements of 49 CFR 173.427 are met (the labeling/marking requirements of 49 CFR 172.310 and 172.403 do not apply)?

Is there a requirement for performing testing and an evaluation report for a freight container that contains LSA and/or SCO waste if the freight container is the waste package and is marked as LSA or SCO - Radioactive and there is no loose radioactive material in the conveyance, no leakage of the radioactive material from the conveyance, and the packaged and unpackaged waste in the freight container is braced so as to prevent shifting of lading under conditions normally incident to transportation? If there is no test requirement and all other requirements of 49 CFR 173.411 (b)(6) are met then can LSA-II/III or SCO-II/III material be shipped in the freight container without further testing e.g. the 49 CFR 173.468(b) requirement for a seven day immersion test? If the freight container is the LSA or SCO waste package are the marking requirements discussed in your A2 response abrogated?

Thank you for your assistance in clarifying the interpretation of this regulation.

Sincerely,

Philip Brandt

U.S. Department
of Transportation

**Pipeline and Hazardous
Materials Safety
Administration**

1200 New Jersey Avenue, SE
Washington, D.C. 20590

JUN - 6 2008

Ms. Ella McNeil, Acting Director
Office of Packaging and Transportation
Office of Safety and Operations
Office of Environmental Management
U. S. Department of Energy
Washington, DC 20585

Ref. No.: 08-0055

Dear Ms. McNeil:

This responds to your letter dated March 5, 2008, requesting clarification regarding the use of freight containers which are designed, tested, and fabricated to ISO 1496-1: "Series 1 Freight Containers – Specifications and Testing – Part 1: General Cargo Containers," as Industrial packagings (IP) Type 1 (IP-1), Type 2 (IP-2) and Type 3 (IP-3) containers under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180). Specifically, you request clarification on whether an offeror must comply with the use and documentation requirements of § 173.411(b)(6) and (c) of the HMR.

According to your letter, Department of Energy (DOE) utilizes freight containers for shipments of low-level radioactive materials destined for disposal. Many times the containers are transported to the disposal sites and buried with the radioactive contents. In accordance with the HMR, these freight containers can be used as IP-1, IP-2, and IP-3. The majority of these containers are designed and fabricated overseas. All of the designs and associated testing, analysis, and fabrication activities are independently reviewed and approved by competent authorities or designated authorized approval agencies (e.g., American Bureau of Shipping, Bureau Veritas, or Germanischer Lloyd). Much of the information required by § 173.411(c), is considered proprietary or confidential and is located in foreign countries. Thus, it is difficult, if not impossible, for an offeror to obtain the complete documentation that may be required.

Your questions are answered as follows:

Question 1:

Would an offeror be required to demonstrate that the requirements of § 173.410(b) have been met even though the freight container has passed all the required tests in ISO 1496-1?

Answer 1:

The answer is yes. An offeror would be required to demonstrate that the requirements of § 173.410(b) have been met, even though a freight container has passed all the required tests in ISO 1496-1. Section 173.411(b)(6)(ii) requires freight containers used as IP–2 or IP–3 to satisfy the requirements for an IP–1 as specified in § 173.411(b)(1). Section 173.411(b)(1) requires each IP–1 to meet the general design requirements prescribed in § 173.410. Section 173.410(b) requires each operable lifting attachment that is a structural part of the package to be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner. ISO 1496-1 and ISO 1161: "Series 1 freight containers – Corner fittings – Specification" do not specify such a design requirement, therefore the minimum safety factor of three against yielding for each operable lifting attachment is an additional HMR requirement for freight containers designed in accordance with ISO 1496-1 and ISO 1161. Alternatively, as prescribed in § 173.410(b), any other structural part of the package must be capable of being rendered inoperable for lifting the package during transport or must be designed with strength equivalent to that required for lifting attachments.

Question 2:

Is documented evidence, (e.g., production certificate), from an approved third party organization acceptable justification for DOT that a freight container is in compliance with ISO 1496-1, when this documented evidence verifies the freight container design has been tested to the same testing criteria found in the ISO 1496-1 standard?

Answer 2:

The answer is no. Documented evidence (e.g., a production certificate) from a third party organization does not provide acceptable justification that a freight container complies with ISO 1496-1, unless it provides complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with the standard. In accordance with § 173.411(c), except for IP–1 packagings, each offeror of an industrial package must maintain on file for at least one year after the latest shipment, and shall provide to the Associate Administrator for Hazardous Materials Safety upon request, complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that Standard. Freight containers designed to conform to ISO 1496-1, excluding dimensions and ratings, are permitted as a partial alternative to the tests required for IP-2 and IP-3 packages in § 173.411. In accordance with § 173.411(b)(6)(iii), the containers must conform to the standards prescribed in ISO 1496-1 and must also be designed such that if subjected to the tests prescribed in ISO 1496-1 and the accelerations occurring during routine conditions of transport they 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 freight containers. It should be noted that the test conditions of accelerations occurring during routine conditions of transport are in addition to the testing prescribed by ISO 1496-1, because the ISO Standard does not include dynamic tests.

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§ 173.411 (b)(6)
Industrial Packaging:
08-0055

Department of Energy
Washington, DC 20585

MAR 05 2008

Mr. Edward Mazzullo
Director of Hazmat Standards
US DOT/PHMSA, Suite 8422
Office of Hazardous Materials Safety
Pipeline and Hazardous Materials Safety Administration
U.S. Department of Transportation
East Building, E21-330, PHH-23
1200 New Jersey Avenue, S.E.
Washington, D.C. 20590-0001

Subject: Clarification on the Use of Freight Containers per 49 CFR 173.411(b)(6)

Dear Mr. Mazzullo:

This letter is to request clarification of the Department of Transportation (DOT) requirements for using freight containers, which are designed, tested, and fabricated to the ISO 1496-1 Standard, as Industrial Packagings Type 2 and 3. Specifically, we are requesting clarification as to the DOT expectations of an offeror to comply with the current regulations relative to the use and documentation required by 49 CFR 173.411(b)(6) and 49 CFR 173.411(c).

The Department of Energy (DOE) utilizes freight containers for shipments of low-level radioactive materials destined for disposal. Many times the containers are transported to the disposal sites and buried with the radioactive contents. In accordance with DOT regulations, these freight containers can be used as Industrial Packaging Types 1, 2, and 3 (IP-1, IP-2, and IP-3). As you are aware, the vast majority of these containers are designed and fabricated overseas. All of the designs and the associated testing, analysis, and fabrication activities are independently reviewed and approved by competent authorities or designated authorized approval agencies (e.g., American Bureau of Shipping, Bureau Veritas, or Germanischer Lloyd). Much of the information required by the regulations, especially by 49 CFR 173.411(c), is considered proprietary or confidential and is located in foreign countries. Thus, it is difficult, if not impossible, for an offeror to obtain complete documentation that may to be required.

To understand specifically what DOT expects of offerors, please provide clarification for the following questions. DOE is providing comments immediately following each question and additional information supporting each comment in the Enclosure for your reference.

Question 1:

To meet the requirements of 173.411(b) (6), freight containers must comply with the requirements of IP-1 containers including 173.410(b). 173.410(b) requires that each lifting attachment be designed with a minimum safety factor of three against yielding. Knowing that a freight container's corner fittings are designed and constructed to meet the ISO 1161 Standard, will an offeror be required to demonstrate that 173.410(b) is met even though the freight container has passed all the required tests in ISO 1496-1?

DOE considers the performance history of these containers as proof that when operated within the design envelop this requirement is satisfied. The standard is designed so that top and bottom corners will provide compatibility in the interchange between transportation modes with the loads that meet the ISO 1161 Standard.

Question 2:

49 CFR 173.411 (b) (3) allows freight containers designed to conform to the ISO 1496-1 Standard be used as IP-1, IP-2 and IP-3 containers for shipment of radioactive material. Is documented evidence (e.g., production certificate) from an approved third party organization acceptable justification for DOT that a freight container is in compliance with the ISO standard, when this documented evidence verifies the freight container design has been tested to the same testing criteria found in the standard?

DOE considers that documented evidence from an approved third party organization is acceptable to prove a freight container meets the ISO 1496-1 Standard as required by 49 CFR173.411 (b)(3).

Your clarification of these issues would be greatly appreciated by the Department. If you need additional information, please contact me at (202) 586-8548, or Mr. Ashok Kapoor of my staff at (202) 586-8307.

Sincerely,

Ella M. Neil

Ella Mc Neil, Acting Director
Office of Packaging and Transportation
Office of Safety Management
and Operations
Office of Environmental Management

Enclosure

cc : D. Chung, EM-60
A. Kapoor, EM-63

Enclosure

The following documentation represents background information for each question submitted. The documentation is based on research performed by, and experiences of, DOE contractors.

Question 1:
When a freight container is designed and tested to ISO1496-1 there are a number of other ISO standards incorporated by reference. One of these standards is ISO 1161, Series 1 Freight Containers – Corner Fittings – Specifications. This Standard was developed by technical and operational personnel drawing from all phases of the transportation industry. The standard is designed so that top and bottom corners will provide compatibility in the interchange between transportation modes. This ISO standard identifies the strength requirements that top and bottom corner fittings will be designed and constructed to and in such a manner and of such materials as to enable them to pass the operating and testing requirements laid down in ISO 1496-1 (Section 4, ISO 1161). From this we see that when a freight container is designed and tested to the ISO 1496-1 requirements, the lifting attachments, i.e. top and bottom corner fittings and fork lift pockets, will operate and function properly when handled within the design envelop. DOE believes the performance history of these containers prove that when operated within the design envelop this requirement is met. In support of this the IAEA Safety Guide TS-G-1.1, Para. 627.1, states that "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." This should be considered sufficient information for an offeror to show that this requirement is already met.

If DOT requires that this requirement be demonstrated it has the potential of reducing the operating design envelop of the freight container. Also if DOE chooses to use the container at its design envelop it may require DOE to have the containers designed and tested to parameters exceeding the ISO 1496-1 standard. This additional design and testing would cost the offeror thousands of dollars for this effort and if they choose to use the freight container at it's reduce design envelop would add an additional burden of using more containers than required.

Question 2:

All of the designs and the associated testing, analysis, and fabrication activities are independently reviewed and approved by competent authorities or a designated an approved third party organization (e.g., ABS, Bureau Veritas, or Germanischer Lloyd). These qualified organizations review and approve the various freight container designs at a minimum to the International Convention for Safe Containers (CSC) criteria. Many, if not most, approval agencies, require the criteria in the ISO 1496-1 Standard to be met in addition to the CSC criteria. When the CSC plate is affixed to a freight container it certifies the approval of the design, testing, and fabrication results by the competent

authorities or designated third party organization. These results are documented in the approval agency production certificates, test certificates, and container test reports. This third party approval process can be compared to the review, approval, and certification that Type B packages undergo. The ability to obtain these documents from an approval agency depends on the approval agency itself and its willingness to research and supply these documents to an end user. It also may depend upon the age of the freight container as the older the container the more difficult the process will be for obtaining documentation. An offeror has a better chance of obtaining these documents if they request the documents at the time the containers are initially procured. To date, DOE contractors do not procure freight containers certified by a specific approval agency (e.g., ABS) because of the risk of delaying procurement. Additionally, many approval agencies will not consider providing any documentation without the consent of the manufacturer, who most likely has no contractual relationship with the offeror unless; however a significantly large quantity of containers is being procured. DOE contractors usually procure from 1 to 10 containers at one time. Lastly, the value of obtaining detailed testing documentation (e.g., container test reports) is of no practical value to the offeror since the ISO-1496-1 Standard test conditions are not directly comparable to the impact on radioactive contents.

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APPENDIX K: Questions and Answers from a Discussion with the American Bureau of Shipping Certifications Group
May 2, 2007

Question:

1. Explain the entire freight container certification process. What is the relationship between International Maritime Organization (IMO)/International Convention of Safe Containers (CSC), United States Coast Guard (USCG)/Department of Homeland Security (DHS), and American Bureau of Shipping (ABS)?

Answer:

In the 1960s, there was a rapid increase in the use of freight containers for the consignment of goods by sea and the development of specialized container ships. In 1967, International Maritime Organization (IMO) undertook to study the safety of containerization in marine transport. The container itself emerged as the most important aspect to be considered.

The IMO, in cooperation with the Economic Commission for Europe, developed a draft convention and in 1972, the finalized Convention was adopted at a conference jointly convened by the United Nations and the IMO on December 2, 1972. The United Sates later adopted the requirements of the convention on January 3, 1978. These convention requirements included the articles of the convention, *Annex I Regulations for Testing and Inspection Approval and Maintenance of Containers,* and *Annex II Structural Safety Requirements and Tests*.

The 1972 International Convention for Safe Containers, known as Convention for Safe Containers (CSC), had two goals. One is to maintain a high level of safety of human life in the transport and handling of containers by providing generally acceptable test procedures and related strength requirements. The other is to facilitate the international transport of containers by providing uniform international safety regulations, equally applicable to all modes of surface transport. In this way proliferation of divergent national safety regulations can be avoided.

The requirements of the Convention apply to the great majority of freight containers used internationally, except those designed specifically for carriage by air. As it was not intended that all containers or reusable packing boxes should be affected, the scope of the Convention is limited to containers of a prescribed minimum size having corner fittings – devices which permit handling, securing, or stacking.

As noted earlier, the United States adopted the rules of the Convention in 1978 and designated the United States Coast Guard as the competent authority and established these requirements in 49 CFR parts 450-453.Subchapter 49 CFR parts 450-453, Subpart B—*Safety Approval of Cargo Containers*) establishes requirements and procedures for safety approval and periodic examination of cargo containers used in international transport, as defined in the International Safe Container Act. In these regulations it identifies that the Commandant of the United States Coast Guard is authorized to approve containers within the terms of the Convention, the International Safe Container Act and Subchapter 49

49 CFR parts 450-453. Section 450 Subpart B of these regulations identifies the procedures that allow the U.S. Coast Guard to delegate this approval authority to other organizations. The United States Coast Guard has designated the American Bureau of Shipping to approve freight containers for use in international transport. The American Bureau of Shipping has established a publication, *Rules for Certification of Cargo Containers*, dated 1998. This publication has captured all the requirements of the CSC and ISO 1496-1 as the basic requirements for the design, testing, and approval of freight containers.

Question:

2. It is our understanding that when a CSC plate is applied to a freight container it signifies that the container meets the requirements of Annex I and Annex II of International Convention for Safe Container approved in 1972 and adopted by the U.S. in 1978. Is this a correct understanding?

Answer:

Yes.

Question:

3. It is also our understanding that when a third party agency such as ABS has approved a freight container and their label is affixed to the freight container, that it meets the design and testing requirements identified in ISO 1496-1. Is this a correct understanding?

Answer:

The answer is yes for ABS provided that the ABS's round emblem (representing general service) is affixed to the container. For other approval authorities (e.g., Lloyds Registry, Bureau of Veritas), their rules for certification must be reviewed.

Question:

4. What is the acceptance criteria used for CSC approval?

Answer:

For new designs, the CSC approval means it meets the requirements of 49 CFR 451 Subpart B. For periodic re-examination of existing containers, the requirements of 49 CFR 452 must be met in order to continue to meet CSC requirements.

Question:

5. a. Are the suppliers of freight containers required to meet 49 CFR 178.2(c)(ii) to provide closer or handling instructions?

Answer:

No, this regulation is not applicable to freight containers because freight containers are not considered specification or United Nations (UN) performance packages.

Question:

b. Do any international rules or standards require these types of instructions to be provided to the user for freight containers?

Answer:

Not to ABS's knowledge.

Question:

6. For domestic use, what organization has the oversight responsibility for the use of and/or fabrication/modification of freight containers?

Answer:

No organization. 49 CFR 450-453 is for international shipments for which the USCG has authority. This authority is usually only applied at ports.

Question:

7. How did ABS get its authority to certify freight containers?

Answer:

ABS received their approval authority from the USCG per 49 CFR 450, Subpart B.

Question:

8. Where do other organizations (e.g., Lloyds Registry, Bureau of Veritas) obtain their approval authority?

Answer:

Any competent authority that is a part of the International Convention for Safe Containers is authorized to delegate approval authority. It should also be noted that any delegated approval authority (e.g., ABS, Lloyds Registry, Bureau of Veritas) can go to any member state to inspect and approve the design and fabrication of a freight container.

Question:

9. What is the role of the International Institute of Container Lessors (IICL)?

Answer:

This is an organization made up of container leasing companies that provides publications and training for anyone wanting to inspect and repair freight containers.

Question:

10. Many of the DOE contractors have read various specifications dealing with freight containers that reference ISO standards (e.g., ISO 668, ISO 830, ISO 1161, ISO 1496-1, and ISO 6346)

a. How do these standards become requirements?

Answer:

They are requirements when (1) they are referenced by regulations; and (2) when they are specifically identified in design specifications.

Question:

b. Also, in these same specifications it is identified that these freight containers meet marine, road, and rail. Where in the U.S. domestic regulations may we find these interfaces between rail and a freight container, marine and a freight container, highway and a freight container?

Answer:

In 49 CFR 450.3(a)(2)(ii).

Question:

11. What functions do the approval authorities perform in approving the design and fabrication of freight containers?

Answer:

The American Bureau of Shipping (ABS) has established the *Rules of Certification* for freight containers. When freight containers meet the design and testing requirements of the *Rules of Certification* they meet the requirements of the International Convention for Safe Containers (CSC) and ISO 1496-1. Chapter 2 of the *Rules of Certification* identifies what a manufacturer is required to submit to ABS when they want to manufacturer a new design series, additional units of an approved design, or make changes to an existing design. These required documents are identified in Table K-1 below. When final approval is given they also meet the requirements for vessel, rail and highway transport.

Table K-1. Documents required for Design Review

New Design Series*	Approved Design Series*	Changes to existing Designs*
For the application of each new design series to be certified, plans and data including at least the following are to be submitted to ABS.	For the application of additional units to be certified to an approved design series, the submittal is to include at least the following information.	When changes are being made to an application or to an approved design series, the submittal is to include at least the following information.
Application Form	Container Data Form	Container Data Form
Container Data Form	Data Form Supplement for Thermal Containers if applicable	Data Form Supplement for Thermal Containers if applicable
Data Form Supplement for Thermal Containers if applicable	Data Form Supplement for Tank Containers if applicable	Data Form Supplement for Tank Containers if applicable
Data Form Supplement for Tank Containers if applicable	Following Drawings ▪ Marking drawing – If owner has changed	Material identification form
Material identification form		Design Comparison Table
Following drawings ▪ General arrangement ▪ Sub-assemblies ▪ Detail of components ▪ Markings, including data plates		Following Drawings ▪ Marking drawing – If owner has changed ▪ General Assembly ▪ Subassembly ▪ Detail drawing as appropriate showing any revision from original design
Prototype Test Agenda		All changes will be reviewed and if the modifications are deemed significant retesting of those parts of the container affected by the modification may be required.
Quality Control Procedures – Required for each facility		
When the application includes a request for certification to governmental requirements, international conventions, or other standards, the submittal is to include the necessary information required for the reviews.		

*Information in Table K-1 was extracted from the ABS Rules of Certification 1998

The ABS upon receipt of the documents identified under, "New Design Series" will perform a through design review of drawings, calculations, test agenda, and quality control procedures. Upon the completion of this design review, which will be based primarily upon the container meeting the design considerations in Section 6, the performance tests in Section 7, and when applicable other requirements identified in Sections 9 and 10 of the *Rules of Certification*.

During the manufacturing of the prototype the authorized ABS surveyor follows the production of the freight container and verifies that the quality procedures are in place, verifies receipt of material that will be used, approved methods of manufacturing are used, and upon completion of the prototype the authorized ABS surveyor witness and ensures that all test identified in the approved test plan are performed correctly.

Certification of the production units will be based upon the satisfactory conclusion of the container plan review, prototype approval, the production tests required by Section 7 of the *Rules of Certification*, the

acceptance of the manufacturer's quality control procedures, and the survey of each container. Also, noted that additional requirements may be required when Sections 9 and 10 of the *Rules of Certification* are required.

When a container is accepted for general service a decal is applied to the freight container signifying that the container is in compliance with the *Rules of Certification*. Also, noted the manufacturer is allowed to apply the CSC plate as required by the International Convention of Safe Containers upon meeting the requirements of the Rules of Certification. The CSC plate is marked with the ABS Approval Reference, e.g., "USA/AB-NNN/YY-NN," as required by the delegation of authority from the U.S. Coast Guard. The ABS CSC Approval Reference validates the CSC plate and provides traceability to the plan review, testing, and certification for a particular container model from a specific manufacturer.

Figure K-1. ABS Logo Applied when meeting the Rules of Certification

Question:

12. Per 49 CFR 173.411(b)(6), when we purchase new (or used one-time) freight containers to meet ISO 1496-1, the DOE sites (as shippers) have to ensure and document that "the containers are designed such that if subjected to the tests prescribed in ISO 1496-1 and the accelerations occurring during routine conditions of transport." That documentation must be maintained per 49 CFR 173.411(c). What type of documentation should a DOE sites /buyer/shipper normally expect, or ask for, from a supplier to ensure compliance 49 CFR 173.411(c)?

Answer:

Based on discussions with the ABS, the most readily available documentation is the production certificate. As a result of the comprehensive approval process that was identified in Question 11 above; there is no need to request full testing documentation.

Question:

13. Will test results be available that indicate specifics (e.g., dimensions) about damaged areas as resulted from the testing performed? For a shipper to meet the requirements of 49 CFR 173.411(b)(6)(iii)(B), all effects to a container as a result of testing must be identified and supplied.

Answer:

Test results will not be available that detail this type of specificity because the approval authorities would not approve designs that resulted in permanent deformations that are outside allowable tolerances of the ISO standard.

Question:

14. If a freight container is purchased to meet ISO 1496-1 and the five-year certification plate expires before you can ship it, what type of inspection program does a site need to have to maintain the certification/ISO standard criteria?

Answer:

The inspection program shall ensure the container meet the CSC requirements that found in 49 CFR 452, *Examination of Containers*. Those performing the inspection need to have the appropriate trained and experience per 49 CFR 452.3(a)(3) plus CSC Circular 134, *Guidance on serious structural deficiencies in containers*.

Question:

15. Can a site maintain the certification?

Answer:

Yes, a site can maintain the certification if they have individuals that are trained and certified to perform the inspections.

Question:

16. If a freight container is purchased by a site and it is (let's say) 10-years old, once was certified to ISO 1496-1, and is still in good condition, can it be re-instated to comply with the ISO 1496-1 standard such that the shipper could use it as an IP-2 or IP-3 container per 49 CFR 173.411?

Answer:

The ISO 1496-1 standard is applicable to new construction only and has no periodic inspection requirements. The container would be inspected to CSC criteria and once approved; the CSC plate would be stamped with the appropriate date.

Question:

17. To use a freight container as an IP-2/IP-3, is the original data (CSC) plate required to be attached or can a supplier provide a COC that states the container meets ISO 1496-1 design?

Answer:

Just because a container has a CSC plate, it does not mean that the container was designed and fabricated to the ISO 1496-1 standard. In order to show the container meets the ISO 1496-1 requirements, you will need a production certificate.

Question:

18. Since the design of a freight container is not owned by a DOE site/shipper, what sort of modifications, additions, or repairs (e.g., bolting or welding hardware/walls to inside of container) can be made to a freight container without invalidating the ISO 1496-1 credentials?

Answer:

As identified in Regulation 11 of Annex I of the CSC, any modifications that result in structural changes would invalidate the ability of the container to meet ISO 1496-1 requirements.

Question:

19. For maintenance/repair work, are there acceptable standards for repair?

Answer:

There are documents that are published for the repair of freight containers (e.g., IICL publications, MIL-HDBK-138B); however, repairs that result in a structural change must be reviewed and approved by the approval authority (e.g., ABS).

Question:

20. Would a repaired container need to be recertified? If so, who would recertify and what qualifications would they need to possess?

Answer:

The container will need to be re-inspected per 49 CFR 452.

Question:

21. For IP-2/IP-3 containers procured to meet ISO 1496-1, is the certification voided if a site modifies the container by:

    a. Closing the original vents and installing a filter(s) (e.g., Nuc Filters)?

Answer:

There is no affect on the certification.

Question:

b. Installing interior tie-down rings or similar hardware?

Answer:

Maybe, depending on the effect on the structure integrity. This could cause the approval authority (e.g., ABS) to request retesting.

Question:

c. What international standard (if any) do commercial shippers use to secure packagings and other payloads interior to the ISO freight container? Are inflatable air bags used much?

Answer:

The *IMO/ILO Guidelines for Packing Cargo in Freight Containers or Vehicles* that have been so widely used for many years by those who pack cargo for transport have now been superseded. The new publication, *IMO/ILO/UN ECE Guidelines for Packing of Cargo Transport Units (CTUs)*, 1997 Edition, is based on the previous Guidelines (1994 edition) but has been revised so that it is applicable to transport by all surface and water modes and the whole intermodal transport chain. Its content has been endorsed by IMO and ILO and by the United Nations Economic Commission for Europe (UN ECE).
(For French and Spanish editions - see IMDG Code Supplement).

See IMO homepage for guidance: www.imo.org.

Question:

d. Installing grout ports to allow grouting prior to burial?

Answer:

There is no effect on the certification.

Question:

e. Can a DOE site add blocking and bracing devices to the inside of the freight container and if so would it affect the certification?

Answer:

Yes, so long as you don't modify the container, it does not affect the certification.

Question:

f. Do the tie downs provided have to be used or what can be added?

Answer:

It would be preferable to use existing tie-downs as adding tie-downs could result a modification to the structure of the container.

Question:

g. MIL-HDBK-138 changed the requirements for the re-inspection date to be marked on the CSC plate from revision A to revision B. Is the first re-inspection date required or can it be assumed to be 5 years from the date on the plate? Why was this changed?

Answer:

In reviewing the requirements of both MIL-HDBK-138A and MIL-HDBK138B dealing with the marking of the re-inspection date, both handbooks 138A and 138B in sections 4.5.4 indicates that the re-inspection date may be identified on the CSC plate. In Handbook 138A Figure 4.5D shows the area where the DD form 2282 Decal may be placed but is left blank, whereas, Handbook 138B Figure 4.5D shows the area where the DD form 2282 Decal is placed and actually shows one in the illustration. In section 6.4.2 (a) of Handbook 138B, it clearly states that the, "decal is not required on a new container since the first re-inspection date is already inscribed on the CSC plate. The first CSC re-inspection due date assigned to a newly manufactured container provides a maximum interval of 5 years." This clarification was not in 138A. As to why was this changed is because the first re-inspection date is already inscribed on the CSC plate.

Question:

22. Some DOE sites will purchase a used freight container that has an expired CSC plate and may be in excess of 8-10 years old. Can a DOE site move this freight container on public roadways with an expired CSC plate?

Answer:

Yes, if it is inspected to meet CSC requirements or use site specific procedures to meet normal conditions of transport.

Question:

23. If a DOE site wishes to bring this used freight container back into compliance with a CSC plate and meet ISO 1496-1 requirements what must they do?

Answer:

In order to meet the CSC and ISO 1496-1 requirements, it must be inspected in accordance 49 CFR 452.

APPENDIX L: Suggested Modifications That Can be made to a Freight Container

Freight Container Suggested Modifications

Standard freight containers are designed for carriage and handling of pre-packaged freight and as such, confine the cargo and keep weather out. The freight container units are robust welded units with forklift loading access and standardized ISO corner to enable easy handling and freight container securement to transport vehicles. Freight containers are manufactured under the oversight of Government approved third party certifiers to ensure the quality and performance of each manufactured unit (See Appendix C). The construction quality, large usable volume and relatively low cost make freight containers good candidates for RAM packaging. The freight container modifications discussed in this section will should enable the units to meet containment requirements for dispersible RAM. The modifications will result in increase unit costs, however units fabricated to date have been reasonable and the cost per unit volume of modified freight containers is still among the lowest of any RAM packaging.

The regulations for RAM packaging ensure the containers provide assured containment and radiation shielding to minimize ionizing radiation exposure to the general public. This requires the Freight Container door systems, floor and overall structure to be "particle tight" and requires the RAM content to be shielded and/or secured so as not to change position during transport. The modifications discussed in the following sections are meant to ensure that freight container door sealing systems, wooden floors, wall to side rail welds, and wall vents will meet the RAM packaging containment and shielding requirements.

Door Sealing Systems

The freight container door seals are required to provide containment under the static loads imposed by the ISO 1496-1 tests as well as routine transport condition vibrations and accelerations. The loads, vibrations and accelerations result in movement/twisting of the door system, which can result in a loss of seal compression, particle migration, and particle leakage. There are a number of approaches that have been used to render the door systems particle tight, including use of 1) caulk, tape, plastic films or coatings/mastic, 2) additional gasket material, and 3) bulk heads that provide an independent back up seal. Qualification of any approach requires testing and/or evaluation under the ISO 1496-1 loads and routine transport conditions to show that the systems remain tight after being subject to flexing and movement.

The use of caulk, tape, plastic films, coatings, or mastics with high adhesion to overlap the door seals is straightforward and readily implemented;, however, assurance is needed that the materials are flexible enough and will adhere under transport conditions. This approach is practical for one-time, one-way disposal shipments since high adhesion materials can be difficult to remove once applied to the door system (see Fig L-1). This approach should have no affect on the freight container structure and its ISO 1496-1 pedigree.

Figure L-1. Flexible membrane material sealed over outside of door joints.

Use of additional gasket material can be accomplished with minor modifications to the door systems to accommodate larger gaskets, lower durometer gasket materials, or additional gasket material. Standard freight container door seal gaskets are of a relatively high durometer material and thus are relatively stiff or hard. This allows them to stand up to re-use, however non-flexible gasket materials are more prone to leakage if subject to deformation or movement in the door system. Replacement with larger area, lower durometer gaskets may greatly improve rear door sealing.

Headers may be used to provide secondary back up seals. For example, a header may be installed along the doorsill that incorporates a low durometer (soft) gasket that compress when the doors are closed against the header (see Figure L-2). This back-up gasket provides additional resistance to particle leakage along the bottom of the doors and the T-joint where the two doors and sill come together. Installation/removal of the header may be required during loading/unloading operations or a ramp used to go over the header.

Supplemental gasket material may be added to the perimeter of the doors or to the interior sealing surfaces of the freight container body. Low durometer gasket material can be added to the door seals and/or the corner posts, doorsill and header. The additional material can make door closure difficult. Any new or modified gasket material or configuration needs to be evaluated to show that it will remain functional under the ISO 1496-1 loads, tests, and routine transportation conditions. Use of modified gaskets or additional gasket materials should have no affect on the freight container structure and its ISO 1496-1 pedigree.

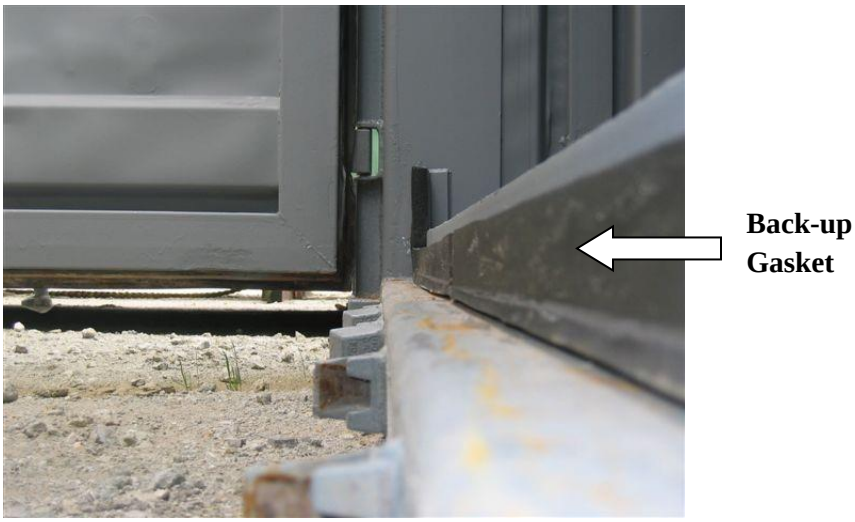


Figure L-2. Additional gasket above doorsill

Adding an additional sealing membrane or bulkhead to a freight container door closure system is a more extensive modification, however it should provide an effective particle tight door closure system. A bulkhead is an additional closure covering the entire door opening with a full perimeter gasket interior to the freight container doors. As such, the bulkhead backs up the freight container door and providing second seal. Bulkheads have been designed and used within the DOE to provide gasket compression by closure of the freight container doors (e.g., sandwich bulk head between doors and inner seal) or by bolting (see Figures L-3 & L-4). The gasket surface for a bulkhead can be added to the interior of the freight container by attachment to the corner posts, doorsill and header. Sufficient clearance and flexibility is required in the bulkhead system to accommodate the racking and transportation induced strains. Welding to the freight container structural members can impact the ability of the container to remain ISO 1496-1 compliant, so an evaluation of ISO 1496-1 compliance should be carried out for bulkhead designs. Since the bulkhead systems should strengthen the overall freight container door region, compliance with ISO 1496-1 should be maintained.

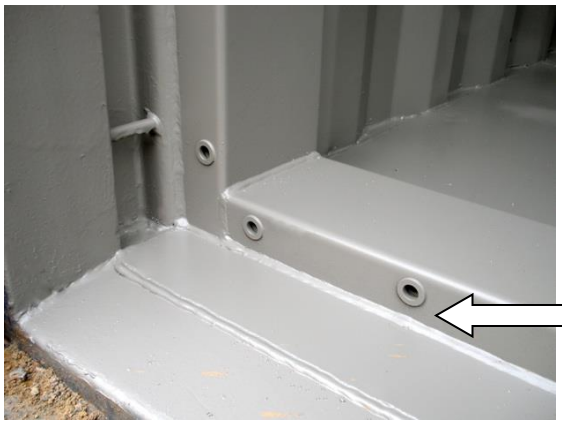
Slip-in Bulk head Provides back-up seal

Additional Gasket Surface for Bulk head

Figure L-3. Bulkhead that sandwiches between outer doors and inner seal

Bolted Bulkhead

Bulk head inserted with forklift



New Seal Surface added to interior of Freight Container. Bulkhead bolts to this sealing surface.

Figure L-4. Bulkhead with bolted closure

Wooden Floors and Wall to Side Rail Joint

If the particle tightness of wooden floor freight containers is a concern the floors can be lined with steel - welded to the side and end rails, coatings can be applied to the floor, or plastic/poly liners can be used. Many DOE sites utilize steel floors due to their robust nature, ease of decontamination and ability to withstand forklift loading and unloading operations without damage. Coatings, such as "rhino-liner[3]" are lightweight and easy to apply, but are not as tough and durable as steel flooring. Liners can be manufactured to custom fit the interior of the freight container but are susceptible to damage during loading operations unless protected. The partial tightness of the wall to rail joint should be addressed along with the floor. This joint is welded and should be particle tight as manufactured, but verification is recommended. Use of a spray coating along the wall to rail joint (top and/or bottom) can insure a leak tight joint. The particle tightness of flooring systems can be verified by leak testing methods utilizing standing water or smoke. Soap bubble testing is difficult to carry out due to the significant number of joints in the undercarriage of the freight container. Welding involving structural freight container

[3] Commercially procured material

members (e.g., side rails, corner posts, sills, headers) can impact the mechanical properties of the members and the ability of the container to remain ISO 1496-1 compliant, so an evaluation should be considered.

Wall Vents

Ventilation ports on the Freight Container walls are utilized to maintain pressure equilibrium between inside and outside air pressure. The vents as configured can provide a leakage path for airborne radioactive materials carried within the container. The vents should be covered or cut out and replaced with similar gage sheet metal containing a port for a particulate filter. The particulate filters will prevent pressure differentials from developing during transportation and will ensure that radioactive material does not escape. Due to the small side or end wall area required for the vents, the ability of the container to remain ISO-1496-1 compliant should not be compromised by modifying the vents.

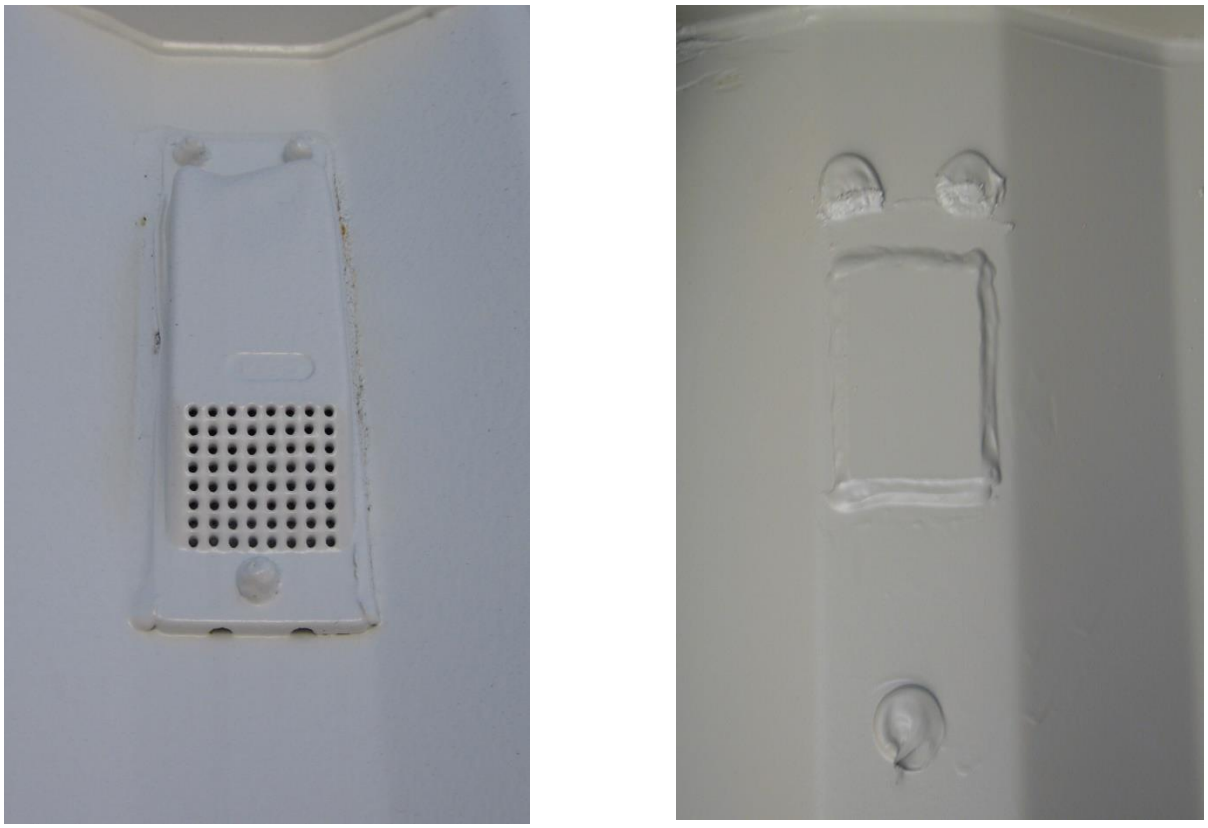


Figure L-5. Freight container vent on exterior wall (left photo). Right photo shows vent with a welded plate over the opening and sealed from the inside by welding and caulking fasteners.

APPENDIX M: A Matrix Showing How Third Party Certifiers Certification

Requirements Meet the Testing Requirements of ISO 1496-1-1990

ISO 1496-1-1990[A] Testing Requirements	International Convention for Safe Containers, 1972 (CSC)[B]	[C]ABS – Rules of Certification of Cargo Containers	[D] Germanischer Lloyd Rules for Classification and Construction	[E] Lloyd's Register EMEA Container Certification Scheme
Section 4, Dimensions and Ratings		7.11.1 – Dimensional Check	Chapter 4, Section 1 – C, Dimensions, Weights, Tolerances	Appendix 3, Section 1, Test 1 – Dimensional Check
Section 6.2 Test No. 1 – Stacking	2, Stacking	7.11.2 – Stacking	Chapter 4, Section 2.1, Test No. – 1, Stacking	Appendix 3, Section 1, Test 2 and 2A – Stacking
Section 6.3 Test No. 2 – Lifting From the Four Top Conner Fittings	1A, Lifting From Corner Fittings (i) Lifting from the top Corner fittings	7.11.3 – Lifting From the Top Corner Fittings	Chapter 4, Section 2.2, Test No. 2 – Lifting from the top corner fittings	Appendix 3, Section 1, Test 3 and 3A – Top Lift
Section 6.4 Test No. 3 – Lifting From the Four Bottom Conner Fittings	1A, Lifting From Corner Fittings (ii) Lifting from the bottom Corner fittings	7.11.4 – Lifting From The Bottom Corner Fittings	Chapter 4, Section 2.3, Test No. 3 – Lifting from the bottom corner fittings	Appendix 3, Section 1, Test 4 – Bottom Lift
Section 6.5 Test No. 4 – Restraint (Longitudinal)	5, Longitudinal Restraint (Static Test)	7.11.9 – Restraint	Chapter 4, Section 2.4 Test No. 4 – Restraint (Longitudinal)	Appendix 3, Section 1, Test 8 – Restraint
Section 6.6 Test No. 5 – Strength of Side Walls	7, Side Walls	7.11.11 – Side Panel Strength	Chapter 4, Section 2.6 Test No. 6 – Loading the side walls	Appendix 3, Section 1, Test 10 – Side Wall Strength
Section 6.7 Test No. 6 – Strength of End Walls	6, End Walls	7.11.10 – End Panel Strength	Chapter 4, Section 2.5 Test No. 5 – Loading End Walls	Appendix 3, Section 1, Test 9 – End Wall Strength
Section 6.8 Test no. 7 – Strength of The Roof (where provided)	3 Concentrated Loads, a – on Roof	7.11.12 – Roof Strength	Chapter 4, Section 2.7 Test No. 7 – Loading the roof	Appendix 3, Section 1, Test 11 – Roof Strength
Section 6.9 Test No. 8 – Floor Strength	3, Concentrated Loads, b – On Floor	7.11.8 – Floor Strength (Concentrated)	Chapter 4, Section 2.8 Test No. 8 – Loading the floor	Appendix 3, Section 1, Test 7 – Floor Strength
Section 6.10 Test No. 9 – Rigidity (Transverse)	4, Transverse Racking	7.11.13 – Transverse Racking	Chapter 4, Section 2.9 Test No. 9 – End Wall Rigidity (Transverse Rigidity)	Appendix 3, Section 1, Test 12 &13 – Transverse Rigidity (racking)
Section 6.11 Test No. 10 – Rigidity (longitudinal)		7.11.14 – Longitudinal Racking	Chapter 4, Section 2.10 Test No. 10 – Side Wall Rigidity (Longitudinal Rigidity)	Appendix 3, Section 1, Test 14 – Longitudinal rigidity (racking)
Section 6.12 Test No. 11 – Lifting From Fork-Lift pockets (Where Fitted)	1B, Lifting By Other Additional Methods (i) Lifting From Fork Lift Pockets	7.11.5 – Lifting From Fork-lift Pockets For Loaded Containers (where provided) 7.11.6 – Lifting From Fork-lift Pockets For Unloaded Containers (where provided)	Chapter 4, Section 2.11 Test No. 11 – Lifting by means of a for lift truck	Appendix 3, Section 1, Test 5 – Fork lift pockets, loaded condition Appendix 3, Section 1, Test 6 – Fork lift pockets, unloaded condition
Section 6.13 Test No. 12 – Lifting From The Base at Grappler Arm Positions (where fitted)	1B, Lifting By Other Additional Methods (ii) Lifting From Grappler Arm Positions	7.11.7 – Lifting From Grappler Arm Positions (where provided)	Chapter 4, Section 2.12 Test No. 12 – Lifting by means of grappler arms	Appendix 3, Section 1, Test 4 – Bottom Lift (Grappler)
Section 6.14 Test No. 13 – Weatherproofness		7.11.16 – Weathertightness	Chapter 4, Section 2.13 Test No. 13 – Weatherproofness	Appendix 3, Section 1, Test 15 – Weathertightness

A - ISO 1496-1-1990, Series 1 freight containers - Specification and testing -Part 1: General cargo containers for general purposes
B – Admiralty and Maritime Law Guide International Conventions, International Convention for Safe Containers, Geneva December 1972.
C – American Bureau of Shipping, Rules of Certification of Cargo Containers
D – Germanischer Lloyd, Rules for Classification and Construction
E – Lloyd's Register EMEA Container Certification Scheme

ISO 1496-1-1990[A] Testing Requirements	**[F]DET Norske Veritas Rules of Certification of Freight Containers**	**[G]Bureau of Veritas Rules for the classification and Certification of Freight Containers**
Section 4, Dimensions and Ratings	Section 2, Part C – 300, Dimensional Checking	Chapter 4, Testing Section 4.2.2, Dimensional Measurements
Section 6.2 Test No. 1 – Stacking	Section 2, Part C – 500, Stacking	Chapter 4, Testing Section 4.5.1, Stacking
Section 6.3 Test No. 2 – Lifting From the Four Top Conner Fittings	Section 2, Part C – 600, Top Lifting Test	Chapter 4, Testing Section 4.5.2, Lifting From the Top Corner Fittings
Section 6.4 Test No. 3 – Lifting From the Four Bottom Conner Fittings	Section 2, Part C – 700, Bottom Lifting Test	Chapter 4, Testing Section 4.5.3, Lifting From the Bottom Corner Fittings
Section 6.5 Test No. 4 – Restraint (Longitudinal)	Section 2, Part C – 800, Longitudinal Restraint Test	Chapter 4, Testing Section 4.5.6, Longitudinal Restraint
Section 6.6 Test No. 5 – Strength of Side Walls	Section 2, Part C – 1000, Side Wall Test	Chapter 4, Testing Section 4.5.8, Side Walls Strength
Section 6.7 Test No. 6 – Strength of End Walls	Section 2, Part C – 900, End Wall Test	Chapter 4, Testing Section 4.5.7, End Walls Strength
Section 6.8 Test no. 7 – Strength of The Roof (where provided)	Section 2, Part C – 1100, Roof Panel Test	Chapter 4, Testing Section 4.5.12, Roof Strength
Section 6.9 Test No. 8 – Floor Strength	Section 2, Part C – 1200, Floor Strength Test	Chapter 4, Testing Section 4.5.11, Floor Strength
Section 6.10 Test No. 9 – Rigidity (Transverse)	Section 2, Part C – 1300, Transverse Racking Test	Chapter 4, Testing Section 4.5.9, Transverse Racking
Section 6.11 Test No. 10 – Rigidity (longitudinal)	Section 2, Part C – 1400, Longitudinal Racking Test	Chapter 4, Testing Section 4.5.10, Longitudinal Racking
Section 6.12 Test No. 11 – Lifting From Fork-Lift pockets (Where Fitted)	Section 2, Part C – 1500, Lifting From Fork Lift Pockets	Chapter 4, Testing Section 4.5.4, Lifting From Fork-Lift Pockets (where Fitted)
Section 6.13 Test No. 12 – Lifting From The Base at Grappler Arm Positions (where fitted)	Section 2, Part C – 1600, Lifting From Side Grappler Lift Positions	Chapter 4, Testing Section 4.5.5, Lifting By Grappler Arm (where Fitted)
Section 6.14 Test No. 13 – Weatherproofness	Section 2, Part C – 400, Weathewrtightness	Chapter 4, Testing Section 4.5.13, Weatherproofness

A - ISO 1496-1-1990, Series 1 freight containers - Specification and testing -Part 1: General cargo containers for general purposes
F – Det Norske Veritas – Rules of Certification of Freight Containers
G – Bureau of Veritas, Rules for the Classification and Certification of Freight Containers

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APPENDIX N: DOT IP Modified Height ISO Freight Container

TABLE OF CONTENTS

1.0 SCOPE

1.1 General Description of the Item

ISO Series 1 Freight Container modified in height and other features as described in this specification.

1.2 Background

- When placed into service packagings modified and completed to this specification will provide for compliance with 49 CFR 173.411 Industrial Packaging Type 1 (IP-1) requirements.
- This specification addresses design modifications, fabrication, assembly, test, inspection, quality assurance program, documentation, and delivery requirements. Per this specification, containers originally designed and produced to ISO specifications for the purpose of hauling general freight are to be modified for general use as DOT Type IP-1 packaging.
- The pre-modified container may be new/like new or used with years of service so long as the essential structure and components will contribute to meeting the 49 CFR and specification requirements imposed herein.

Note: This specification provides for multiple heights and lengths of modified containers. For any given order, specific height and length dimensions from this document are to be identified by the shipper/offeror in the ordering document (i.e., PO).

2.0 REFERENCES

2.1 Definitions

Buyer – Procurement entity responsible for contract management

EDR – Engineering Document Requirements

EDSL – Engineering Document Summary List

QVDR – Quality Verification Document Requirements

PO – Purchase Order document issued by the Buyer

RE – Responsible Engineer, individual or organization (technical and quality assurance point-of-contact)

SDDR – Supplier Deviation Disposition Request

2.2 Codes / Standards / Orders / Regulations

2.2.1 Title 49 CFR Chapter I, Subchapter C, Hazardous Materials Regulations

- Part 172, Subpart H - Training
- 172.310, [Marking] Class 7 (radioactive) materials
- 173.411, Industrial Packagings

2.2.2 Material Standards

A. ASTM A 36/A 36M – 08, Standard Specification for Carbon Structural Steel.

B. ASTM A 500/A 500M – 07, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

C. ASTM A 1011/A 1011M -08, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

Note: Prior or subsequent editions or amendments to those listed above may be used provided the material has equivalent or higher yield strength and equal or better physical properties for its design application (e.g., weld able with RE approved procedures, ductility under stress, etc.) and proven performance (i.e., able to withstand applied loads). This is to be validated by the supplier prior to use and will be verified at the shipper/offeror upon delivery of material test reports and prior to final acceptance of hardware.

2.2.3 Welding Codes

A. AWS D1.1/D1.1M:2008, Structural Welding Code – Steel

B. AWS D1.3/D1.3M:2008, Structural Welding Code – Sheet Steel

C. 2007 ASME BPVC, Section IX, Welding and Brazing Qualifications

2.2.4 ASME NQA-1-2000, Quality Assurance Requirements for Nuclear Facility Applications

2.2.5 ISO 1161:1984, Series 1 freight containers – Corner fittings - Specification

2.2.6 SSPC-SP 1 Editorial Rev. 11/1/04, Solvent Cleaning

2.2.7 SSPC-SP10/NACE No. 2:2007, Near-Whit Metal Blast Cleaning

2.2.8 SSPC-SP 11, Power Tool Cleaning to Bare Metal, 11/1/87; Editorial Changes 11/1/2004.

2.3 Applicable Documents

SDDR Form (attached to the PO)

3.0 ITEM REQUIREMENTS

3.1 Performance Requirements

3.1.1 When placed into service, each modified, Type IP-1 container must maintain contents:

- By complying with technical requirements of this specification for design and construction; and
- Consistent with proof of integrity verified through inspection and testing required by this specification.

3.1.2 When placed into service, each container, including its components, must perform as designed and justified through analysis in a manner that promotes DOT compliance and operational/industrial safety during handling, lifting, opening, closing and transport activities.

3.2 Design Requirements

3.2.1 Design Features & Technical Requirements

Item	Description	Requirement
1.	Original Equipment	1. Use equipment, originally classified and designated as an ISO Series 1 freight container, as a base unit for the modifications provided for in this specification. 2. New, like new, or used containers may be used as long as the post-modification remaining material, components, and structure are suitable for their intended function in compliance to this specification. 3. When applicable for the design, standalone ISO Series 1 freight container base platforms may be used in lieu of a complete container.
2.	Length	Container is to be one of the ISO standard nominal lengths listed below. Required length(s) for a given order is to be as specified on the PO: a. 45 ft c. 30 ft e. 10 ft b. 40 ft d. 20 ft
3.	Height	1. Container is to be one of the classified heights listed below as specified on a given PO: a. 6'-0" b. 4'-0" c. 2'-0" 2. All height dimensions are internal clearance as measured from the finished floor to the underneath side of the lid assembly. The lid assembly includes any cross members used to provide lid or sidewall support. 3. Tolerance for all height dimensions are +2/-0 in.
4.	Longitudinal / Lateral Clearance	1. Container design is to provide for maximum allowable side-to-side and end-to-end internal clearance at the top opening. 2. Side-to-side clearance is to be no less than the nominal external width minus 1'-0" (except for cross-member mounting brackets). 3. End-to-end clearance is to be no less than the nominal external length minus 2'-6" on a 20' or less container. For 30' or longer containers, the clearance is to be no less than 4'-0".
5.	Floor System	1. Existing wood floor is to be fully covered with steel plating (thickness adequate to support maximum allowable payload) unless otherwise specified on a given PO. 2. Steel plating is to be fully seal welded (liquid leak tight) at all joints and to the container structure at the perimeter (i.e., no exposed wood on the container interior).

6.	(No) Side or End Access	1. Remove any existing side or end access doors and associated hardware. 2. Replace access doors with steel plating and support structure as required. Fully seal weld (liquid leak tight) all plate joints and plate to existing container frame/structure connections.
7.	Removable Lid	1. Lid design is to accommodate multiple removal/ replacements. Lid system design, including cross members if used, is to minimize side-wall flexing when lid is removed. 2. Lid design is to minimize lid bowing when lifting lid by fork channels as well as lifting rings. 3. Top perimeter cross-bracing designed to support side-walls and/or lid sections is to be readily removable/replaceable using standard hand tools such as wrenches, hammers, and drift pins.
8.	Internal Tie-downs	1. The original equipment, i.e. container, is to include internal tie-down lashing rings. Any rings removed for purpose of modification are to be replaced on the lower and upper perimeter as close as possible to their original locations and joined to the structure equal to or greater than the original design. 2. Designs utilizing base platforms only are to include internal tie-down rings sized, located and joined to the structure in a manner consistent with completed containers of the same length. 3. Additional tie-down/restraining hardware may be required and if so, will be specified on a given PO.
9.	Lifting/Handling	1. Container base is to have fork pockets sized and reinforced to manipulate the container when empty. Minimum fork pocket vertical clearance is to be 4.5-inches. 2. ISO 1161 corner blocks are to remain on the container bottom (platform) and placed/replaced on the container top. The corner blocks are to be joined to the structure consistent with the original design and adequate for the handling/lifting strength requirements given below. 3. ISO 1161 corner block/container joined-to-structure design is to facilitate the lifting configurations provided in Attachment 1 for a fully loaded (maximum allowable gross weight) container. The design shall comply with the 49 CFR 173.410(b) safety-factor of 3 against yield. 4. 45 ft. container lifting is to be restricted to the corner blocks located at the 40 ft. spacing. 5. Lid/lid sections are to be removable by use of fork channels as well as lifting rings. Spacing of lid fork channels is to equal to spacing (center-to-center) of container base fork pockets.

10.	Payload	Container design, i.e. floor loading, corner block joining, lifting, etc. is to accommodate a minimum payload of 40,000 lbs. Payload is to be considered as equally distributed throughout the container unless otherwise noted on a given PO.
11.	Compressive Strength	Container design should maintain a compressive strength (i.e., stacking with units of equal length and allowable gross weight) equal to the ISO requirements for Series 1 freight containers. However, the compressive strength is never to be less than 5 times the maximum allowable gross weight of any container delivered to the shiper/offeror.
12.	Closure System	1. Lid-to-base closure system is to provide a complete seal and containment of the container internal area. 2. The design is to facilitate a placement of lid/lid sections and securing with fastener hardware that minimizes personnel "hands-on" time and effort. 3. For fastening, a combination of ratchet style load-binders and D-rings is acceptable. Bolting hardware on a perimeter closure angle system is not to be used.
13.	View Port/Filter Threaded Fitting	1. The design is to include a 2 in. x 11.5 NPS (M or C, i.e., straight thread) threaded fitting installed in the container rear wall. Fitting will be used for viewing container internals and/or installation of a nuclear filter. 2. Fitting is to be located approximately 1'-0" below container top and 1 ft. 6 in. or greater from either outer edge. 3. Fitting is to be full perimeter welded both on the container interior and exterior. Chase after welding to restore threads. 4. A rain diverter is to be installed (welded) directly above the fitting. a. Center over the fitting b. Located 6-inch. or less from top of fitting to top of diverter c. Length is to be outside diameter of fitting plus 4-inch. minimum d. Depth is to be greater than 1-inch. and less than 2.5-inch. beyond face of fitting. e. Diverter is not to interfere with installation of plug or filter. 5. Include installation of steel plug with torque value as an option in the container closure instructions. Do not provide the steel plug with the container. 6. Ship the container with a plastic threaded plug (complete with a drilled 3/8-inch. minimum breathing hole) installed in the fitting.
14.	Containment	1. Containers are to be manufactured leak tight (i.e., void of unintended holes or penetrations in containment boundary). 2. Gaskets are to be fully installed (as designed) on delivered containers and be void of damage.

3.2.2 Materials and Components

Item	Description	Requirement
1.	General	1. Direct replacement material that is not new (like for like components taken from other containers) may be used. All material is to have adequate integrity/remaining useful life to perform its intended function. A moderate degree of dents/creases in used container side-walls is acceptable. 2. Fastener hardware (e.g., ratchet load-binders) and gasket material is to be new and unused. Supplier is to ensure no suspect/counterfeit fastener hardware is used.
2.	Steel Standards	1. Add on material (not of a used container's original design) is to be new and unused. 2. Structural steel shapes and bar are to comply with ASTM A36 requirements. 3. Plate and sheet steel are to comply with ASTM A36 or ASTM A1011 CS Type B (or a suitable SS classification) requirements appropriate for the needed thickness and application. 4. Tubular shape structural steel components are to comply with ASTM A500 B or C. 5. Other steel materials not listed above may be used when suitable for the design and are to be specifically listed on design documents submitted for review/approval by the RE.
3.	Gasket Material	Material selected is to be suitable for multiple years of service (> 5) under typical outdoors environmental conditions and multiple lid removal/replacements. Material selected is to provide the compression and seal required for the intended application.
4.	Coatings	1. Containers are to be primed on the interior/exterior and top coated on the exterior. 2. Exterior coating system "a" below is the standard for containers ordered using this specification and is to be used unless system "b" is specifically required on a given PO. a. Long lasting paint in accordance with Attachment 2. Color is to be supplier's choice unless otherwise noted on a given PO. b. Supplier's standard paint. Color is to be supplier's choice unless otherwise noted on a given PO.
5.	Spare/ Replacement Parts	Spare/replacement parts such as gaskets, bolts, nuts, and ratchet load-binders are to be identified on design documents with details adequate for re-ordering (i.e., manufacturer, part nos., applicable standard specification, class, grade, etc.)

3.2.3 Weld Design

Item	Description	Requirement
1.	General	1. Welds are to be designed of sufficient size and shape to develop the full strength of materials being joined. 2. Welds are to transmit stress without permanent deformation or failure when the materials joined by the weld are subjected to service loading as well as handling and transportation vibration and stresses. 3. All welds are to be identified by location, type and size on design drawings.

3.2.4 Engineering Calculations

Item	Description	Requirement
1.	Maximum Uniformly Distributed Lid Load Calculation	Supplier is to calculate the maximum uniformly distributed load in pounds per square inch (psi) the container lid will support without failure. This is to simulate a soil-like load applied from above (not to be confused with a container on container stacking load).
2.	Floor Load Calculation	Supplier is to calculate the load in pounds per square foot (psf) applied to a supporting floor system by the surface area of container base members that will contact the floor. Base the calculation on the maximum allowable gross weight of the container design.
3.	ISO Corner Block Calculation	Supplier is to provide an engineering calculation demonstrating the design of the ISO corner blocks and modifications that impact their connection to the container frame complies with the lifting requirements of 49 CFR 173.410(b) as it applies to the shipper/offeror's lifting configurations shown in Attachment 1.
4.	Lid Lifting Analysis/ Calculation	Supplier is to provide an engineering analysis or calculation demonstrating the lid lifting hardware design (D-rings and fork channels) is adequate for safely lifting and handling the lid. Include the lid weight and safety factor of hardware.
5.	Compressive Strength	Supplier is to provide an engineering analysis demonstrating a compressive (stacking) strength equivalent to applicable ISO standards has been maintained or a calculation demonstrating the design is equal to or greater than 5 times allowable gross weight for stacking.

3.3 Service Conditions

When placed in service, the modified ISO freight containers will be subjected to lifting stresses and transportation vibrations, as well as various outdoors weather conditions (typical for the Southeastern U.S.).

3.4 Fabrication and Assembly Requirements

3.4.1 Work is to be performed to this specification and engineering documents submitted, reviewed and approved by the RE.

3.4.2 During fabrication, new steel materials are to be protected from kinks, sharp bends, and other conditions that would be detrimental to the finished product.

3.4.3 All bends are to be made by controlled means to ensure uniformity of size and shape.

3.4.4 Sheared edges (not subsequently welded) are to be ground to eliminate shear cracks and shear discontinuities. Break all sharp corners and edges not covered by other materials and left exposed. Remove all burrs.

3.4.5 Welding

A. Welding and weld procedures are to be in compliance with AWS D1.1/D1.1M or AWS D1.3/D1.3M. Weld procedures complying with ASME Section IX are also acceptable. The selected code is to be appropriate for the material being joined. The applicable code is to be identified in weld procedures submitted for review and approval by the RE.

B. Surfaces being welded are to be free from rust, scale, paint, grease, or other foreign matter.

3.4.6 Paint/Coatings Application

A. Coated surfaces are to be prepared per standard SSPC-SP 1 unless otherwise specified by the coating's manufacturer or in this specification.

B. All coatings, primer and finish, are to be uniformly applied. Application is to be per the coating manufacturer's recommendations.

C. Dry film thickness (DFT) is not to be less than the coating manufacturer's standard or Attachment 2 for long lasting paint when applicable.

3.4.7 Containers are to be delivered with lid-to-base closure system gaskets installed. Gasket material used must be installed within its documented shelf-life.

3.5 Quality Assurance Program Requirements

3.5.1 For work to this specification, supplier is to possess a quality assurance program that, at a minimum, complies with the ASME NQA-1-2000 criteria identified in Attachment 3.

3.5.2 Technical and QA requirements of this specification are to be invoked on sub-tier suppliers applicable to activities performed when contracted to provide components/parts or for services directly related to work, inspection or testing performed on containers. Supplier is responsible for verifying implementation of these requirements by the sub-tier suppliers and made available to Buyer or authorized representative on request.

3.5.3 Engineering documents and quality reports/records, generated in association with this specification, are to be maintained by the supplier for a minimum of one (1) year after shipment and shall be made available to Buyer authorized representatives when requested.

3.6 Personnel Qualifications/Certification

3.6.1 Personnel are to be qualified or certified in accordance with the supplier's quality assurance and training programs. Comprehensive training records/certifications are to be maintained to demonstrate employee qualifications.

			sheets for all products used.
4.	Spare/Replacement Parts List	3.2.2 Item 5	Submit a list for all components that may require replacement on containers with multiple years of service. Include the detailed information required by the referenced section.
5.	Maximum Uniformly Distributed Lid Load Calculation	3.2.4 Item 1	Submit per referenced section.
6.	Floor Load Calculation	3.2.4 Item 2	Submit per referenced section.
7.	ISO Corner Block Calculation	3.2.4 Item 3	Submit per referenced section.
8.	Lid Lifting Analysis/ Calculation	3.2.4 Item 4	Submit per referenced section.
9.	Compressive Strength Analysis/ Calculation	3.2.4 Item 5	Submit per referenced section.
10.	Weld Procedures (WPS &PQR)	3.4.5	Submit for all weld processes to be used.
11.	Quality Assurance Program Documents	3.5.1	Submit the Quality Assurance Manual and any other program documents used to demonstrate compliance. Documents are to be submitted with the bid proposal.
12.	Welder Qualifications	3.6.2	Submit for welders performing work on the container.
13.	Weld Inspector Qualifications	3.6.3	Submit for inspector(s) performing work on the container.
14.	49 CFR Part 172 Subpart H Training Matrix and/or Certificates	3.6.4	Submit for all personnel to be directly involved in the manufacture of the container (design, fabrication, inspection, testing, etc.) Document(s) to demonstrate that required training has been received. Submit with the bid proposal.
15.	Inspection Procedure(s)	4.1.1	1. Submit a procedure for: a. Final dimensional and completion or work inspections b. Weld inspections c. Pre-modification inspection/light test 2. Submit, with each procedure, applicable inspection report templates. Each report is to include a reference to inspection procedure/revision, drawing number/revision, acceptance criteria/results, and acceptance signature/date.

16.	Test Procedure(s)	4.1.2	1. Submit a procedure for: a. Spray Test b. Standing Water Test (container floor) 2. Submit, with each procedure, applicable test report templates. Each report is to include a reference to test procedure/revision, drawing number/revision, acceptance criteria/results, and acceptance signature.

3.7.3 **Quality Verification Document Deliverables**

Quality verification documents are to be delivered with each shipment of containers as identified in Attachment 6. The documents to be delivered are as follows:

Item	Description	Sec. Ref.	Requirement
1.	Material Test Reports, Steel	3.2.2 Item 2	Deliver material test reports for all shapes, bar and plate of new steel material used for structural support or provides direct containment of payload.
2.	Gasket Certificate	3.2.2 Item 3	Deliver for lid closure system gaskets. Certificate is to list time frame of manufacture (month/year or qtr/year), applicable ASTM specification, and shelf-life expiration.
3.	Inspection Report(s)	4.1.1	Completed report(s) initially submitted as a template per 3.7.2 Item 15.
4.	Test Report(s)	4.1.2	Completed report(s) initially submitted as a template per 3.7.2 Item 16.

3.8 Packaging, Handling, Shipping, and Storage Requirements

Packaging, handling, shipping and storage are to be the supplier's standard with the following additions:

3.8.1 Completed containers ready for shipment to the shipper/offeror are to be stored in a manner that precludes the entry of water, dirt or debris. Storage practices are to prevent incidental damage from surrounding work activities.

3.8.2 Remove all debris and foreign matter prior to shipment.

3.8.3 When shipped, containers shall be fully assembled with all components required by design and all openings closed and sealed (unless otherwise noted on a given PO).

3.9 Marking and Identification Requirements

Item	Description	Requirement
1.	Method of Marking	Stenciling or durable weather-resistant labels.
2.	49 CFR 172.310 Marking	Mark each container with "USA Type IP-1" per DOT requirements

3.	Traceability and Usage	(1) Markings specified below are to be 1-inch minimum in height with a background of contrasting color. (2) Markings are to be on both long sides of container. (3) Markings on container sides are to include: a. PO number. b. A unique serial number. c. Tare weight in kg followed by lbs. in brackets d. Maximum allowable payload in kg followed by lbs in brackets. e. Maximum allowable gross weight in kg followed by lbs in brackets. f. Internal Volume in ft^3. (4) Mark "Lid Lift Only" in vicinity of lid fork channels and lifting rings. (5) Mark "Lift Empty Only" adjacent to each fork pocket on the container base.

3.10 Deviations/Exceptions

3.10.1 After contract award, the supplier is to submit a SDDR form for each proposed deviation from or exception to the technical or quality requirements in this specification or other PO attachments.

3.10.2 Supplier is to complete the SDDR form in accordance with provided instructions.

3.10.3 Submit the SDDR to the shipper/offeror's Document Control Center.

3.10.4 Supplier is not to make delivery of any container for which an SDDR is submitted until written authorization is received in the form of a PO change notice that incorporates the SDDR.

4.0 ACCEPTANCE OF ITEM

4.1 Inspection/Testing Requirements

4.1.1 Supplier Inspection/Examination

A. Supplier is to perform a sufficient level of in-process and final dimensional and assembly inspections to ensure containers are modified/constructed to meet the approved design and requirements of this specification.

B. Perform a visual inspection (VT) on all supplier's welds, as identified on design drawings, to ensure compliance with design and applicable code requirements. The acceptance criteria of AWS D1.1 or an equivalent is to be used. All welds are to be acceptable at final inspection. Inspector is to verify qualified weld procedures and welders (with documents reviewed/approved by the RE) were used.

C. Prior to the beginning of modification work, the original container is to be inspected/light tested for the presence of any penetrations in the side walls or floor. Affected areas that will remain after modification work is complete and could negatively impact containment are to be identified,

documented and repaired. Note: This does not apply to standalone base platforms.

4.1.2 Supplier Testing

A. Spray Test

The external surface of sides, ends and lid are to be tested. Container assembly is to be complete, all parts installed, and the lid fully secured on the base. Soak all surfaces. Special attention is to be given to gasketed joints and weld areas. Test is acceptable if there are no water leaks on the container interior resulting from the water spray.

B. Standing Water Test (Container Floor)

Container is to be sufficiently elevated for access and viewing of the underneath side. Fill container to 6-inches minimum at its shallowest point. Container is to be filled and stationary a minimum of 10 minutes prior to inspecting for leaks. Test is acceptable if there is no evidence of leaks on bottom rim or underneath side of container.

4.2 Surveillance and Audits

4.2.1 Buyer or authorized representatives reserve the right of access to the supplier's or sub-tier supplier facilities for the purpose of program audits and review, surveillance, and observation of fabrication activities.

4.2.2 Supplier surveillance may be invoked for any given contract. When invoked, supplier surveillance will be performed by the shipper/offeror to the criteria provided in Attachment 7.

4.3 Final Acceptance Method

4.3.1 Final acceptance of each shipment is based on delivery of items/documentation that meet PO requirements and will, as a minimum, include verification of:

- Markings
- [No] Physical Damage & Packaging Correct
- Cleanliness
- Configuration & Workmanship
- [No] Counterfeit/Suspect Items
- Delivery of Required and Acceptable Documentation

4.3.2 Any container which does not meet the requirements of the PO including this specification is subject to return and replacement by the manufacturer without charge.

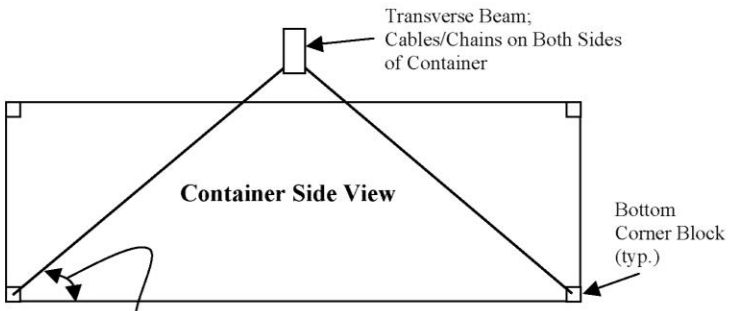
5.0 ATTACHMENTS

1. Shipper/offeror Lifting Methods (1 page)
2. Long Lasting Paint Requirements (3 pages)
3. Supplier Quality Assurance Program Requirements Data Sheet – (1 page; Form OSR No. 19-283)
4 Engineering Document Requirements – (3 pages; includes form OSR 45-6)
5 Engineering Document Summary List – (2 pages)
6 Quality Verification Document Requirements – (3 pages; includes form OSR 45-5)
7. Supplier Surveillance Criteria – (2 pages)

Attachment 1,

Shipper/offeror Lifting Methods

Bottom Lift Configuration



(1) 45, 40, and 30 ft. containers must be designed to accommodate a 30° or greater (from horizontal) lift angle. NOTE: 45 ft. containers must be lifted from the corner blocks located at the 40 ft. spacing.
(2) 20 and 10 ft. containers must be designed to accommodate a 40° or greater (from horizontal) lift angle.
(3) Connections to bottom corner fittings will utilize a rotating lift lug such as or equivalent to a Tandemloc® Rotary Lug

TOP Lift Configuration

(1) Containers of all sizes will be lifted using a 4-point lift configuration at 90° from horizontal.
(2) Connection to top corner fittings will utilize a twistlock lifting device equivalent to ISO 1161, Annex B.

Attachment 2 (page 1 of 3)

Long Lasting Paint Requirements

1. SCOPE

These requirements are applicable when long lasting paint (three coat epoxy / epoxy / polyurethane system) has been specified for a container exterior sides and top. Bottom exterior coating shall be original manufacturer's standard; repair/recoat as needed if damaged or removed. The intent is for the applied coating system is to have an effective (no appreciable degradation, peeling, blistering, etc.) life span of up to 7 to 10 years.

2. SURFACE PREPARATION

A. For new steel or if removing existing coatings to bare metal:
- Initially, any grease or oil shall be completely removed by solvent cleaning in accordance with SSPC-SP 1.
- Surface preparation shall be in accordance with SSPC-SP10, Near White Metal Blast Cleaning.
- Surface profile shall be a minimum of 1 mil and a maximum of 2 mils.

B. For preparing surfaces with existing coatings not taken to bare metal:
- Supplier shall analyze the type and condition of the existing coating system and determine the most appropriate SSPC Surface Preparation Standard for use. A test of the preparation methods prescribed by the Standard shall be performed on the existing coatings to establish the Standard's effectiveness to achieve the desired results (all finish coats removed and primer exposed). After preparation, apply 3 mils of new primer (see below), allow to cure and perform an adhesion test.
- Supplier shall submit a proposed Existing Coatings Surface Preparation document to the RE for review and approval per Attachment 4 or 5 as applicable. Include the preparation methods and adhesion test results.
- Initially, any grease or oil shall be completely removed by solvent cleaning in accordance with SSPC-SP 1.
- Prepare surface per approved standard. Note: All finish coats shall be removed and the existing primer exposed unless otherwise approved through the Existing Coatings Surface Preparation document.

3. MATERIALS

A. Unless otherwise indicated, all specified materials have a VOC less than 3.5 lbs/gal.

B. This coating system shall be applied in three coats. The first coat shall be applied to a dry film thickness of 3 mils minimum. The second coat shall be applied at a dry film thickness of 4 mils minimum. The third coat shall be applied to a dry film thickness of 3 mils minimum. The total dry film thickness of the system shall be 10 mils minimum.

Attachment 2 (page 2 of 3)

Long Lasting Paint Requirements

C. Approved Materials: All coats are to be by same manufacturer unless otherwise noted.

1. Prime Coat

Manufacturer	1st Coat
Ameron	Amercoat 68HS
Carboline	D858
PPG	Aquapon WB 98-46 Water Base Epoxy
Sherwin Williams	Zinc Clad IV B69A8/B69V8
Valspar	MZ-4 (13-F-4)*

*VOC is greater than 3.5 lbs/gal.

2. Intermediate Coat

Manufacturer	2nd Coat
Ameron	Amerlock 400
Carboline	893
PPG	Aquapon WB 98-1 Water Base Epoxy
Sherwin Williams	Recoatable Epoxy Primer B67H5/B67V5
Valspar	*Val-Chem 89 Series* Hi-Build Epoxy

3. Top Coat

Manufacturer	3rd Coat
Ameron	Amershield
Carboline	834
PPG	Durethane WB 98-8200 Water Base Urethane
Sherwin Williams	Hi-Solids Polyurethane B65W301/B65T304/B60V30
Valspar	V-Thane 54 Series Hi-Solids Urethane

D. Alternate coating materials may be used subject to prior approval from the RE (i.e., submittal for review/approval as an attachment to the Cleaning, Coating and Finish Repair procedure). When proposing an alternate material, the following information shall be included:

1. The specific area or item to be coated.
2. Statement of justification for alternate material.

Attachment 2 (page 3 of 3)

Long Lasting Paint Requirements

3. The Coating System number for which the alternate materials are being proposed.
4. Name and number of proposed material.
5. Material manufacturer's product data sheets and application instructions.
6. Description of the proposed system including surface preparation, number of coats, sequence of coats, dry film thickness range for each coat and total dry film thickness range of the system.

4. TOUCH-UP AND REPAIR

A. Surface preparation for repair of areas greater than 1 square foot in area shall be by abrasive blast cleaning in accordance with Section 2 whenever possible. Vacuum blast equipment should be used in areas where open blasting cannot be performed.

B. Surface preparation for small touch-up spots or for larger repairs where blast cleaning cannot be performed shall be by power tool cleaning in accordance with SSPC-SP 11, Power Tool Cleaning to Bare Metal. All damaged and defective coating shall be completely removed. The steel surface shall be cleaned to bright metal free of oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and any other foreign matter. The cleaned steel surface shall then be roughened with a needle gun (using small, sharp needles) or roto-peen.

C. The surrounding edge of sound coating shall be sanded to a taper to provide a smooth transition from the repair material into the original coating.

D. Coating material used for touch-up and repair shall be the same as those originally applied.

E. Coating application for touch-up and repair may be performed by brush or spray and shall include the same number of coats, applied in the same sequence to the same dry film thickness ranges.

F. If the zinc rich epoxy primer is applied by brush, coating shall be thoroughly stirred, immediately before inserting the brush, making sure the zinc powder is uniformly dispersed and there is no zinc settled at the bottom of the can. When applying zinc rich epoxy by brush, the coating shall be lightly worked to a uniform coat. If more than one brush coat is needed to achieve the specified thickness, the previous coat shall first be allowed to dry to touch.

Attachment 3

Supplier Quality Assurance Program Requirements

NOTE Any clarifications/supplements and/or exceptions shall be listed below (if required, add a continuation sheet). Level 1 requirements are subject to evaluation and verification through the performance of an audit. For Level 2 procurements where Supplier quality is deemed necessary, the method(s) of assuring Supplier quality shall be identified in Section D.

Section A

ASME NQA-1 Part I Basic (Paragraph 100) Requirements

- ☒ Organization
- ☒ Quality Assurance Program
- ☒ Design Control
- ☒ Procurement Document Control
- ☒ Instructions, Procedures and Drawings
- ☒ Document Control
- ☒ Control of Purchased Items and Services
- ☒ Identification and Control of Items
- ☒ Control of Processes
- ☒ Inspection
- ☒ Test Control
- ☒ Control of Measuring and Test Equipment
- ☒ Handling, Storage and Shipping
- ☒ Inspection, Test and Operating Status
- ☒ Control of Nonconforming Items
- ☒ Corrective Action
- ☒ Quality Assurance Records
- ☒ Audits

Section B

Other Supplier Quality Program Requirements (ASME NQA-1 Part 1 Supplemental [Paragraphs 200-900] Requirements; ASME NQA-1 Part II Requirements; and other National Consensus Standards)

- ☐ NQA-1 Part II Subpart 2.7 (Software Quality Requirements)
- ☐ NQA-1 Part I Requirement 7, Paragraph 503 (C of C Requirements)
- ☐ ANSI/NCSL Z540-1, Part I (Calibration Standard)
- ☐ ASME Section VIII Division 1 (Appendix 10)
- ☐ ISO 17025 (Calibration/Testing Standard)
- ☐ Other _____
- ☐ Other _____
- ☐ Other _____

Section C

Clarification/Exceptions

Supplier surveillance activities marked in Section D are an option in this specification and will be invoked at the CTF's discretion on a PO by PO basis.

Section D

Methods of Assuring Supplier Quality for Level 2 Procurements
For Level 2 Procurements, in addition to reviewing the Supplier's QA Manual, the items marked below shall be performed to assure Supplier quality (a minimum of one method shall be applied).

- ☐ Performance of an audit by QCS
- ☐ Performance of an audit by the requesting organization's CQF
- ☒ Document submittals identified on EDR document (e.g., process procedures, welder qualifications, etc.)
- ☐ Submittal of current applicable ASME certificate
- ☒ Supplier surveillance activities
- ☒ Receipt inspection activities
- ☐ Other _____
- ☐ Other _____

Attachment 4 (Page 1 of 3)

Engineering Document Requirements

The EDR form (page 2 of this attachment) is a consolidated list of engineering documents required for submittal to the shipper/offeror for review and/or approval. Submittal schedule for each document is listed on the form. Form instructions are on page 3 of this attachment.

1. All hard copy (paper) documents are to be submitted on white (or white recycled) paper.
2. For initial (first time) orders, all documents listed on the EDR form are to be submitted for review. For subsequent (repeat) orders, an EDSL may be used when applicable (reference Attachment 5).
3. Submit hard copy EDR Documents with a Cover Sheet specifically identifying supplier's name, this specification number, list of enclosed documents and PO number, to the address given on the purchase order.
4. As an alternative to 3 above, the documents may be submitted electronically to the RE or made electronically accessible via the internet.
   - Documents submitted electronically must be in Adobe® PDF format. Forward the documents to the email address provided on the PO or contact the buyer for the address if not provided.
   - For documents accessible via the internet, the supplier is to provide a list (e-mail or memo) of the documents, the appropriate URL for their location, and their revision or effective date that is applicable to the containers ordered.
5. EDR documents submitted by the supplier in accordance with this specification will be reviewed and processed within 30 calendar days from the date of receipt. The supplier will be informed of each document status as follows:

Status 1	Work may proceed
Status 2	Submit final document, work may proceed
Status 3	Revise and resubmit, work may proceed subject to resolution of comments
Status 4	Revise and resubmit, work may not proceed
Status 5	Permission to proceed not required

6. The supplier is to incorporate changes as required by comments provided and resubmit corrected engineering documents for review within 15 calendar days.
7. Assignment of Status 1 to the documents does not relieve the supplier of any part of these obligations to meet all of the requirements of this specification or the responsibility for the correctness of such documents and the adequacy and suitability of materials and equipment represented therein for their intended function.
8. Changes/revisions to any engineering document, previously submitted and reviewed by the shipper/offeror for use with the containers ordered, will require resubmittal for review/approval prior to its use.

Attachment 4 (Page 2 of 3)

Engineering Document Requirements

1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of Copies	8. Remarks
			Yes	No		Init	Final		
1.3	3.7.2 Item 1	Modification Design Drawing	X		Prior to Fabrication	1	1	HC -or- Electronic	
4.1	3.7.2 Item 2	Closure, Lifting & Handling Instructions	X		Prior to Fabrication	1	1	HC -or- Electronic	
15.0	3.7.2 Item 3	Coating Application & Repair Procedure	X		Prior to Fabrication	1	1	HC -or- Electronic	
2.0	3.7.2 Item 4	Spare/Replacement Parts List	X		Prior to Shipment	1	1	HC -or- Electronic	
8.0	3.7.2 Item 5	Max. Uniformly Distributed Lid Load Calculation	X		Prior to Fabrication	1	1	HC -or- Electronic	
8.0	3.7.2 Item 6	Floor Load Calculation	X		Prior to Fabrication	1	1	HC -or- Electronic	
8.0	3.7.2 Item 7	ISO Corner Block Calculation	X		Prior to Fabrication	1	1	HC -or- Electronic	
8.0	3.7.2 Item 8	Lid Lifting Analysis/ Calculation	X		Prior to Fabrication	1	1	HC -or- Electronic	
8.0	3.7.2 Item 9	Compressive Strength Analysis/Calculation	X		Prior to Fabrication	1	1	HC -or- Electronic	
12.0	3.7.2 Item 10	Weld Procedures (WPS & PQR)	X		Prior to Fabrication	1	1	HC -or- Electronic	
6.0	3.7.2 Item 11	Quality Assurance Program Documents	X		With Bid Proposal	1	1	HC -or- Electronic	
12.0	3.7.2 Item 12	Welder Qualifications	X		Prior to Fabrication	1	1	HC -or- Electronic	
12.0	3.7.2 Item 13	Weld Inspector Qualificaitons	X		Prior to Fabrication	1	1	HC -or- Electronic	
30.0	3.7.2 Item 14	49CFRPart 172Subpart H Tng. Matrix/Certs	X		With Bid Proposal	1	1	HC -or- Electronic	
25.0	3.7.2 Item 15	Inspection Procedure(s)	X		Prior to Fabrication	1	1	HC -or- Electronic	
26.0	3.7.2 Item 16	Test Procedure(s)	X		Prior to Fabrication	1	1	HC -or- Electronic	
15.0	Att. 2	Existing Coatings Surface Preparation	X		Prior to Fabrication	1	1	HC -or- Electronic	Submit if Applicable
15.0	Att. 2	Alternate Coating Proposal w/justification	X		Prior to Fabrication	1	1	HC -or- Electronic	Submit if Applicable

Attachment 4 (Page 3 of 3)

Engineering Document Requirements Form Instructions

Purpose The Engineering Document Requirements (EDR) form is prepared by the originator, establishes a basis for actions required of a Supplier and provides the schedule for the submittal of engineering documents by the Supplier.

Legend

Entry No. **Information Required**

1 Document category number — see below.
2 Applicable specification number and appropriate paragraph.
3 Description corresponding to document category number.
4 Permission to proceed with fabrication or other specific processes is marked yes, if required.
5 List a milestone after award i.e., prior to fabrication, prior to test, prior to shipment, or with shipment that the listed document is to be submitted by Su
6 Number of copies required for submittal.
7 Reproducible, Mylar, Vellum, etc.
8 Enter remarks when appropriate.

Document Category Number and Descriptions

1.0 Drawings
- 1.1 Outline Dimensions, Services, Foundations and Mounting Details — Drawings providing external envelope, including lugs, centerline(s), location an for electrical cable, conduit, fluid, and other service connections, isometrics and details related to foundations and mountings.
- 1.2 Assembly Drawings — Detailed drawings indicating sufficient information to facilitate assembly of the component parts of an equipment item.
- 1.3 Shop Detail Drawings — Drawings which provide sufficient detail to facilitate fabrication, manufacture, or installation. This includes pipe spool drawi internal piping and wiring details, cross-section details and structural and architectural details.
- 1.4 Wiring Diagrams — Drawings which show schematic diagram equipment, internal wiring diagrams, and interconnection wiring diagram for electrical
- 1.5 Control Logic Diagrams — Drawings which show paths which input signals must follow to accomplish the required responses.
- 1.6 Piping and Instrumentation Diagrams — Drawings which show piping system scheme and control elements.

2.0 Parts Lists and Costs — Sectional view with identified parts and recommended spare parts for one year's operation and specified with unit cost.
3.0 Complete WSRC Data Sheets — Information provided by Supplier on data sheets furnished by WSRC.
4.0 Instructions
- 4.1 Erection/Installation — Detailed written procedures, instructions, and drawings required to erect or install material or equipment.
- 4.2 Operations — Detailed written instructions describing how an item or system should be operated.
- 4.3 Maintenance — Detailed written instructions required to disassemble, reassemble and maintain items or systems in an operating condition.
- 4.4 Site Storage and Handling — Detailed written instructions, requirements and time period for lubrication, rotation, heating, lifting or other handling requirements to prevent damage or deterioration during storage and handling at jobsite. This includes shipping instruction for return.

5.0 Schedules: Engineering and Fabrication/Erection — Bar charts or critical path method diagram which detail the chronological sequence of activities, i.e., Engineering submittals, fabrication and shipment.
6.0 Quality Assurance Manual/Procedures — The document(s) which describe(s) the planned and systematic measures that are used to assure that structures systems, and components will meet the requirements of the procurement documents.
7.0 Seismic Data Reports — The analytical or test report which provides information and demonstrates suitability of material, component or system in relation conditions imposed by the stated seismic criteria.
8.0 Analysis and Design Reports — The analytical data (stress, electrical loading, fluid dynamics, design verification reports, etc.) which demonstrate that an it satisfies specified requirements.
9.0 Acoustic Data Reports — The noise, sound and other acoustic vibration data required by the procurement documents.
10.0 Samples
- 10.1 Typical Quality Verification Documents — A representative data package which will be submitted for the items furnished as required in the procurem documents.
- 10.2 Typical Material Used — a representative example of the material to be used.

11.0 Material Descriptions — The technical data describing a material which a Supplier proposes to use. This usually applies to architectural items, e.g., metal decking, doors, paints, coatings.
12.0 Welding Procedures and Qualifications — The welding procedure, specification and supporting qualification records required for welding, hard facing, overl brazing and soldering.
13.0 Material Control Procedures — The procedures for controlling issuance, handling, storage and traceability of materials such as weld rod.
14.0 Repair Procedures — The procedures for controlling material removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection.
15.0 Cleaning and Coating Procedures — The procedures for removal of dirt, grease or other surface contamination, and preparation and application of protecti coatings.
16.0 Heat Treatment Procedures — The procedures for controlling temperature and time at temperature as a function of thickness, furnace atmosphere, cooling and methods, etc.
19.0 UT — Ultrasonic Examination Procedures — Procedures for detecting discontinuities and inclusions in materials by the use of high frequency acoustic ene
20.0 RT — Radiographic Examination Procedures — Procedures for detecting discontinuities and inclusions in materials by x-ray or gamma ray exposure of photographic film.
21.0 MT — Magnetic Particle Examination Procedures — Procedures for detecting surface or near surface discontinuities in magnetic materials by the distortion applied magnetic field.
22.0 PT — Liquid Penetrant Examination Procedures — Procedures for detecting discontinuities in materials by the application of a penetrating liquid in conjunc with suitable developing materials.
23.0 Eddy Current Examination Procedures — Procedures for detecting discontinuities in materials by distortion of an applied electromagnetic field.
24.0 Pressure Test — Hydro, Air, Leak, Bubble or Vacuum Test Procedures — Procedures for performing hydrostatic or pneumatic structural integrity and leak tests.
25.0 Inspection Procedures — Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance res etc.) are met.
26.0 Performance Test Procedures — Test performed to demonstrate that functional design and operational parameters are met.
- 26.1 Mechanical Tests — e.g., pump performance, data, valve stroking, load, temperature rise, calibration, environmental, etc.
- 26.2 Electrical Tests — e.g., impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.

27.0 Prototype Test Reports — Reports of a test which is performed on a standard or typical examination of equipment or item, and which is not required for eac produced in order to substantiate the acceptability of equal items. This may include tests which result in damage to the item(s) tested.
28.0 Personnel Qualification Procedures — Procedures for qualifying welders, inspectors and other special process personnel.
29.0 Supplier Shipping Preparation Procedures — Procedures used by a Supplier to prepare finished materials or equipment for shipment from its facility to the jobsite.

Attachment 5 (Page 1 of 2)

Engineering Document Summary List

1. For repeat orders, the supplier may substitute an EDSL for documents that have not been changed/revised from a previous submittal. The following shall apply:
   a. A revision or change to any part of a document will require the re-submittal of the entire document.
   b. The EDSL (and its use) is not applicable to quality verification documents, any engineering document that is unique to an item or lot of items, or documents excluded from this provision by other PO documents.
   c. A sample EDSL is provided on page 2. The information required in the attachment shall be provided regardless of format used by the supplier.
   d. The EDR form requirements for proceeding with work, submittal schedule, and statusing will apply to the EDSL commensurate with the documents listed therein.
2. All hard copy (paper) documents are to be submitted on white (or white recycled) paper.
3. Submit hard copy EDSLs to the address given on the PO.
4. As an alternative to 3 above, the EDSL may be submitted electronically to the Responsible Engineer. Documents submitted electronically must be in Adobe® PDF format. Forward the documents to the email address provided on the PO or contact the buyer for the address if not provided.
5. An EDSL submitted by the supplier in accordance with this specification will be reviewed and processed within 30 calendar days from the date of receipt. The supplier will be informed of the status of each document as follows:

Status 1	Work may proceed
Status 2	Submit final document, work may proceed
Status 3	Revise and resubmit, work may proceed subject to resolution of comments
Status 4	Revise and resubmit, work may not proceed
Status 5	Permission to proceed not required

6. The supplier is to incorporate changes as required by comments provided and resubmit corrected EDSL for review within 15 calendar days. Supplier is not to change Status 1 documents without notifying the RE and resubmitting the documents.
7. Assignment of Status 1 to an EDSL does not relieve the supplier of any part of these obligations to meet all of the requirements of the specification, or the responsibility for the correctness of such documents as listed on the EDLS and the adequacy and suitability of materials and equipment represented therein for their intended function.
8. Changes/revisions to an EDSL, previously submitted and reviewed by the shipper/offeror, will require resubmittal for review/approval prior to the use of any document listed document affected by the change.

Attachment 5 (Page 2 of 2)

Engineering Document Summary List

Shipper/offeror PO Number:_____

Supplier (Company Name/Address):_____

The following documents have not been changed/revised since their previous submittal under the PO# listed below:

Data Sheet /Attachment Section Ref.	Document Title	Rev/Eff. Date*	PO Under Which 'Document' was Submitted and Approved by the shipper/offeror

*Record "No Change" if document has no revision/effective date.

Authenticated By: _____

Supplier Management Representative/Date

Attachment 6 (Page 2 of 3)

Quality Verification Document Requirements

1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Release	5. Receipt Inspection Check-In	6. Remarks	7. DOC Supplier Page Count
17.1	3.7.3 Item 1	Maerial Test Reports, Steel				
13.0	3.7.3 Item 2	Gasket Certificate				
12.0, 25.0	3.7.3 Item 3	Inspection Report(s)				
26.0	3.7.3 Item 4	Test Report(s)				

8. Supplier's Order No.	9. Supplier's Part	10. Supplier's Part Name	11. Quantity
12. PO No.	13 /Equip Tag or Code No.	14. Part Name	

15. Supplier's Conformance Statement

We certify that the work and required documents meet the requirements of the procuring documents.

Authorized Supplier Signature _____ Title _____ Date _____

16. Source Surveillance Representative at Suppliers Facility

Work was released based on satisfactory completion of quality surveillance and review of documentation.

☐ With Authorized Deviations Noted in Column 6
☐ No Deviations

Signature _____ Date _____

17. Receiving Inspection

This form and the quality verification documents referenced hereon have been received and their relationship to the hardware items verified.

Signature _____ Date _____

Attachment 6 (Page 3 of 3)

Back of
OGR 45-5 (Rev 10-29-2008)

Attachment No. 6
Revision No. 1
Spec/Req'n No. M-SPS-G-00110
Page 3 of 3

Quality Verification Document Requirements Form Instructions

Purpose The Quality Verification document Requirements (QVDR) is initiated [redacted] and completed by the Supplier when providing quality verification documents. The QVDR is a multipurpose form to

Transmit quality verification documents from the Supplier,
Provide evidence of [redacted] release of documentation and/or work, and
Provide evidence of an [redacted] inspection check of documentation received at SRS.

WSRC Entries

Entry No.	Information Required
1	Enter Document Category Number — see below.
2	Enter Specification Number and Paragraph Reference.
3	Enter Description corresponding to the Document Category Number.
4	SSR to initial upon item release.
6	Enter "Remarks: as appropriate.
16	SSR and dates release.

Field Entries

Entry No.	Information Required
5	[redacted] inspector at the jobsite to complete check-in.
17	The [redacted] Inspector will review the quality verification documentation package. If found satisfactory, he signs and dates the check-in statement.

Supplier Entries

Entry No.	Information Required
7	Enter number of pages of quality verification document being submitted.
8	Enter information required.
9	Enter information required.
10	Enter information required.
11	Enter the quantity of units covered by the documents submitted. For each item on Entry No. 12 being released, provide a separate copy of this completed form and the supporting quality verification documents.
12	Enter information required.
13	Enter information required.
14	Enter information required.
15	Supplier — Signature of an employee authorized to sign such documents.

Document Category Numbers and Descriptions

12.0 Welding Verification Reports — Reports of welding performed to include weld identification, and certification that qualified welding procedures and welders were used.
13.0 Material Verification Reports — Reports relative to material which confirm, substantiate or assure that an activity or condition has been implemented in conformance with code and material specifications imposed by the procurement documents.
14.0 Major Repair Verification Reports — Reports may include weld repair locations (maps), material test reports for filler metal, pre- and post-weld heat treatment records, NDE records, etc. The resolution of whether a repair is major or not is an [redacted] responsibility.
15.0 Cleaning and Coating Verification Reports — Reports include a certification of visual examination for surface preparation, surface profile, materials, etc.; and also humidity data, temperature data and coating thickness data as required by the procurement documents.
16.0 Heat Treat Reports — Reports normally include furnace charts and similar records which identify and certify the item(s) treated, the procedure used, furnace atmosphere, time at temperature, cooling rate, etc.
17.0 Material Property Reports
- 17.1 MTR (Material Test Reports) — These reports include all chemical, physical, mechanical, and electrical property test data required by the material specification and applicable codes. These are applicable to cement, concrete, metals, cable jacket materials, rebar, rebar splices, etc.
- 17.2 Impact Test Data — Reports of Charpy or drop weight tests including specimen configuration, test temperature and fracture data.
- 17.3 Ferrite Data — Reports of the ferrite percentage for stainless steel materials used, including castings and welding filler metals as deposited.
- 17.4 Material Certificate of Conformance — Documents which certify conformance to the requirements of the applicable material specification.
- 17.5 Electrical Property Reports — Reports of electrical characteristics, e.g., dielectric, impedance, resistance, flame tests, corona, etc.

18.0 Code Compliance — Verifying documents (such as data Forms U-1, M-2, State, etc.), which are prepared by the manufacturer or installer and certified by the Authorized Code Inspector.
19.0 UT — Ultrasonic Examination and Verification Reports — Examination results of certain characteristics of discontinuities and inclusions in material by the use of high frequency acoustic energy.
20.0 RT — Radiographic Examination and Verification Reports — Examination results of certain characteristics of discontinuities and inclusions in materials by x-ray or gamma-ray exposure of photographic film, including film itself.
21.0 MT — Magnetic Particle Examination and Verification Reports — Examination results of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.
22.0 PT — Liquid Penetrant Examination and Verification Reports — Examination results of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.
23.0 Eddy Current Examination and Verification Reports — Examination results of discontinuities in material by distortion of an applied electromagnetic field.
24.0 Pressure Test — Hydro, Air, Leak, Bubble or Vacuum Test and Verification Reports — Results of hydrostatic or pneumatic structural integrity and leakage tests.
25.0 Inspection and Verification Reports — Documented findings resulting from an inspection.
26.0 Performance Test and Verification Reports — Reports of Test Results
- 26.1 Mechanical Test, e.g., pump, performance data, valve stroking, load, temperature rise, calibration, environment, etc.
- 26.2 Electrical Tests, e.g., load, impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.

27.0 Prototype Test Report — Report of the test which is performed on a standard or typical example of equipment, material or item, and which is not required for each item produced in order to substantiate the acceptability of equal items. This normally includes tests which may, or could be expected to, result in damage to the item(s) tested.
28.0 Certificate of Conformance—A document signed or otherwise authenticated by an authorized individual certifying the degree to which items or services meet specified requirements.

Attachment 7 (Page 1 of 2)

Supplier Surveillance Criteria

SURVEILLANCE APPLICABILITY

The RE in consultation with a requisitioning organization, is to determine when supplier surveillance is to be invoked for a given PO and the level/extent to which surveillance will be performed. When invoked, surveillance activities are to be identified on a purchase requisition and subsequently on the PO. Surveillance Hold Points (SHPs) and Document Reviews (DRs) are listed below.

SAMPLING

When sampling is specified, the shipper/offeror is to sample a given lot (of containers) with a plan that is based on ANSI/ASQC Z1.4 using an AQL of 1.0 and Special Inspection Level S4 (unless directed otherwise in the PO). The random selection of surveillance samples is the responsibility of the shipper/offeror. When a sample is unacceptable (for a given SHP) based on the number of rejections, 100% of the remaining lot is to be verified and each container individually accepted/rejected.

SURVEILLANCE HOLD POINTS (SHP), and SSR VERIFICATION CRITERIA

Unless otherwise specified in the PO, all of the following verifications and witness of tests are to be included in the supplier's Work Control Documents as SHPs to be performed by the shipper/offeror. **Supplier production inspection and testing are to be completed/accepted prior to SSR verifications/witnessing for any hold point.**

SHP-1 On a [container] sampling basis, the shipper/offeror is to visually verify supplier made welds (only) are acceptable in accordance with the weld code of record. For the containers selected, verify the welder's qualification records have been reviewed/approved by the RE. Rejected and reworked welds are to be visually verified by the SSR.

SHP-2 On a [container] sampling basis, the shipper/offeror is to witness Spray and Standing Water Leak Tests and verify performance of test is to RE approved procedures and that test acceptance criteria are met. Rejected and reworked boxes are to be retested and witnessed by the shipper/offeror.

SHP-3 Post Fabrication/Container Interior. After completion of modifications activities and on a [container] sampling basis, the shipper/offeror is to verify the following:

a. Closure system gaskets are installed where required by design, have complete adhesion to the surface applied along their entire length, and show no evidence of voids or damage.

b. Container interior is free of debris or rubble.

c. Container internal height from floor to top of top rail is per design. Note: Measurement at two randomly selected points is acceptable.

Attachment 7 (Page 2 of 2)

Supplier Surveillance Criteria

SHP-4 Release for Shipment. Prior to release for shipment and through review of documentation and/or physical checking, the shipper/offeror is to verify the following:

a. Container nominal length is as specified on the PO.

b. Lid fits on box without encumbrance. Lid can be removed without the gasket material adhering to the non-adhesive surface.

c. Box exterior shows no signs of damage (e.g., holes, tears).

d. Primer (interior) and paint (exterior) provide a uniform cover over all surfaces.

e. Markings are installed per this specification.

f. Lid to container base fastener hardware (e.g., load-binders) appear as new and function as intended.

g. Filter coupling includes plastic plug with breathing hole.

DOCUMENT REVIEWS

Prior to release for shipment, the shipper/offeror is to perform the following document reviews:

DR-1 Supplier drawing(s) and procedures used for modification work, inspection, and test have been approved by the RE and are accurately reflected (correct number and revision) on inspection and test reports.

DR-2 By review of steel MTRs, material requirements are met (e.g. type of steel and material thickness are per design).

DR-3 Quality verification document package is complete and prepared for delivery to the shipper/offeror (QVDR form included as cover sheet, all required documents attached, and documents have been completed as required).

REPORTING SURVEILLANCES

A report of surveillance results is to be documented by the shipper/offeror with copies provided to the Buyer and RE.

APPENDIX O: Quality Assurance Matrix

Various National Consensus Standard Requirements

Potential Elements of a Quality Assurance Program	DOE Order 414.1X Attachment 2	10 CFR 830 Subpart A	ANSI/ASME NQA-1[1]	10 CFR 71 Subpart H	10 CFR 50 Appendix B	ISO 9001:2008
Organization	1	1	1	103	I	4.1
Quality Assurance Program	1, 2, 9	1, 2, 9	2	105	II	5.0, 6.2
Design	6	6	3	107	III	7.1, 7.2, 7.3
Procurement Document Control	7	7	4	109	IV	7.4
Instructions, Procedures, and Drawings	5	5	5	111	V	4.2
Document Control	4	4	6	113	VI	4.2
Control of Purchased Material, Equipment, & Services	7	7	7	115	VII	7.4
Identification & Control of Materials, Parts, & Components	5	5	8	117	VIII	7.5.3
Control of Special Processes	5	5	9	119	IX	7.5
Inspection	8	8	10	121	X	8.2.4
Test Control	8	8	11	123	XI	7.5
Control of Measuring & Test Equipment	5, 8	5, 8	12	125	XII	7.6
Handling, Storage, & Shipping	5	5	13	127	XIII	7.5.5
Inspection, Test, & Operating Status	8	8	14	129	XIV	7.5, 8.2.4

Potential Elements of a Quality Assurance Program	**DOE Order 414.1X Attachment 2**	**10 CFR 830 Subpart A**	**ANSI/ASME NQA-1[1]**	**10 CFR 71 Subpart H**	**10 CFR 50 Appendix B**	**ISO 9001:2008**
Non-Conforming Materials, Parts, or Components	3	3	15	131	XV	8.3, 8.4
Corrective Action	3, 9	3, 9	16	133	XVI	8.4, 8.5
Quality Assurance Records	4	4	17	135	XVII	4.2
Audits	3, 10	3, 10	18	137	XVIII	5.6, 8.4, 8.5
Suspect Counterfeit Items Prevention	Attachment 3					
Safety Software Quality Assurance Requirements for Nuclear Facilities	Attachment 4		Subpart 2.7			

[1]NQA-1 will be applied based on the graded approach – Not all elements may apply.

APPENDIX P: Stresses a Freight Container Will Encounter During Transport

The stress on a freight container has been documented by Gesamtverband der Deutschen Versicherungswirtschaft e.V. (GDV, German Insurance Association) in an online document called the *Container Handbook*. Section 2 or titled, *Causes of Damage/Loss During Transport*, covers the stresses incurred during transport that a freight container will experience.

- Static Mechanical Shipping Stresses
- Dynamic Mechanical Shipping Stresses
- Mechanical Stresses in Maritime Transport
- Mechanical Stresses in Road Transport
- Mechanical Stresses in Rail Transport
- Mechanical Stresses in Inland Waterway
- Mechanical Stresses During Cargo Handling
- Climate Stresses
- Biotic Stresses
- Chemical Stresses

The *Container Handbook* can be found using the following link:
http://www.containerhandbuch.de/chb_e/stra/index.html.

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APPENDIX Q: Example of a Set of American Bureau of Shipping Certification Documents Demonstrating Compliance to ISO-1496-1

TECHNICAL SPECIFICATION
FOR
STEEL DRY CARGO CONTAINER
40'x8'x8'6" ISO 1AA TYPE

- OPEN AT BOTH END -
- WITH FORKLIFT POCKETS -

MODEL NO: *TYC-110DDP*
SPEC. NO: *TYC-110DDP-S*
DATE OF ISSUE: *JUL., 2006*
OWNER: O.K. Logistics

I N D E X

1. General

1.1 Scope

This specification will cover the design, construction, materials, testing and inspection performances of 40'x8'x8'6" ISO. 1AA type steel dry cargo containers.

These containers specified herein will be manufactured at Yangzhou Runyang Logistic Equipment Co., Ltd. (hereinafter referred to RYC) under strict quality control by RYC and be approved by the classification society or agency.

1.2 Operational environment

The container will be designed and constructed for carriage of general cargo by marine (on or below deck), road and rail throughout the world.

All materials used in the construction will be to withstand extremes of temperature range from -40℃(-40℉) to +70℃(+158℉) without effect on the strength of the basic structure and watertightness.

1.3 Standards and Regulations

The container will satisfy the following requirements and regulations, unless otherwise mentioned in this specification.

1.3.1 ISO Container Standards (1AA type)

ISO 668 - Series 1 freight containers - Classification external dimensions and ratings (4^{th} edition - 1988) (except internal length)

ISO 830 - Terminology in relation to freight container (1^{st} edition - 1981)

ISO 1161 - Series 1 freight containers - Corner fittings Specification (4^{th} edition - 1984)

ISO 1496-1 - Series 1 freight containers - Specification and testing.
Part 1: General cargo containers for general purposes (5^{th} edition - 1990)

ISO 6346 - Freight containers - coding, identification and marking (3^{rd} edition - 1995)

1.3.2 T.I.R. Certification

All the containers will be certified and complied with "The Customs Convention on the International Transport of Goods under the cover of T.I.R. Carnets." or "The Customs Convention on Containers."

1.3.3 C.S.C. Certification

All the containers will be certified and complied with the requirements of the "International Convention for the Safe Containers."

1.3.4 T.C.T. Certification

All exposed wooden components used for container will be treated to comply with the requirements of "Cargo Containers-Quarantine Aspects and Procedures" of the Commonwealth Department of Health, Australia.

1.3.5 Classification society

All the containers will be certified for design type and individually inspected by classification society, BV, ABS, LR, GL or CCS.

* Note: BV: Bureau Veritas (France)
ABS: American Bureau of Shipping (USA)
LR: Lloyd's Register of Shipping (UK)
GL: Germanischer Lloyd (Germany)
CCS: China Classification Society (P.R.C)

1.4 Handling

The container will be constructed to be capable of being handled without any permanent deformation under the following conditions:

a) Lifting, full or empty, at top corner fittings vertically by means of spreaders fitted with hooks, shackles or twistlocks.

b) Lifting, full or empty, at bottom corner fittings using slings with terminal fittings at any angles between vertical and 30 degrees to the horizontal.

c) Lifting, empty, at forklift pockets using forklift truck.

1.5 Transportation

The container will be constructed to be suitable for transportation in the following modes:

a) Marine: In the ship cell guides of vessels, seven (7) high stacked.
On the deck of vessels, four (4) high stacked and secured by vertical and diagonal wire lashings.

b) Road: On flat bed or skeletal chassis, secured by twistlocks or equivalent at the bottom corner fittings.

c) Rail: On flat cars or special container cars secured by twistlocks or equivalent at the bottom corner fittings.

2. Dimensions and Ratings

2.1 External Dimensions

Length	12,192 + 0mm	40'	+0
	-10mm		-25/64"
Width	2,438 + 0mm	8'	+0
	- 5mm		-3/16"
Height	2,591 + 0mm	8'6"	+0
	- 5mm		-3/16"

1) No part of the container will protrude beyond the external dimensions mentioned above.

2) Maximum allowable differences between two diagonals on anyone of the following surfaces will be as follows:

Roof, bottom and side diagonals	:	19mm	3/4"
Front and rear diagonals	:	10mm	3/8"

2.2 Internal Dimensions (nominal)

Length	11,978 + 0mm	39' 3 37/64"	+0
Width	2,352 + 0mm	7' 8 38/64"	+0
Height	2,393 + 0mm	7' 10 7/32"	+0

2.3 Door opening dimensions (nominal)

Width	2,343 + 0mm	7' 8 16/64"	+0
Height	2,280 + 0mm	7' 5 49/64"	+0

2.4 Internal cubic capacity (Nominal)

67.4 cu.m 2,381 cu.ft

2.5 Forklift Pockets

Width	360 mm		1' 2 11/64"
Height	min. 115 mm		4 1/2"
Center to center	2,050 mm +/- 50 mm		6' 9" +/- 2"

2.6 Gooseneck tunnel

Length	3,266	mm		
Width	1,029	+3mm	3' 4 1/2"	+1/8"
		-0mm		-0
Height	120	+0mm	4 23/32"	+0
		-3mm		-1/8"

2.7Ratings

Max. Gross Weight (R)	30,480 kgs	67,200 lbs
Tare Weight (design) (T)	3,850 kgs	8,490 lbs
Max. Payload (P)	26,630 kgs	58,710 lbs

3. Materials

3.1 General

The following materials will be used in the construction of containers:

3.2 Part specification

Parts	*Materials by JIS*
1) All steel except screws, rivets, bolts/nuts, door hardwares and other shown on drawings and specification	Anti-corrosive steel. SPA-H or equivalent Y.P. : 35 kg/mm^2 T.S. : 49 kg/mm^2
2) Rear corner posts (inner)	Rolled high tensile steel. SM50A Y.P. : 33 kg/mm^2 T.S. : 50 kg/mm^2
3) Door hinges	S25C Y.P. : 27 kg/mm^2 T.S. : 45 kg/mm^2
4) Door locking bars	Structural steel round pipe. STK41 Y.P. : 24 kg/mm^2

T.S. : 41 kg/mm^2

5) Corner fittings	Casted weldable steel. SCW49 Y.P. : 28 kg/mm^2 T.S. : 49 kg/mm^2
6) Locking gear cams and keepers	S20C Y.P. : 25 kg/mm^2 T.S. : 41 kg/mm^2
7) Door hinge pins Gasket retainers	Stainless steel
8) Door gasket	EPDM
9) Floor board	Hardwood plywood.
10) Ventilator	ABS resin labyrinth type

* Note: Y.P. - Yielding Point
T.S. - Tensile Strength

4.Construction

4.1General

4.1.1 The container will be constructed with steel frames, fully vertical-corrugated steel sides, horizontal-corrugated steel double doors at both end, die-stamped steel roof and corner fittings.

4.1.2 All welds of exterior including the base frames will be continuous welding using CO_2 gas.

4.1.3 Interior welds - when needed - will be stitched with a minimum length of 15 mm.

4.1.4 Gaps between adjacent components to be welded will not exceed 3 mm or the

thickness of the parts being welded.

4.1.5 Chloroprene sealant is to be applied at periphery of floor surface and inside unwelded seams, butyl sealant is used to caulk at invisible seam of floor joint area and between door gasket and frame.

4.1.6 The internal bend radii of pressed sections of steel will be not less than 1.5 time the thickness of the materials being pressed.

4.1.7 The wooden floor will be fixed to the base frames by zinc plated self-tapping screws.

4.2 Protrusion

4.2.1 The plane formed by the lower faces of all transverse members shall be positioned by 12.5 mm +5/-1.5 mm above the plane formed by the lower faces of the bottom corner fittings.

4.2.2 The top corner fittings are to protrude a minimum of 6 mm above the highest point of the roof.

4.2.3 The outside faces of the corner fittings will protrude from the outside faces of the corner posts by nominal 3 - 4 mm.

4.2.4 The outside faces of the corner fittings will protrude from the outside faces of the sides by nominal 7 - 8 mm.

4.2.5 Under maximum payload, no part of the container will protrude below the plane formed by the lower faces of the bottom corner fittings at the time of maximum deflection.

4.2.6 Under 1.8 x maximum gross weight, no part of the container will protrude more than 6.0 mm below the plane formed by the lower faces of the bottom corner fittings at the time of maximum deflection.

4.3 Corner fittings

The corner fittings will be designed in accordance with ISO 1161 and manufactured at the works approved by classification society.

4.4Base frame structure

Base frame will be composed of two (2) bottom side rails, twenty-eight (28) cross members, and a set of forklift pockets and a set of gooseneck tunnel.

4.4.1Bottom side rail

Each bottom side rail is built of a 50x158x30x4.5mm thick cold formed channel section steel made in one piece.

The floor guide rails of 2.3mm thick pressed angle section steel are provided to the bottom side rails by staggered stitch welding.

The lower flange of the bottom side rail is outward so as to facilitate easy removal of the cross members during repair and of less susceptible corrosion.

Reinforcement plates to be made of 4.0mm thick flat steel is welded to bottom corner fitting.

4.4.2Cross member

The cross members are made of pressed channel section steel with a dimension of 45x122x45x4.0mm for the normal areas and 75x122x45x4.0mm for the floor butt joints. The large one is reinforced by three 4.0 mm thick gussets. The cross members are placed fully to withstand floor strength and welded to each bottom side rail.

4.4.3 Forklift pockets

Each forklift pocket is built of 3.0 mm thick full depth flat steel top plate and two 200 mm deep x 6.0 mm thick flat lower end plates between two channel section cross members. The upper flange and web area above each forklift pocket is reinforced by 460x4.0 mm thick angle plate.

The one set of forklift pockets is designed in accordance with ISO. requirements.

4.4.4Gooseneck tunnel

The gooseneck tunnel consists of 4.0 mm thick one piece pressed hat section tunnel plate, twelve 4.5 mm thick pressed channel section bows, one 4.0 mm thick enclose section tunnel rear bolster which is made of two pressed ”C” section, and sixteen 4.0 mm thick tunnel outriggers.

The gooseneck tunnel is designed in accordance with ISO requirements.

4.5Flooring

The floor will consist of twelve pieces plywood boards, floor center rail, and self-tapping screws.

4.5.1Floor

The wooden floor to be constructed with 28mm thick 19-ply or more hardwood plywood boards are laid longitudinally on the transverse members between the 50x4.0mm thick flat section steel floor centre rail and the 2.3mm thick pressed angle section steel floor guide rails stitched welded to the bottom side rails.

The floor boards are tightly secured to each transverse member by self-tapping screws, and all butt joint areas and peripheries of the floor boards are caulked with sealant.

1) Wood species: Apitong / Hardwood.
2) Glue: Phenol-formaldehyde resin.
3) Treatment:
   a) Preservative: Meganium or equivalent.
      In accordance with Australian Health Department Regulations.
   b) Average moisture content will be 14% before installation.

4.5.2Self-tapping screw

Each floor board is fixed to the transverse members by zinc plated self-tapping screws that are 8.0mm dia. shank x 16mm dia. head x 45mm length, and fastened by four screws per cross member but five screws at joint areas. Screw heads are to be countersunk with about 2mm below the floor top surface.

4.6 Rear frame structure

The rear frame will be composed of one door sill, two corner posts, one door header and four corner fittings, which will be welded together to make the door-way.

4.6.1 Door sill

The door sill to be made of a 4.5 mm thick pressed open section steel is reinforced by four internal gussets at the back of each locking cam keeper location.

The upper face of the door sill has a 10 mm slope for better drainage.

There is cut out at each end of the door sill and reinforced by a 200x75x9.0 mm channel steel as a protection against handling equipment damages.

4.6.2 Rear corner post

Each rear corner post of hollow section is fabricated with 4.5 mm thick pressed steel outer part and 40x113x12 mm thick hot rolled channel section steel inner part, which are welded continuously together to ensure a maximum width of the door opening and to give a sufficient strength against stacking and racking forces.

Four (4) sets of hinge pin lugs are welded to each rear corner post.

4.6.3 Door header

The door header is constructed with a 4.0 mm thick pressed "U" section steel lower part having four internal gussets at the back of each locking cam keeper location and a 3.0 mm thick pressed steel upper part, which are formed into box section by continuous welding.

4.7Door

4.7.1 Each container will have double wing doors at rear end frame, and each door will be capable of swinging approximately 270 degrees.

4.7.2 Each door is constructed with two 3.0 mm thick pressed channel section steel horizontal frames for the top and bottom, two 100x50x3.2 mm thick rectangular hollow section vertical frames for the post side and center side of door, 2.0 mm thick horizontally corrugated steel door panel, which are continuously welded within frames.

4.7.3 Two sets of galvanized "BE2566 MN" bolt on model locking assemblies with forged steel handles and two points sealing system are fitted to each door using zinc plated steel bolts according to TIR requirements. Locking bar retainers are fitted with nylon bushings at the top, bottom and intermediate bracket.
Locking gears should be assembled after painting of container.

4.7.4 The left hand door can not be opened without opening the right hand door when the container is sealed in accordance with TIR requirements.

4.7.5 The door hold-back of nylon rope is provided to the center locking bar on each door and a hook of steel bar is welded to each bottom side rail.

4.7.6 Each door is suspended by four hinges being provided with stainless steel pins, self-lubricating nylon bushings and the stainless steel washers, which are placed at the hinge lugs of the rear corner posts.

4.7.7 The door gasket to be made of an extruded J&C-type EPDM rubber is installed to the door peripheral frames with stainless steel gasket retainers which must be caulked with butyl sealant before installation of gasket, and fastened by stainless steel

rivets at a pitch of 150 mm.

4.8 Roof structure

The roof will be constructed with eleven five-corrugated (die-stamped) steel panels and four corner protection plates.

4.8.1 Roof panel

The roof panel is constructed with 2.0mm thick die-stamped steel sheets having about 5.0mm upward smooth camber, which are welded together to form one panel and continuously welded to the top side rails and top end rails. All overlapped joints of inside unwelded seams are caulked with chloroprene sealant.

4.8.2 Protection plate

Each corner of the roof in the vicinity of top corner fitting is reinforced by 3.0mm thick rectangular steel plate to prevent the damage caused by mishandling of lifting equipment.

4.9 Top side rail

Each top side rail is made of a 60x60x3.0mm thick square hollow section steel.

4.10 Side wall

The trapezium section side wall is constructed with 2.0 mm thick fully vertically continuous-corrugated steel outer panels near the each post and 1.6 mm thick intermediate inner panels, which are butt welded together to form one panel and continuously welded to the side rails and corner posts.
All overlapped joints of inside are caulked with chloroprene sealant.

4.11 Front structure

The front end structure will be composed of the same as rear frame and door except following contents:

a) Front door sill

The upper part of the front door sill to be made of a 30x113x12 mm thick hot rolled channel section steel with 4.5 mm thick cover steel plate, the lower parts are made of two 4.0 mm thick "U" section steel rails which separated into "L" and flat section, and two 4.0 mm thick floor board supports, which are welded together.
There is cut out at each end of the door sill and reinforced by a 200x75x9.0 mm channel steel as a protection against handing equipment damage.

5.1 Surface preparation

1) All steel surfaces - prior to forming or after - will be fully abrasive shot blasted conforming to Swedish Standard SA 2 1/2 to remove all rust, dirt, mill scale and all other foreign materials.
The shot blasted surface profile shall be have a maximum peak to valley height not exceeding 50 microns and average peak to valley height of about 25 microns.

2) All door hardwires will be hot-dipping zinc galvanized with approximately 75 microns thickness.

3) All fasteners such as self-tapping screws and bolts, nuts, hinges, cam keepers and lashing fittings will be electro-galvanized with approximately 13 microns thickness.

5.2 Coating

5.2.1 Prior to assembly
All steel surfaces will be coated with 10 microns thick two-pack polyamide cured zinc rich epoxy primer immediately after shot blasting, and then dried up in drying room.

5.2.2 After assembly
All weldments will be shot blasted to remove all welding fluxes, splatters, burnt primer coatings caused by welding heat, and other foreign materials.
Then all blasted weldments will be coated with zinc rich epoxy primer.

5.2.3 The total dry film will be (microns):
All surface of the assembled container will be have coating system as follows:

Where	*Paint name*	*DFT (u)*
Exterior surface	zinc rich primer	30
	Epoxy primer	40
	Chlorinated rubber or Acrylic	40
	Total: 110	
Interior surface	zinc rich primer	30
	Epoxy high build coating	40
	Total: 70	
Under structure	zinc rich primer	30
	Bitumen	190

Total: 220

6. Marking

6.1 Arrangements

The containers will be marked in accordance with ISO, TCT, CSC and TIR requirements, owner's marking specifications and other required regulations.

6.2 Materials

1) Decal: - Self-adhesive, high tensile PVC film for seven (7) years guarantee without peeling off, tenting or color fading.

2) Certification plate: Stainless steel plates to be chemically etched by acid.

6.3 Specifications

1) Identification plates such as consolidated data plate consisting of CSC, TIR and TCT will be riveted on the door permanently by stainless steel rivets. The entire periphery except underside will be caulked with sealant.

2) The owner's serial numbers and manufacturer's serial numbers will be stamped on top face of the bottom rear corner fitting.

7. Testing

7.1 Prototype testing

The prototype container manufactured in accordance with this specification will be tested by manufacturer under the supervision of classification society.

	Test items & loads	**Test methods**
A)	Stacking Internal load : 1.8R-T Test load : 86,400 kg/post.	Hydraulic cylinder load will be applied to each corner post through top corner fittings. Offset: 25.4 mm lateral 38.0 mm longitudinal

B)	Lifting (from top corner fittings) Internal load : 2R-T	Lifting vertically. Time duration : 5 minutes
C)	Lifting (from bottom corner fittings) Internal load : 2R-T	Lifting 30 deg. to the horizontal. Time duration : 5 minutes
D)	Lifting Internal load : 0.625R-T (for empty forklift pockets)	Lifting by horizontal bars. Bar length : 1,828 mm, Bar width : 200 mm Time duration : 5 minutes
E)	Restraint (longitudinal) Internal load : R-T Test load : 2R	Hydraulic cylinder load will be applied to the bottom side rails.
F)	Floor strength Test load : 7,260 kgs (16,000 lbs)	Use of a special truck. Total contact area: 284 sq.cm Wheel width : 180 mm Wheel centre : 760 mm
G)	Wall strength (side) Test load : 0.6(R-T)=0.6P	Compressed air bag will be used on one side only.
H)	Wall strength (door) Test load : 0.4(R-T)=0.4P	Compressed air bag will be used.
I)	Roof strength (weakest part) Test load : 300 kgs	Applied area will be 600x300mm longitudinal and transverse.
J)	Racking (transverse) Test load : 15,240 kgs	Hydraulic cylinder load will be applied to the header rail through top corner fittings.
K)	Racking (longitudinal) Test load : 7,620 kgs	Hydraulic cylinder load will be applied to the top side rail through top corner fitting on one side only. Two times for pulling and pushing.
L)	Operation of door	After completion of test, the operation of

		doors, locks, hinges, etc. will be checked.
M)	Dimensions and weight	After completion of test, the dimensions and weight will be checked.
N)	Weatherproofness	Inside dia. of nozzle : 12.5mm Distance : 1.5 m Speed : 100 mm/sec. Pressure : 1 kg/sq.cm

* Note:	**R**	Maximum Gross Weight
	T	Tare Weight
	P	Maximum Payload

8. Guarantee

8.1 Structure

All the containers shall be guaranteed by manufacturer to be free from defects in materials, workmanship and structure for a period of one (1) year from the date of acceptance of the container by the buyer.

8.2 Painting

8.2.1 The paint system coated on the container surface shall be guaranteed to be free from corrosion and failure for a period of five (5) years from the date of acceptance of the container by the buyer.

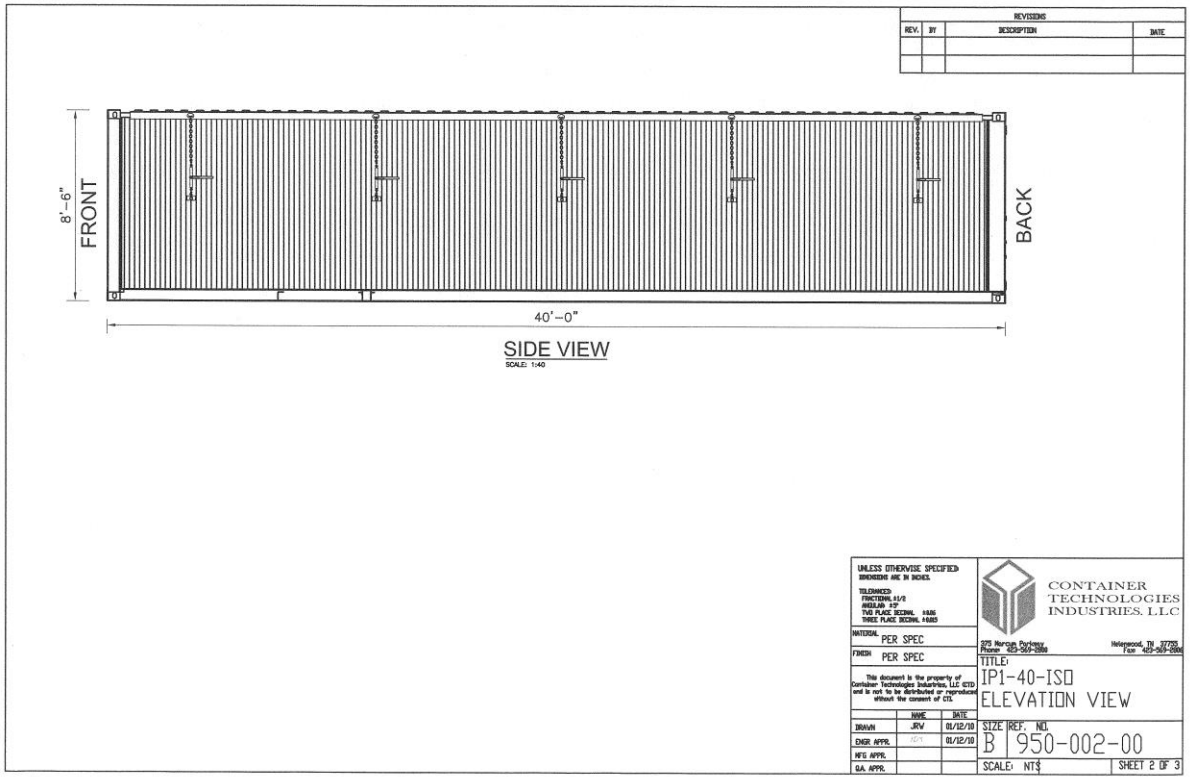
8.2.2 Corrosion is defined as rusting which exceeds RE3 (European Scale of degree of Rusting) on at least ten (10) percent of the total container surface, excluding that resulting from impact or abrasion damage, contact with solvents or corrosive chemicals and abnormal use.

8.2.3 If the corrosion exceeds RE3 as defined above within the guarantee period, inspection of the corrosion shall be carried out by the buyer, RYC and paint manufacturer to detect the cause.

As the result of the inspection, if it is mutually agreed and accepted that the corrosion has been caused by the defective paint quality and/or poor workmanship, RYC and/or paint manufacturer shall correct the defect on their accounts.

8.3 Decals

Decals applied on the container shall be guaranteed for a period of seven (7) years without peeling off, tenting or color fading if decals are supplied by RYC.


REVISIONS
REV. BY DESCRIPTION DATE
8'-6"
FRONT
BACK
40'-0"
SIDE VIEW
SCALE: 1:40
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: FRACTIONAL ±1/8 ANGULAR ±1° TWO PLACE DECIMAL ±.005 THREE PLACE DECIMAL ±.005
MATERIAL PER SPEC
FINISH PER SPEC
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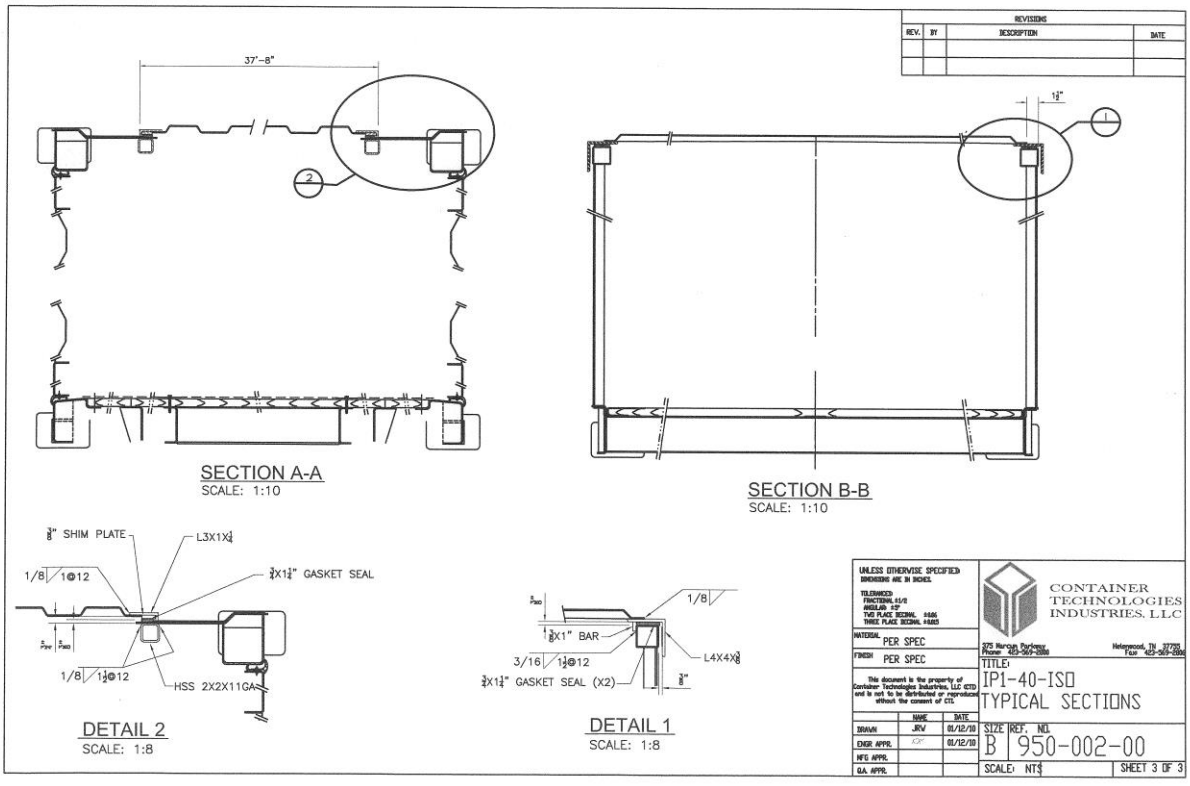
CONTAINER TECHNOLOGIES INDUSTRIES, LLC
375 Morgan Parkway Phone 423-360-2000 Heiskell, TN 37773 Fax 423-360-2006
TITLE: IP1-40-ISO ELEVATION VIEW
SIZE B REF. NO. 950-002-00
SCALE: NTS SHEET 2 OF 3


REVISIONS
REV. BY DESCRIPTION DATE
37'-8"
SECTION A-A
SCALE: 1:10
SECTION B-B
SCALE: 1:10
3/8" SHIM PLATE
L3X1X1/4
1/8 1@12
3/4X1 1/4" GASKET SEAL
1/8 1 1/2@12
HSS 2X2X11GA
DETAIL 2
SCALE: 1:8
1/8
3/8X1" BAR
3/16 1 1/2@12
3/4X1 1/4" GASKET SEAL (X2)
L4X4X3/8
DETAIL 1
SCALE: 1:8
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: FRACTIONAL ±1/8 ANGULAR ±1° TWO PLACE DECIMAL ±.005 THREE PLACE DECIMAL ±.005
MATERIAL PER SPEC
FINISH PER SPEC
This document is the property of Container Technologies Industries, LLC (CTI) and is not to be distributed or reproduced without the consent of CTI.
NAME DATE
DRAWN JRV 01/12/10
ENGR APPR. 01/12/10
MFG APPR.
QA APPR.
CONTAINER TECHNOLOGIES INDUSTRIES, LLC
375 Morgan Parkway Phone 423-360-2000 Heiskell, TN 37773 Fax 423-360-2006
TITLE: IP1-40-ISO TYPICAL SECTIONS
SIZE B REF. NO. 950-002-00
SCALE: NTS SHEET 3 OF 3

OKLPC805020

American Bureau of Shipping

Cargo Container
Production Certificate

Design Type Number: AB/ 535 / 05 - 16

Certificate No.: SQ1007606-A This Certificate is for 100 Containers

Date: Jun.18, 2008 Manufactured during the month of June 20 08

THIS IS TO CERTIFY THAT ONE HUNDRED (100) UNITS 40'X8'X8'6" STEEL DRY CARGO Containers

built by Yangzhou Runyang Logistic Equipment Co., Ltd.

for O.K. Logistics

have been thoroughly inspected at each stage of manufacture by our inspection department under the quality control surveillance of the American Bureau of Shipping; and that the details of design, materials, construction and workmanship of the containers conform to the applicable specifications and to the American Bureau of Shipping Rules for Certification of Cargo Containers.

The container(s) are constructed in accordance with prints reviewed on Jun.2, 2008 reference T-8-7/9627 ; under general arrangement drawing TYC-110DDP-000A , the prototype of which has serial number WGCU 700500 was tested on 21 Oct. 2005 , and subsequent dates; and accepted with the issuing of prototype test certificate SQ650183 .

Size: 40'X8'X8'6" Model: TYC-110DDP

Max. Gross Mass..	30,480	kg	Tare:	3,850	kg	Maximum Permissible Payload:	26,630 kg
	67,200	lb		8,490	lb		58,710 lb

Manufacturers serial numbers:	RY 8032684	through	RY 8032783
	----	through	----
	----	through	----
Owners operating numbers:	OKPU 805351	through	OKPU 805450
(with alpha prefix)	----	through	
	----	through	

Quality Control Superintendent

The undersigned has visited the plant of YANGZHOU RUNYANG LOGISTIC EQUIPMENT CO., LTD

located at 99th YANGWEI ROAD, YANGZHOU, JIANGSU, P.R.CHINA

and carried out quality control surveillance as indicated in the Rules for Certification of Cargo Containers.

Surveyor ROC YANG

Note: This Certificate evidences compliance with one or more of the Rules, guides, standards or other criteria of American Bureau of Shipping and is issued solely for the use of the Bureau, its committees, its clients or other authorized entities. This Certificate is a representation only that the container specified herein has been found to comply with one or more of the Rules, guides, standards or other criteria of American Bureau of Shipping. The validity, applicability and interpretation of this Certificate is governed by the Rules and standards of American Bureau of Shipping who shall remain the sole judge thereof. Nothing contained in this Certificate or in any Report issued in contemplation of this Certificate shall be deemed to relieve any designer, builder, owner, manufactruer, seller, supplier, repairer, operator or other entity of any warranty express or implied.

CTR AB TEMPL

80t020

INTERNATIONAL CONVENTION FOR SAFE CONTAINERS (CSC)

This Is To Certify that the Containers on the obverse of this certificate meet the requirements of the International Convention for Safe Containers and the regulations promulgated by the United States Department of Transportation. The containers are hereby approved and the applicant may affix, to every container noted hereon, a Safety Approval Plate with Approval number:

USA/AB- 535 / 05 - 16

Surveyor
ROC YANG

The containers identified on the obverse of this certificate carry an International Convention for Safe Container approval plate bearing the number USA/AB-535/05-16 .

CUSTOMS CERTIFICATION (TIR)

This is to certify that the undersigned has visited the plant of the manufacturer to examine random containers from the group identified on the obverse of this certificate for adherence to the certificate of approval by design type for transport of goods under customs seal and found such containers in compliance.

Design Type Approval Certificate Number: USA / **535 -AB/ 05 - 16**

Surveyor
ROC YANG

This is to certify that each of the containers identified on the obverse of this certificate have been manufactured in full compliance with the applicable certificate of approval by design type.

Quality Control Superintendent
Dong Rui

The containers identified on the obverse of this certificate carry a Customs approval plate bearing the number USA/535-AB/05-16

INTERNATIONAL UNION OF RAILWAYS (UIC)

This is to certify that the containers identified on the obverse of this certificate have been constructed in accordance with approved drawings and are in compliance with UIC Code 592-2 OR.

The containers conform to the prototype of the design series; were tested to UIC Requirements; and are as represented on prints **TYC-110DDP-700R(OKPU)** .

These containers are to be registered with Austrian Federal Railways and bear the participating railway code number ic 81 .

Surveyor ROC YANG

WOOD TREATMENT

The exposed timber of the containers identified on the obverse of this certificate has been treated in accordance with the Australian Department of Health Regulations as set forth in "Cargo Containers and Unit Loads - Quarantine Aspects and Procedures".

Quality Control Superintendent
Dong Rui

Treatment **IM/ TAILILEUM 400 /08**

American Bureau of Shipping

Prototype Test Certificate

Certificate No.: SQ650183-A

Design Type No.: AB/ 535 / 05 - 01

CSC Approval Reference: USA/AB- 535 / 05 - 01

This is to certify that the undersigned Surveyor to the American Bureau of Shipping did, at the request of YangZhou RunYang Logistic Equippment Co., Ltd, attend the test facility located at Yangzhou, Jiangsu, China on Oct. 21, 2005 and subsequent dates in order to examine and report upon a prototype cargo container which was tested in accordance with the ABS Rules for the Certification of Cargo Containers and the International Convention for Safe Containers. This container was constructed in accordance with General Arrangement drawing no. TYC-110DDP-000 reviewed on (date) Oct. 19, 2005 with T-3 reference no. T-8-7/5890

CONTAINER IDENTIFICATION

Manufacturer:	YangZhou RunYang Logistic Equippment Co., Ltd	Max. Gross Weight (MGM):	30,480 (kg)	67,200 (lb)	
Model:	TYC-110DDP	Size: 40'x8'x9'6"	Tare:	3,850 (kg)	8,490 (lb)
Serial no.:	WGCU700500 -7 (TY5700500)	Maximum Permissible Payload:	26,630 (kg)	58,710 (lb)	
Refrigeration Machinery Manufacturer and Model:		N/A			

ABS TEST NO & DESCRIPTION		TEST FORCE	INTERNAL LOAD	SEQUENCE
7.11.1	Dimensional Check	Per Rules	-	1,9
7. 11.2a	Stacking, Front	86,400 kg / post	51,040kg	2
7.11.2b	Stacking, Rear	Identical to front frame	51,040kg	NO
7.11.3	Lifting, Top	60,960 kg	57,110kg	3
7.11.4	Lifting, Bottom	60,960 kg	57,110kg	NO*
7.11.5	Lifting, FLP Loaded	--kg	44,918 kg	N/A
7.11.6	Lifting, FLP empty	19050 -- kg	-	NO*
7.11.7	Lifting, Grappler Arm	-- kg	-	N/A
7.11.8	Floor Strength, Concentrated	7,260 kg	-	4#
7.11.9	Restraint	60,960 kg	26,630kg	NO*
7.11.10a	End Panel, Front	10,652 kg	-	NO*
7.11.10b	End Panel, Rear	Identical to front frame	-	NO
7.11.11	Side Panel	15,978kg	-	NO*
7.11.12	Roof Strength	300 kg	-	NO*
7.11.13a	Racking, Transverse, Front	15,240 kg	-	5
7.11.13b	Racking, Transverse, Rear	Identical to front frame	-	NO
7.11.14	Racking, Longitudinal	7,620 kg	-	6
7.11.15	Cargo Securing Devices	Per Rules	-	7
7.11.16	Weathertightness	Per Rules	-	8

Additional tests (if any) listed on the reverse. Refer to test report no. SQ650183-A for further details.

The container was examined before, during and after testing and was found to be satisfactory.

Issued on: Oct. 21, 2005 (date) at Yangzhou,Jiangsu,China (place) by (Surveyor) HONG LIN ZHANG

CTR AB TEMPL

Certificate No.: SQ650183-A

ABS TEST NO & DESCRIPTION		TEST FORCE	INTERNAL LOAD	SEQUENCE
10.9.2	Air Leakage	-	-	-
10.9.3	Heat Leakage	-	-	-
10.9.4	Performance	-	-	-
9.11.2	Longitudinal Inertia	-	-	-
9.11.3	Lateral Inertia	-	-	-
9.11.4	Pressure	-	-	-
9.11.5	Walkway	-	-	-
9.11.6	Ladder	-	-	-
-	Dynamic Impact	-	-	-
7.11.2	Stacking, Platform, Folded	-	-	-
7.11.3	Lifting, Platform, Folded	-	-	-
Other tests:				
-				8
-				

This design series has an allowable stacking weight of: 192,000kg[423,280lbs]
*Waived,based on same model with BV approval and test report [no.BVCT0580168/S]
Manufacturer's proposed test value.

CTR AB 205 Page 2 of 2 [REV. 2/99]

American Bureau of Shipping Container Test Report

PROTOTYPE TEST
OWNER: FLEX-BOX
MANU.: YANGZHOU RUNLANG LOGISTIC EQUIPMENT CO.,LTD
MODEL: TYC-110DDP
TYPE: 1AA-ISO
SIZE: 40'x8'x8'6"
D.T. No.: AB/535/05-01
DATE: Oct. 21, 2005

AMERICAN BUREAU OF SHIPPING

CONTAINER TEST REPORT

REPORT NUMBER	CHECKLIST OF SUBMITTED REPORTS	DESIGN TYPE NO.	PAGE
SQ650183-A		AB/ 535 / 05-01	1

- ☒ CONTAINER IDENTIFICATION
- ☒ 7.11.1 DIMENSIONAL CHECK
- ☒ 7.11.2 STACKING TEST
- ☐ 7.11.2 STACKING TEST—PLATFORM CONTAINER, FOLDED
- ☐ 7.11.3 LIFTING TEST—PLATFORM CONTAINER, FOLDED
- ☒ 7.11.3 LIFTING TEST—FROM TOP CORNER FITTINGS
- ☐ 7.11.4 LIFTING TEST—FROM BOTTOM CORNER FITTINGS
- ☐ 7.11.5 LIFTING TEST—FROM FORK LIFT POCKETS, LOADED CONTAINERS
- ☐ 7.11.6 LIFTING TEST—FROM FORK LIFT POCKETS, UNLOADED CONTAINERS
- ☐ 7.11.7 LIFTING TEST—FROM GRAPPLER ARM POSITIONS
- ☒ 7.11.8 FLOOR STRENGTH TEST—CONCENTRATED
- ☐ 7.11.9 RESTRAINT TEST
- ☐ 7.11.10 END WALL STRENGTH TEST
- ☐ 7.11.11 SIDE WALL STRENGTH TEST
- ☐ 7.11.12 ROOF STRENGTH TEST
- ☒ 7.11.13 TRANSVERSE RACKING TEST—DOOR END
- ☒ 7.11.13 TRANSVERSE RACKING TEST—CLOSED END
- ☒ 7.11.14 LONGITUDINAL RACKING TEST
- ☒ 7.11.15 CARGO SECURING DEVICES
- ☒ 7.11.16 WEATHERTIGHTNESS

TANK CONTAINERS

- ☐ 9.11.2 LONGITUDINAL INERTIA TEST
- ☐ 9.11.3 LATERAL INERTIA TEST
- ☐ 9.11.4 PRESSURE TEST
- ☐ 9.11.5 WALKWAY TEST
- ☐ 9.11.6 LADDER TEST

THERMAL CONTAINERS

- ☐ 10.9.2 AIR LEAKAGE TEST
- ☐ 10.9.3 HEAT LEAKAGE TEST
- ☐ 10.9.4 PERFORMANCE TEST

ADDITIONAL TESTS

- ☐ TOP/BOTTOM LIFTING: WITH CONCENTRATED LOADING
- ☐ STAKING TEST WITH ONE DOOR OFF
- ☐ RACKING TRANSVERSE WITH ONE DOOR OFF

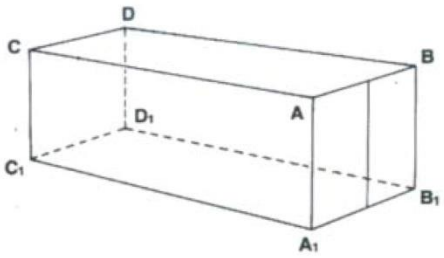
OPTIONAL TESTS

- ☐ CONTROL CHECK OF BASE DEFLECTIONS
- ☐ LASHING TEST—TRANSVERSE COMPRESSION
- ☐ LASHING TEST—TRANSVERSE TENSION
- ☐ LASHING TEST—VERTICAL TENSION
- ☐ LASHING TEST—LONGITUDINAL TENSION
- ☐ LIFTING TEST—FROM SIDE APERTURES OF CORNER FITTINGS
- ☐ DYNAMIC IMPACT TEST—TANK CONTAINERS
- ☐ DEFLECTIONS OF BOTTOM RAILS AND CROSS MEMBERS

CTR AB211 10/98

AMERICAN BUREAU OF SHIPPING
CONTAINER TEST REPORT

REPORT NUMBER	7.11.1 DIMENSIONAL CHECK	DESIGN TYPE NO.	PAGE
SQ650183-A		AB/ 535 /05-01	7



DESIGN DIMENSIONS				
	mm	± Δ	ft.-in	± Δ
LENGTH	12192	+0 -10	40'	+0 -3/8
WIDTH	2438	$\pm^{0}_{5}$	8'0"	$\pm^{0}_{3/16}$
HEIGHT	2591	+0 -5	8'6"	+0 -3/16

ACTUAL DIMENSIONS

	REFERENCE	BEFORE TESTING	AFTER TESTING	± Δ
LENGTH	A-C	12189	12189	0
	B-D	12188	12188	0
	A_1-C_1	12188	12188	0
	B_1-D_1	12187	12187	0
DOOR END	A-A_1	2591	2590	-1
	B-B_1	2589	2588	-1
	A-B	2437	2437	0
	A_1-B_1	2436	2436	0
FRONT END	C-C_1	2590	2589	-1
	D-D_1	2589	2588	-1
	C-D	2437	2437	0
	C_1-D_1	2438	2438	0

DIAGONALS	REFERENCE	BEFORE TESTING	AFTER TESTING	± Δ
SIDE WALLS	A-C_1	12456	12456	0
	C-A_1	12459	12458	-1
	B-D_1	12457	12457	0
	D-B_1	12455	12454	-1
ROOF	A-D	12428	12429	+1
	B-C	12425	12425	0
BASE	A_1-D_1	12423	12424	+1
	B_1-C_1	12427	12426	-1
DOOR END	A-B_1	3552	3550	-2
	B-A_1	3551	3553	+2
FRONT END	C-D_1	3552	3552	0
	D-C_1	3553	3553	0

COMMENT:

Satisfactory

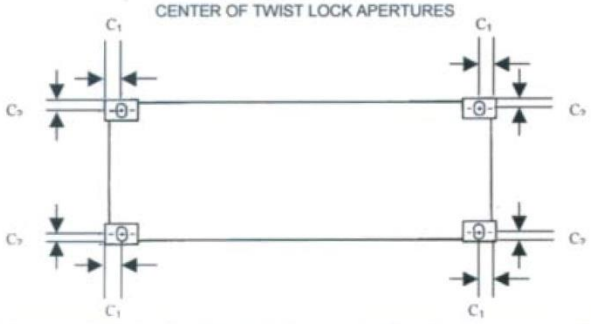
H. L. ZHANG SURVEYOR

CTR AB211 10/98

AMERICAN BUREAU OF SHIPPING
CONTAINER TEST REPORT

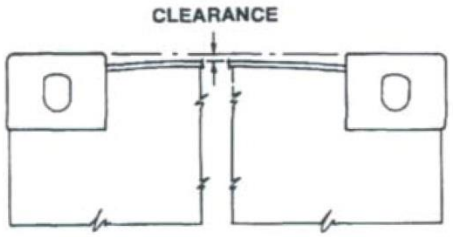
REPORT NUMBER	7.11.1 DIMENSIONAL CHECK	DESIGN TYPE NO.	PAGE
SQ650183-A		AB/ 535 / 05-01	8

CORNER FITTINGS
CENTER OF TWIST LOCK APERTURES



	mm	inches
C_1	$101.5 \pm^{0}_{1.5}$	$4 \pm^{0}_{1/16}$
C_2	$89.0 \pm^{0}_{1.5}$	$3\ 1/2 \pm^{0}_{1/16}$

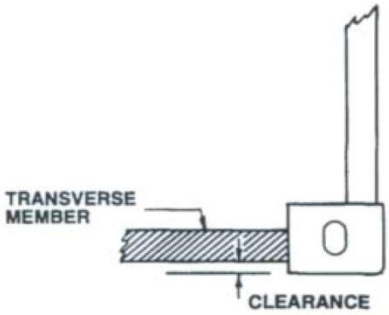
H.L. ZHANG SURVEYOR



TOP CORNER FITTING PROTRUSION

MINIMUM CLEARANCE = 6 mm (1/4")

H.L. ZHANG SURVEYOR



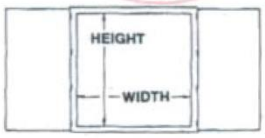
LOAD TRANSFER ZONES

CLEARANCE = 12.5 mm $\pm^{5}_{1.5}$ (1/2" $\pm^{3/16}_{1/16}$)

H.L. ZHANG SURVEYOR

EXTERNAL HEIGHT	MINIMUM DOOR OPENING				
	WIDTH		HEIGHT		
	DRY CARGO	THERMAL*	DRY CARGO	THERMAL*	
2438 mm 8'-0"	2286 mm (90")	2218 mm (87 5/16)	2134 mm (84")	2093 mm** (84 3/8")	2053 mm*** (80 13/16")
2591 mm 8'-6"	2286 mm (90")	2218 mm (87 5/16)	2261 mm (89")	2246 mm** (88 7/16")	2206 mm*** (86 7/8")
2896 mm 9'-6"	2286 mm (90")	2218 mm (87 5/16)	2566 mm (101")	2551 mm** (100 7/16")	2511 mm*** (98 7/8")

* ISO Type Code Designation: 32
** No Gooseneck Tunnel
*** With Gooseneck Tunnel

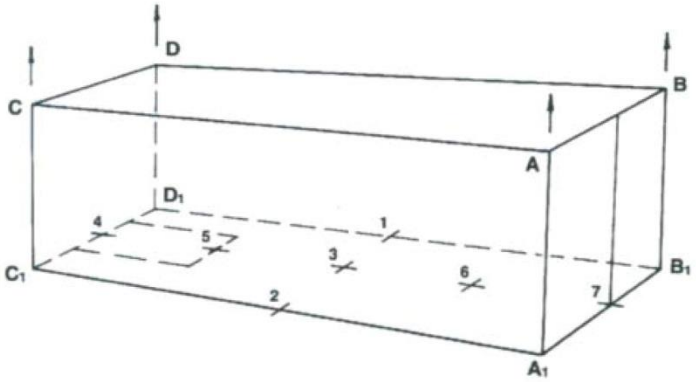


H.L. ZHANG SURVEYOR

CTR AB211 10/98

AMERICAN BUREAU OF SHIPPING
CONTAINER TEST REPORT

REPORT NUMBER: SQ650183-A	7.11.3 LIFTING TEST FROM TOP CORNER FITTINGS	DESIGN TYPE NO. AB/535/05-01	PAGE 17



T=TARE
R=MAXIMUM GROSS MASS
2R=60,960 kg(lb)

INTERNAL LOAD
2R-T=57,110 kg(lb)

CONDITION	1	2	3	4	5	6	7
EMPTY	56	62	158	111	139	167	48
DEFLECTIONS MEASURED WHILE LOADED AND ON PADS BEFORE LIFTING.	46	52	141	111	123.5	150	47
DEFLECTIONS MEASURED DURING LIFTING.	45	51	139.5	111	123	149	46
DEFLECTIONS MEASURED WHILE LOADED AND ON PADS AFTER LIFTING.	45.5	51.5	140.5	111	123.5	150	47
EMPTY	55	61	156.5	111	138	166	48

COMMENTS:

Satisfactory

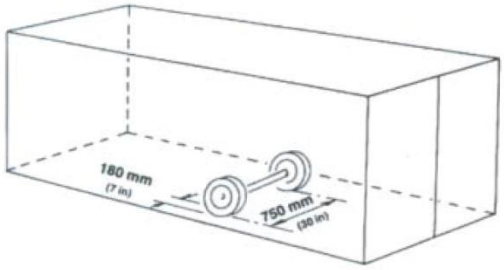
H. L. ZHANG

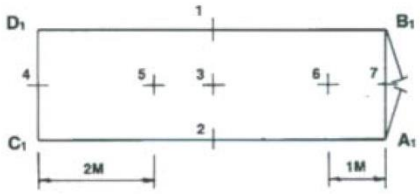
H. L. ZHANG SURVEYOR

CTR AB211 10/98

AMERICAN BUREAU OF SHIPPING
CONTAINER TEST REPORT

REPORT NUMBER	7.11.7 FLOOR STRENGTH TEST	DESIGN TYPE NO.	PAGE
SQ650183-A	CONCENTRATED	AB/535/ 05-01	27





Test vehicle front axle load 7,260kg 16,000lb

CONDITION	DEFLECTIONS 1	2	3	4	5	6	7
BEFORE TEST	55	61	156.5	111	**219**	**171**	**48**
DURING TEST	**54**	**60**	**139**	**111**	**200**	**154.5**	**36**
AFTER TEST	**55**	**61**	**155.5**	**111**	**216**	**170**	**47.5**
PERMANENT DEFORMATION	**0**	**0**	**1.0**	**0**	**3.0**	**1.0**	**0.5**

COMMENTS:

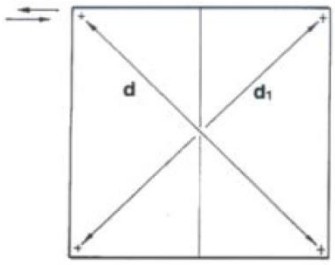
Satisfactory

H-L-ZHANG

H .L. ZHANG SURVEYOR

AMERICAN BUREAU OF SHIPPING
CONTAINER TEST REPORT

REPORT NUMBER	7.11.13A TRANSVERSE RACKING TEST	DESIGN TYPE NO.	PAGE
SQ650183-A	DOOR END	AB/535 /05-01	37-B



MINIMUM TEST FORCE=

TEST FORCE=15,240 kg(lb)

LOADING	CONDITION	FORCE	DIAGONALS d		DIAGONALS d_1	
COMPRESSION	BEFORE TESTING	0	A	3300	A	3300
	DURING TESTING		B	3275	B	3325
	SUM OF ABSOLUTE VALUES	|A – B|	25+25=50			
	AFTER TESTING	0	3299		3301	
TENSION	BEFORE TESTING	0	A	3299	A	3301
	DURING TESTING		B	3325	B	3275
	SUM OF ABSOLUTE VALUES	|A – B|	26+26=52			
	AFTER TESTING	0	3302		3298	

COMMENTS:

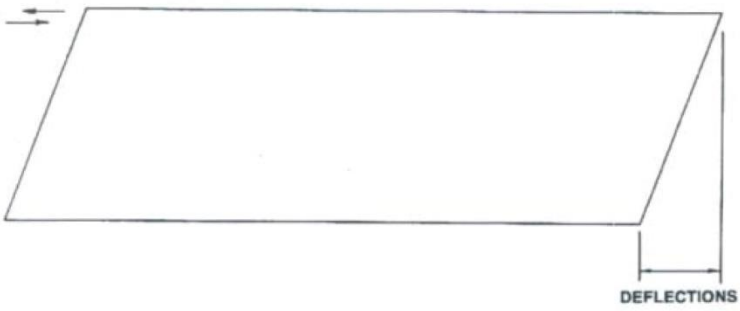
Satisfactory

H .L. ZHANG SURVEYOR

CTR AB211 10/98

AMERICAN BUREAU OF SHIPPING
CONTAINER TEST REPORT

REPORT NUMBER	7.11.14 LONGITUDINAL RACKING TEST	DESIGN TYPE NO.	PAGE
SQ650183-A		AB/535 /05-01	41



TEST FORCE=)

TEST FORCE=7,620 kg(lb)

LOADING	CONDITION	FORCE	DEFLECTIONS	
			SIDE AC	SIDE BD
COMPRESSION	BEFORE TEST	0		250
	DURING TEST			255
	AFTER TESTING	0		250
TENSION	BEFORE TEST	0		250
	DURING TEST			244
	AFTER TEST	0		249.5

COMMENTS:

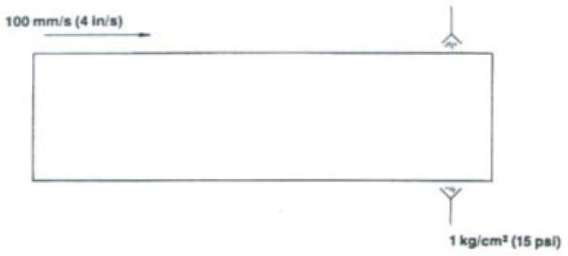
Satisfactory

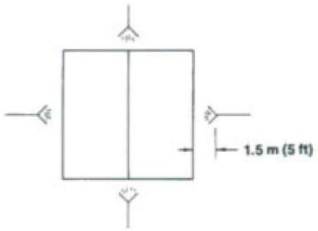
H .L. ZHANG SURVEYOR

CTR AB211 10/98

AMERICAN BUREAU OF SHIPPING
CONTAINER TEST REPORT

REPORT NUMBER	7.11.16 WEATHERTIGHTNESS TEST	DESIGN TYPE NO.	PAGE
SQ650183-A		AB/ 535 / 05-01	45





COMMENTS:

Satisfactory

H. L. ZHANG SURVEYOR

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