



WNTI

WORLD NUCLEAR TRANSPORT INSTITUTE

FACT SHEET

Industry Interpretation of TI and CSI Limits for the transport of UF₆ packages by Sea

Dedicated to the safe, secure, efficient and reliable
transport of radioactive materials

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The World Nuclear Transport Institute (WNTI) was established to bring together and support the radioactive materials transport community, in developing commonly agreed statements and position papers.

1. PURPOSE OF PAPER

To determine the Transport Index (TI) and the Criticality Safety Index (CSI) limits on vessels, to be used for the consignment of Uranium Hexafluoride UF₆ packages in order to comply with the requirements of the International Maritime Dangerous Goods Code IMDG 2014 edition. This paper considers the transport of UF₆ packages comprised of type 48X, 48Y and type 30B cylinders.

It gives also guidance on how to apply these limits in case of mix loading of UF6 consignments with other consignments in large freight containers (closed containers) aboard the same ship.

2. INTRODUCTION

Type 48X and 48Y cylinder packages

Packagings using type 48X and 48Y cylinders are primarily used for transport and storage of natural and depleted UF₆ (≤ 1 wt % ²³⁵U) and may contain up to 12,501 kg of UF₆. They constitute industrial packages; subject to type H (U) unilateral approval under the following Certificates of Approval of Package Design for the Carriage of Radioactive Material with additional validations in the USA and Russia.

48Y (48X) UF6 Cylinder (with Blanket Thermal Protector) GB/3570/H (U)-96

48Y (48X) UF6 Cylinder (with Composite Thermal Protector) GB/3571/H (U)-96

48Y (48X) UF6 Cylinder (bare cylinder with low quantity of UF6) GB/3572/H (U)-96

The Certificates of Approval of Package Design for the Carriage of Radioactive Material require that the packages be used, handled, maintained and inspected by the consignor and consignee in accordance with ANSI N14.1 or ISO7195 and INS Transport Report No 111.

Type 30B cylinder packages

Packagings using type 30B cylinders are primarily used for transport and storage of enriched natural uranium UF6, with a maximum enrichment in 235U of 5%, and may contain up to 2,277 kg of UF6. Packages are composed of a 30B cylinder placed in an outer protective packaging of various designs (UX-30, MST-30, COG OP 30B) and are either Type B(U) or Type A packages. The packages are subject to multilateral approval for transport of fissile material under the following base Certificates.

Type UX-30 - USA/9196/B (U) F-96 CSI=5,0

Type MST-30 - J/159/AF-96 CSI=5,0

Type COG-OP-30B – F/358/AF-96, F/358/B(U)F-96, F/358/IF-96 CSI=0

The Certificates require that the packages be used, handled, maintained and inspected by the consignor and consignee in accordance with ANSI N14.1 or ISO7195 and the relevant Package Design Safety Reports.

The CSI values per package design are equal to 5,0 or 0 (zero) according to the applicable package design approvals.

3. DEFINITIONS CHAPTER 1.2 IMDG 2014 EDITION

- Cargo transport unit: means a road transport tank or freight vehicle, a railway transport tank or freight wagon, a multimodal freight container or portable tank, or an MEGC (Multi Element Gas Container).
- Closed cargo transport unit: with the exception of class 1, means a cargo transport unit which totally encloses the contents by permanent structures with complete and rigid surfaces. Cargo transport units with fabric sides or tops are not considered closed cargo transport units.

NOTA for large freight containers the term closed container may be used based on this definition, and covers also the term dry container and which, see below, may also provide the role of packaging for certain radioactive materials.

- Open cargo transport unit: means a unit which is not a closed cargo transport unit.

NOTA : the term "open large freight containers" covers the terms "flatracks" and "platforms" which are most regularly used for international multimodal shipment of UF6 packages and fresh nuclear fuel assemblies packages, based on this definition. Flatracks and platforms, not being enclosed, may not perform the function of packaging.

- Conveyance means:

1. For transport by road or rail : any vehicle
2. For transport by water: any ship or any cargo space or defined deck area of a ship.
3. For transport by air: any aircraft.

- Defined deck area: means the area, of weather deck of a ship, or of a vehicle deck of a roll-on/roll-off ship, which is allocated for the stowage of dangerous goods.

NOTA The term Defined area is used in the table of TI limits in the IMDG code, but not in SSR-6, hence these two terms and definitions should be considered as identical.

- Exclusive use: for the transport of radioactive material, means the sole use, by a single consignor, of a conveyance, or of a large freight container, in respect of which all initial, intermediate and final loading and unloading and shipment are carried out in accordance with the directions of the consignor or consignee, where so required by the this Code.
- Freight container: means an article of transport equipment that is of permanent character and accordingly strong enough to be suitable for repeated use; specially designed to facilitate the transport of goods, by one or more modes of transport, without intermediate reloading; designed to be secured and/or readily handled, having fittings for these purposes, and approved in accordance with the International Convention for Safe Containers (CSC), 1972, as amended. In addition: small freight container means a freight container that has an internal volume of not more than 3 cubic metres. Large freight container means a freight container that has an internal volume of more than 3 cubic metres. For freight containers for the transport of radioactive material, a freight container may be used as a packaging.

NOTA: The SSR-6 2012 edition specifies in addition that the term "Freight container" does not include the vehicle.

- Overpack: means an enclosure used by a single consignor to contain one or more packages and to form one unit for the convenience of handling and stowage during transport. Examples of overpacks are a number of packages either:
 1. Placed or stacked onto a load board, such as a pallet, and secured by strapping, shrink-wrapping, stretch-wrapping, or other suitable means; or
 2. Placed in a protective outer packing such as a box or crate.

NOTA: This term is inappropriate, and should not be used, for designation of the outer protecting packagings or equipment whose are part of the "packages" as specified in the corresponding package design certificates of approval. Similarly, a large container (closed or open) should not to be regarded as an overpack in the context of the application of the IMDG Code.

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- *Package*: means the complete product of the packing operation, consisting of the packaging and its contents prepared for transport.
 - *Packaging*: means one or more receptacles and any other components or materials necessary for the receptacles to perform their containment and other safety functions.
 - *Vehicle*: means a road vehicle (including an articulated vehicle, i.e. a tractor and semi-trailer combination) or a railroad car or railway wagon. Each trailer shall be considered as a separate vehicle.

Other deduced definitions and meanings from the IMDG 2014 edition:

- *Cargo space*: means in a sea vessel any hold or compartment physically separated from other cargo spaces.

4. SHIPMENT OF UF6 PACKAGES

To allow multimodal transport and for ease of handling and securing to the conveyances for transport, UF6 packages are often secured to Flatracks (open type large freight containers).

This enables the lowering of possible radioactive dose uptake to personnel handling and securing the packages, particularly at sea ports, onboard vessels and at road / rail transfer terminals, by reducing the amount of time required for these operations. Use of open sided flatrack not only allows for the ease of loading the cylinder on the flatrack but also allows for the ease of movement around the packages and better oversight of securing arrangements compared to those that would be available when using closed or open top large freight containers.

Type 48X and 48Y packages which may, as required by the Certificates of Approval of Package Design for the Carriage of Radioactive Material, be packed into thermal protective outer packagings, are secured to Flatracks by the use of specially designed cradles and strapping affixed to the cylinder lifting lugs. One package is loaded per 20ft flatrack.

Type 30B cylinders are packed into the different design Protective outer packagings by cradle latches and locking pins. The complete packages are in turn secured to the Flatracks using high strength bolts. Generally up to 4 complete packages are secured to each flatrack.

Flatracks facilitate transport by one or more modes, without intermediate unpacking of the flatrack and facilitates the use of standard lifting and securing means. Flatracks, are designed and tested to ISO 1461-1, and approved and maintained in accordance with the International Convention for Safe Containers (CSC).

UF6 packages are secured in such a manner that package labels remain visible for all packages. As well since flatracks are large freight containers, they are also labelled

Placarding of flatracks is performed in accordance with IMDG 5.3 placarding and marking of cargo transport units.



Fig (1) 20FT Fixed Post Flatrack (30B cylinder packed in type UX-30 outer packagings)



Fig (2) 20FT Flatrack loaded with a 48Y package (with no thermal protection)



Fig (3) 20FT Fixed Post Flatrack with a 48Y package (with Composite Thermal Protector)



Fig (4) Flatracks on a sea vessel

5. DETERMINATION OF TI AND CSI LIMITS

In accordance with IMDG 2014 paragraph 7.1.4.5.3 the TI and the CSI limits are determined based on the Table in 7.1.4.5.3.1 "TI limits for freight containers and conveyances not under exclusive use" and the Table in 7.1.4.5.3.4 "CSI limits for freight containers and conveyances containing fissile material".

Except under conditions of exclusive use, the limit of the total TI for a freight container and the conveyance shall not exceed the limits shown in the table 7.1.4.5.3.1.

The limits of the total CSI for large freight containers and conveyances shall not exceed the limits shown in table 7.1.4.5.3.4 . The CSI limits are presented for transport under and not under exclusive use.

Since Flatracks may be considered in accordance with IMDG 2014 to be large freight containers, but are not specifically mentioned in the tables in part 7.1.4.5.3 of the IMDG code 2014 which defines limits for closed containers, the lowest TI and CSI limits are used, that is the limits presented for the groups of packages, overpacks and small freight containers in the tables 7.1.4.5.3.1 and 7.1.4.5.3.4.

TI limits for conveyances not under exclusive use.

For this reason, under non-exclusive use, the TI limit for type 30B, 48X, 48Y packages secured on Flatracks for a complete hold compartment or defined deck area is 50.

NOTA:

The equivalent TI limit for packages in large closed freight containers is 200. Hence, for non-exclusive use, in case of mixing of 30B, 48X, 48Y packages secured on Flatracks with large freight containers (closed containers), the TI limits of 50 for flatracks, and of 200 for the sum of all Flatracks and closed containers, per complete hold compartment or defined deck area, would apply together to avoid exclusive use.

Also, for this reason, under non-exclusive use, the TI limit for type 30B, 48X, 48Y packages secured on Flatracks for the total vessel is 200.

NOTA: For packages in large closed freight containers there is no total TI vessel limit applicable to remain under non-exclusive use. In case of mixing between the flatracks and closed containers, the vessel limit of 200 for flatracks, and the no limit for closed containers, apply together to avoid exclusive use.

CSI limits for conveyances not under exclusive use.

For this reason, under non-exclusive use, for type 30B packages secured on Flatracks, the CSI limit for a complete cargo space (that is complete hold or compartment) or defined deck area is 50.

NOTA:

The equivalent CSI limit for packages in large closed freight containers is 50. Hence, for non-exclusive use, in case of mixing of 30B packages secured on Flatracks with large freight containers (closed container), the CSI limit of 50 must also be considered and applied as a total limit for the sum of all flatracks and closed containers present in a complete hold, compartment or defined deck area, to avoid exclusive use.

Also, for this reason, under non-exclusive use, the CSI limit for the total vessel for type 30B packages secured on Flatracks is 200.

NOTA: For packages in large closed freight containers there is no total CSI vessel limit applicable to remain under non-exclusive use. In case of mixing between flatracks and closed containers, the total vessel limit of 200 for type 30B packages secured on Flatracks, and the no limit for closed containers, must be applied together to avoid exclusive use.

All this is subject to the additional requirements in b) of table 7.1.4.5.3.4, and especially that consignments must be handled and stowed in such a way that the total sum of CSIs in any group does not exceed 50, and that each group is handled and stowed so as to maintain a spacing of at least 6 metres from other groups.

The maximum number of type UX-30 type packages permitted within a single hold compartment (cargo space) or defined (deck) area is 10, since the CSI of each UX-30 package is equal to 5. The maximum number of UX-30 packages permitted aboard the entire vessel is 40.

TABLE 7.1.4.5.3.1

TI limits for freight containers and conveyances not under exclusive use

Type of freight container or conveyance	Limit on the total sum of transport indexes in a freight container or aboard a conveyance
Freight container	
Small freight container	50
Large freight container	50
Vehicle	50
Inland waterway vessel (barge)	50
Seagoing vessel ^a	
1 <i>Hold, compartment or defined area</i>	
Packages, overpacks, small freight containers	50
Large freight containers (closed containers)	200
2 <i>Total vessel</i>	
Packages, overpacks, small freight containers	200
Large freight containers (closed containers)	No limit

- a packages or overpacks transported in or on a vehicle which are in accordance with the provisions of 7.1.4.5.5 may be transported by vessels provided that they are not removed from the vehicle at any time while on board the ship

TABLE 7.1.4.5.3.4

CSI limits for freight containers and conveyances containing fissile material

Type of freight container or conveyance	Limit on the total sum of transport indexes in a freight container or aboard a conveyance	
	Not under exclusive use	Under exclusive use
Freight container		
Small freight container	50	n.a.
Large freight container	50	100
Vehicle	50	100
Inland waterway vessel (barge)	50	100
Seagoing vessels ^a		
1 <i>Hold, compartment (cargo space) or defined deck area</i>		
Packages, overpacks, small freight containers	50	100
Large freight containers (closed containers)	50	100
2 <i>Total vessel</i>		
Packages, overpacks, small freight containers	200 ^b	200 ^c
Large freight containers (closed containers)	No limit ^b	No limit ^c

a Packages or overpacks transported in or on a vehicle which are in accordance with the provisions of 7.1.4.5.5 may be transported by ships provided that they are not removed from the vehicle at any time while on board the ship. In the case, the entries under the heading “under exclusive use” apply.

b The consignment shall be served handled and to do that the total sum of CSI's in any group does not exceed 50, and that each group is handled and stowed so as to maintain a spacing of at least 6 m from the other groups

c The consignment shall be handled and stowed that the total sum of CSI is in any group does not exceed 100, and that each group is handled and stowed so as to maintain spacing of at least 6 m from other groups. The intervening space between groups may be occupied by other cargoes.

NB.

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