

Stowage of radioactive packages, materials or objects for transportation

GUIDE No. 27

Version of 11/30/2016



Preamble

The ASN collection of guides is intended for professionals concerned by the nuclear safety and radiation protection regulations (licensees, users or transporters of ionising radiation sources, health professionals).

These guides can also be issued to the various stakeholders, such as the local information committees (CLIs).

Each guide sets out recommendations with the aim of:

- explaining the regulations and the rights and obligations of the persons concerned by the regulations;*
- explaining the regulatory objectives and, as applicable, describing the practices considered by ASN to be satisfactory*
- giving practical tips and information concerning nuclear safety and radiation protection*

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1. INTRODUCTION

1.1. Purpose of the guide

Secure stowage of packages is an important aspect of the defence in depth approach which serves to ensure the safety of transport operations. The regulations therefore require consignments to be securely stowed¹. This is why ASN, in consultation with the actors of the profession, has drawn up this guide and its recommendations, which aim to ascertain the quality of stowage of radioactive packages, materials and objects for transportation.

The third part of this document provides a review of the regulatory requirements and presents the ASN recommendations for all the enterprises involved in the stowage process.

The fourth part of the document sets out the ASN recommendations concerning specific training in the stowage of loads for all persons involved, be it the design, planning, implementation or inspection of the stowage.

1.2. Definitions

In the remainder of the document:

- the term "loads" designates the radioactive packages, materials or objects;
- the term "transport units" designates the road vehicles, railway wagons or containers;
- the term "Unit Load Device" or "ULD" designates the loading units used specifically for transporting air freight.

1.3. Scope of application

This guide applies to:

- stowage operations for road transport, performed by the road transport loaders or consignors;
 - o including stowage operations in containers intended for road transport;
- stowage operations for rail transport, performed by the rail transport loaders or consignors;
 - o including stowage operations in containers intended for rail transport;
- stowage operations on or in transport units intended for transport by ship, carried out by the loaders;
 - o the stowage of the loads on the ships is excluded from these recommendations;
- the stowage operations inside transport containers (freight containers other than ULDs) intended for air transport, carried out by the consignors or loaders;
 - o the stowage of the loads in the aircraft and in the ULDs is excluded from these recommendations;
 - o the stowage of the loads in transit within the bounds of the airport is excluded from these recommendations.

¹ Paragraphs 7.5.11 CV33 (3.1) of the ADR [3], 7.5.11 CW33 (3.1) of the RID [4], 7-2.4.2 of the ICAO TIs [7], rule 5 of appendix III of chapter VII of part A of the SOLAS Convention [5].



They do not substitute for the regulatory requirements or the requirements specific to the modes of transport by road, rail, sea and air (see § 2).

This guide does not cover the design of the attachment points integrated on the packages, which is covered by IAEA guide SSG-26 [2].

1.4. Document status

This guide results from the reflections of the working group set up by ASN on the issues relating to stowage and human factors, which brought together various transport industry players at the sessions of 19 January, 21 March and 25 May 2016. It formed the subject of a public consultation in September 2016.

2. REGULATORY CONTEXT

2.1. Regulatory references

The main reference texts are listed below:

- [1] IAEA (International Atomic Energy Agency) Specific Safety Requirements publication No. SSR-6 Regulations for the Safe Transport of Radioactive Material, 2012 issue.
- [2] Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition) Series No. SSG-26;
- [3] European agreement concerning the international carriage of dangerous goods by road, known as "ADR";
- [4] Regulations concerning the international carriage of dangerous goods by rail, appearing as appendix C to the COTIF convention, "known as "RID";
- [5] International maritime code for dangerous goods, regulations implementing chapter VII part A of the 1974 international convention for the safety of human life at sea (SOLAS convention), known as the "IMDG code";
- [6] INF Code: International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on board Ships;
- [7] Technical instructions for the safe transport of dangerous goods by air, supplementing appendix 18 to the 1944 Chicago convention on international civil aviation, known as "ICAO TI".
- [8] Council Regulation (EEC) No.3922/91 of 16 December 1991 on the harmonisation of technical requirements and administrative procedures in the field of civil aviation;
- [9] Commission Regulation (EC) No. 859/2008 of 20 August 2008 amending Council Regulation (EEC) No. 3922/91 as regards common technical requirements and administrative procedures applicable to commercial transportation by aeroplane;
- [10] Directive 2014/47/EU of 3 April 2014 relative to the technical roadside inspection of the roadworthiness of commercial vehicles circulating in the Union
- [11] Order of 29 May 2009 amended, on the land transport of dangerous goods (known as the "TMD order");
- [12] Order of 23 November 1987 amended on the safety of ships;
- [13] Order of 18 July 2000 amended regulating the transport and handling of dangerous goods in seaports;



2.2. Standards and recommendations

The principal standards and recommendations in effect concerning the stowage of loads are listed below:

Standard NF EN 12195 "Load restraint assemblies on road vehicles – Safety";<

- Part 1: Calculation of securing forces;
- Part 2: Web lashing made from man-made fibre;
- Part 3: Lashing chains;
- Part 4 : Lashing steel wire ropes;

- [15] Standard NF EN 12640 "Securing of cargo on road vehicles - Lashing points on commercial vehicles for goods transportation - Minimum requirements and testing
- [16] Standard NF EN 12642 "Securing of cargo on road vehicles. Body structure of commercial vehicles. Minimum requirements";
- [17] Standard NF ISO 27956 "Road vehicles — Securing of cargo in delivery vans — Requirements and test methods":
- [18] Standard NF ISO 1496 "Series 1 freight containers - Specifications and testing";
- [19] Standard NF ISO 16049 "Air cargo equipment – Restraint straps";
- [20] IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code);
- [21] European best practice guidelines – Cargo securing for road transport;
- [22] Loading guidelines of the UIC (International Union of Railways);
- [23] International Convention for Safe Containers (CSC) of 1972;
- [24] EPSF (French national railway safety authority) Recommendation RC A-B 7d No.3 "Vehicle loading requirements".

2.3. Regulatory framework and applicable technical requirements

2.3.1 Cargo stowage for road transport in France and the EU

The general rules for stowing cargo on or in road vehicles are stipulated in the legislation concerning road safety in the various EU member countries.

In France these rules are stipulated in article R-312-19 of the Transport Code. They do not make reference to any standards, but they indicate general principles.

With regard to dangerous goods, paragraph 7.5.7 of the ADR [3] stipulates the stowage rules that are considered satisfactory when stowage is carried out in accordance with standard [14].

In 2014 the European Commission's Directorate-General for Mobility and Transport published a code of practice [20] based on the European Standard [14]. This code was established by a group of experts designated by the EU member states and industry. The code is intended to support application of the international rules that are set by the ADR [3] and the European Directive [10].

As a result of this, responsibility for stowage lies with several players, primarily those involved in planning, loading and driving, and the standard routinely used for proof of stowage quality is standard [14].



2.3.2 Cargo stowage for rail transport in France and the EU

According to the rail transport regulations in force in the EU and France, cargos must be stowed in accordance with the stowage guidelines drawn up by the railway companies.

The General Contract of Use for wagons - GCU, which has been signed by the majority of railway companies and companies owning EU wagons, obliges the railway companies to ensure that consignors comply with the guidelines [22].

The French national railway safety authority (EPSF) considers that performing stowage operations in accordance with the principles set out in the guidelines [22] constitutes an acceptable means of complying with the railway safety regulations [24].

As a result of this, responsibility for the stowage of cargo on a wagon lies with the loader or railway consignor, and the minimum stowage requirements are those of the loading guidelines [22] published and updated regularly by the UIC (International Union of Railways).

2.3.3 Cargo stowage for maritime transport in France and the EU

According to the international and French regulations, the transport units (road vehicle, railway wagons and freight containers) and the cargo stowed directly on the ship - whether it is INF cargo or not (INF cargo: irradiated nuclear fuel packages, high-level or plutonium waste) - must be stowed and secured exclusively in accordance with the ship's "cargo securing manual". These stowage and lashing (securing) operations are carried out by the ship's crew or the port handling personnel under the sole responsibility of the ship's crew.

Cargo loading, lashing and bracing in or on the transport units (road vehicle, wagon or container with its load placed on board the ship) must be carried out in accordance with the provisions of the CTU Code of Practice [20] under the responsibility of the person (loader) who signs the loading certificate that accompanies the consignment, on the transport unit loading site (on the consignor's premises or in an intermediate transit facility).

2.3.4 Cargo stowage for air transport in France and internationally

According to the international and European regulations, the stowage of cargo on board aircraft is the responsibility of the air operator (airline) in accordance with the aircraft weight and balance manual (WBM), approved by the authority that certified the aircraft. More specifically, the stowage equipment (pallets, igloo container, air transport container, nets, chains and lashings) are those authorised for the aircraft in accordance with the WBM. The cargo is stowed in the aircraft by specialised personnel trained in accordance with the operator's directives.

Likewise, the stowage of loads during road transit within the airport is ensured by trained personnel in accordance with the procedures of the freight company and complies with the specific instructions of the operator.

If a closed container (other than a ULD) is handed over to air transport by the consignor or loader, only the stowage of the container on board the aircraft is the responsibility of the operator: the stowage of the packages inside the container is therefore the responsibility of the consignor or loader.



3. REGULATORY REQUIREMENTS AND ASN RECOMMENDATIONS CONCERNING THE STOWAGE OF RADIOACTIVE LOADS

- 1- The company's **management system**² must be established for all the activities associated with the movement of radioactive materials. It should specifically address the load stowage activity, and indicate in particular:
 - the stages of the stowage process;
 - the personnel involved in the stowage process;
 - the training this personnel has received;
 - the various inspections planned for and the personnel in charge of them.

The documents relating to the various stages of the stowage process are recorded in order to ensure the traceability of the operations performed, particularly the inspections.

Incidents relating to stowage must be recorded, notified to ASN³ in accordance with the regulations in effect, and analysed. The aim of tracking and analysing such incidents is to identify any corrective measures to apply to prevent their recurrence or aggravation.

- 2- The persons involved in the design, planning, implementation and inspection of stowage must follow **specific training in the stowage of loads** on the transport units, as appropriate for their area of involvement, in order to satisfy the regulatory requirements⁴. In accordance with these requirements, the persons involved must be trained before they assume their responsibilities. For workers to fulfil functions for which they have not yet received the required training, they must be placed under the direct supervision of a trained person. Periodic "refresher" training must be provided to maintain a satisfactory level of proficiency. This training should moreover comply with the ASN recommendations set out in part 4 of this guide. In the case of road transport, this training should supplement the training given to road transport drivers on account of the regulations (ADR certificate)⁵.
- 3- **Packing plans, stowage plans** or **specific instructions** are provided for situations involving complex or unusual loads. They are produced in accordance with the standards and recommendations in effect in the countries **passed through**, by competent personnel trained in accordance with paragraph 2 above. The plans or instructions are **made available** to the persons carrying out the stowage operations and inspections, along with the necessary information. It is recommended under all circumstances to ensure the traceability of the stowage operations (diagrams, photos, instructions, etc.).
- 4- If there are no stowage plans, **the appropriate stowage system** is chosen by competent workers on the basis of an analysis of the load to transport (geometry, materials, weight, presence of retention devices), of the transport unit used and the available stowage equipment. The system shall comply with the standards and recommendations in effect (see § 2.2).
- 5- The **appropriateness of the available equipment for the stowage operations** is systematically checked by the workers. The equipment must be in good condition and comply with the requirements and standards in effect. Nonconforming equipment must be detected and replaced before starting stowage.

² § 1.7.3 of the ADR [3] and of the RID [4]: "Management system" / § 1.5.3 of the IMDG code [5]: "Quality Assurance" / Part 1.6.3 of the ICAO TI [7]: "Management system"

³ ASN Guide to the procedures for notifying events involving radioactive material transport

⁴ § 1.3 of the ADR [3] and of the RID [4]: "Training of persons involved in the carriage of dangerous goods" / § 1.3 of the IMDG code [5]: "Provisions concerning training" / Part 1.4 of the ICAO TIs [7]: "Training"

⁵ § 8.2.2 of the ADR [3]: "Special requirements concerning the training of drivers"



Examples of nonconforming equipment:

- vehicle and/or stowage system not suited to the loads;
 - wear of the stowage system (straps, chains, bars, mats, etc.);
 - absence or nonconformity of the anchor points / bracing systems necessary to secure the loads on the vehicle platform or inside the container.
- 6- The **documentation necessary for ensuring correct stowage** is made available to the workers. This documentation can consist of the standards and recommendations in effect, a stowage guide specific to the company's activity, or technical instruction manuals for the stowage systems. The aim is to help the workers carry out the stowage-related activities correctly (design, planning, implementation and inspection). This documentation should therefore be appropriate for the activities involved and remain practical (be self-sufficient, provide concrete examples, address situations actually encountered by the company, indicate how to use the equipment provided for the workers, be sufficiently compact for make for easy consultation, etc.).
- 7- The necessary measures to ensure worker safety during the loading and stowage operations must be taken in accordance with the regulations⁶. More specifically, the workers must wear the **personal protective equipment** necessary to perform these operations safely (gloves, safety footwear, jackets, etc.), and have **appropriate tools** for the stowage systems used.
- 8- **A stowage quality inspection** is always carried out. The management system **specifically** defines the methods of this inspection, according to the technical complexity of stowage and the associated risks. It is recommended that an inspection be carried out by a competent person other than the person who performed the stowage, who is trained in accordance with paragraph 2 above, at least for non-routine operations (package of non-standard shape or complex packing plan) or for packages that require ASN approval. This inspection must serve in particular to:
- verify the appropriateness and condition of the stowage system used;
 - verify stowage effectiveness (example: verification of strap tension, of load bracing);
 - check there are no risks of stowage system deterioration during transport (example: protection of straps or chains against sharp edges);
 - ensure that any other objects present in the vehicle cannot damage the package during transport (example: unsecured blunt-edged tools placed beside the package).

When possible, the driver should check that loads are correctly secured during carriage, particularly at the start of the journey and after any abnormal situation during the journey, as well as in the event of a long-duration stoppage.

4. RECOMMENDATIONS CONCERNING SPECIFIC TRAINING IN THE STOWAGE OF RADIOACTIVE LOADS

4.1. Conditions of training

All the workers involved in the design, scheduling, implementation or inspection of stowage are concerned by this training.

The minimum duration of training should be 2 days, with at least one day devoted to practical exercises.

⁶ Article L.230-2 of the Labour Code



The training should include a formal final assessment to validate the acquired skills. This assessment, which shall be adapted to suit the type of worker (designer, operator, inspection delegate), should include at least one theory test and one practical test.

A "refresher" course should be planned every 5 years at least to guarantee the maintaining of proficiency. This refresher course should last at least one day and include a formal assessment.

The instructors conducting the training courses should have extensive experience with stowage issues. They themselves should be trained beforehand by organisations competent in the stowage of loads on means of transport, or else, depending on the complexity of the operations carried out in the company, be experienced employees capable of passing on the knowledge described below. The instructors should also be well versed in the transport of dangerous and radioactive goods (risks and specific stowage provisions).

The recommendations of this part can be adapted according to the complexity of the stowage operations.

4.2. Content of the training

This training should include a common core followed by all the workers and addressing at least the following subjects:

- presentation of the regulatory and technical basics of load stowage (regulations, responsibilities, risks, lessons learned from recurrent incidents, etc.);
- description of the various forces acting on the loads depending on the modes of transport;
- presentation of the different types of means of transport, the associated anchor points and their capacities (container, flat-bed vehicle, van, light vehicle, wagon, etc.), and the principle of load distribution;
- presentation of the main stowage methods, their physical principles and the associated equipment (straps, chains, bars, angle sections, mats, nets, bracing blocks, etc.);
- explanation of the choice of the appropriate stowage system according to the means of transport, the anchor points and the load characteristics (geometry, material, weight, retention devices, etc.);
- presentation of the inspection points to check the proper stowage of a load on a means of transport, and the satisfactory condition of the stowage equipment and the anchor points;
- practical exercises:
 - choice of appropriate equipment according to the situation;
 - verification of the condition and conformity of the equipment and anchor points;
 - utilisation of the principal stowage equipment;
 - utilisation of different types of equipment to secure a given load;
 - stowage of loads with different characteristics;
 - self-checking and mutual checking of stowage operations.

The "practical exercises" can be adapted to the types of stowage the trainees are required to carry out within their companies in order to draw maximum benefit from them.

To be able to fulfil their functions, the persons responsible for stowage design must be capable of:

- dimensioning and justifying the means of stowage (choice of equipment and drawing up design calculation notes in accordance with the standard in effect);
- writing stowage instructions (concise, simple and easy to understand).

The training followed by these workers must therefore be supplemented to address these subjects, taking account of the skills already acquired in previous training courses.

As a general rule the training should be adapted to suit the types of workers.



4.3. Objectives of the training

On completion of training, the trainee should be capable of:

| | Designers | Operators | Inspection delegates ⁷ |
|--|-----------|-----------|-----------------------------------|
| Estimating the physical forces and stresses induced according to the mode of transport used | X | X | X |
| Identifying the different types of means of transport and the associated anchor points | X | X | X |
| Determining the different stowage methods and the associated stowage equipment | X | X | X |
| Designing and justifying a stowage technique in accordance with the rules in effect (choice of stowage method, choice of stowage equipment, design calculation note) | X | | |
| Writing stowage instructions (concise, simple and easy to understand). | X | | |
| Determining, inspecting and judging the condition of the stowage equipment (straps, hooks, rings, slings, chains, tensioners, nets, anti-slip mats, etc.) and their loading capacity | X | X | X |
| Checking the condition of the means of transport and their anchor points | X | X | X |
| Checking the condition of the loads to be stowed and the securing devices provided on them, where applicable | X | X | X |
| Carrying out stowage in accordance with the instructions provided and the rules of good practice and verifying its effectiveness | | X | |
| Carrying out simple stowage operations in accordance with the rules of good practice without stowage instructions | | X | |
| Inspecting a simple stowage operation or one carried out on the basis of stowage instructions | X | X | X |
| Proposing the optimisation of a stowage configuration deemed insufficient by an inspection | | | X |

⁷ Drivers who are required to inspect the stowage are also "inspection delegates"





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