

Design of Methodological Procedures for the Handling and Transport of Dangerous Goods by Air

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Abstract: This article consists of identifying important elements of the transport process of dangerous goods in all modes of transport, in recognizing and warning about the differences between theory and practice and designing optimized methodological procedures used in this transport process. The methodological procedures should have importance during whole transport process, from the order, through the accepting and identification of the goods, the packing, handling to the actual transport of dangerous goods by air.

Keywords: Aviation, dangerous goods, freight-forwarding, methodological procedures

1. Introduction

Air transport differs significantly from other modes of transport for its technology and transport process. As the transport of persons and cargo is carried out in the airspace and not on the roads, great importance is placed on safety before the transport itself. Air transport is different from other modes of transport for its speed and overcome of large distances, particularly on an international scale.

Very specific is the transport of dangerous goods, which is subject to a number of international agreements, regulations and procedures that are different from other modes of transport and updated in a more frequent period. Methodological procedures by which airlines, airport handling agents and other employees are managed are currently fully developed by companies themselves, taking into account all international agreements and regulations that need to be followed. In cooperation with them, a proposal for a uniform methodological procedure covering all areas of the transport process was carried out.

2. Data and Methods

Air carriers, operators and ground handling companies, consignors and freight-forwarders and their employees generally manage identification, handling and transport of dangerous goods by internal documents, manuals and methodological procedures that they designed according to international conventions and agreements. In practice, these documents commonly refer to „Workbooks“, „Dangerous Goods Loading Plans“, „Dangerous Goods Guide Books“, or they include these information in their „Ground Operations Manuals (GOM)“, „Ground Handling Manuals (GHM)“ and other documents.

A few examples of methodological procedures used (for illustration):

- Menzies Aviation – „Dangerous Goods Categories 7, 8, 9, 10, 12 Workbooks“
- Austrian Airlines – „Aircraft Handling and Ramp Supervision – Self Study“
- NextJet – „Ground Operations Manual GOM“
- Titan Airways – „Ground Handling Manual GHM“
- DHL – „Lithium Battery Guidance“
- Swiss International AirLines – „Ground Operations Manual GOM“
- SAS – „Ground Operations Manual GOM“
- AirFrance – „Dangerous Goods Loading Plans“

In order to verify the differences between theory and practice, a customer test was carried out to attempt to send a UN3480 – Li-ion battery LGABB41865 to a destination in Northern Ireland by DHL, UPS and Slovak Post (Fig. 1). After learning about shipping and business conditions, it was found that the Slovenská pošta has excluded any dangerous goods from international shipments even if they are properly identified, marked and packed [1].



Fig. 1 Battery LGABB41865 (UN3480). Source: [1]

UPS and DHL companies require more detailed information about dangerous goods from the customer. In the case of UN3480 and other UN-related batteries, there are also lithium battery guides. In both cases, however, the transport was refused, respectively companies demanded a personal audit. Physical persons cannot therefore submit a shipment containing dangerous goods [2,3]. The test assumes that companies are guided by internal procedures, which they also follow. Used methodological procedures contain several requirements and restrictions that need to be followed. These are not uniformed.

In developing a proposal for a unified structure of methodological procedures, several documents used in cooperation with several airlines were taken into account. This section should include sufficient technical information to enable the experiments to be reproduced. In theoretical papers comprising the computational analyses, technical details (methods, models applied or newly developed) should be provided to enable the readers to reproduce the calculations.

3. Results

The aim is to propose a unified form of methodological procedures applicable to all companies and organizations involved in the transport of dangerous goods. Since each handling company is required to draw up the „AHM – Aircraft Handling Manual“ and each airline „GHM – Ground Handling Manual (or GOM)“, it is appropriate that the parts of the documents relating to the carriage of dangerous goods have a unified form. The proposed structure of unified methodological procedures includes the following 10 key points:

1. Company information – A chapter containing information about organization, its structure, form, contacts. It is advisable to inform about which legislation and international agreements are used in the methodological procedures.










2. Responsibility and training – It is a need to define responsible persons, their duties and areas of activity, to regularly train all the employees involved and to keep records about, to take into account all new issues of documents governing the transport of dangerous goods.

3. Definitions – This chapter defines the basic terms, persons involved in the transport, terms and definitions, abbreviations, codes, signs and marks.

4. Classification of dangerous goods and safety labels – IATA DGR precisely defines which persons must know aspects relating to the classification of dangerous goods in air transport. The full classification of dangerous goods should be supplemented by a simplified card for the fast identification of dangerous goods (Table1).

Table 1 Excerpt from the dangerous goods classification card for methodological procedures.

Source: [4]

Safety label	Class	IMP code	Class name	Risks	Comment
	1.1 1.2 1.3	REX RCX RGX	1 – Explosives	Fire or minor explosion	REX forbidden
	1.4B 1.4C 1.4D 1.4E 1.4G 1.4S	RXB RXC RXD RXE RXG RXS	1 – Explosives	Fire with another significant danger	
	1.5	REX	1 – Explosives	Fire or explosion	REX forbidden
	1.6	REX	1 – Explosives	Fire or explosion	REX forbidden
	2.1	RFG	2.1 – Flammable gases	Ignition when leaking	
	2.2	RNG	2.2 – Non-flammable non-toxic gases	High pressure	
	2.2	RCL	2.2 – Non-flammable non-toxic gases - cryogenic	High pressure, very low temperature	
	2.3	RPG	2.3 – Toxic gases	High pressure, toxic inhalation	Only authorized in CAO, min. 25metres
	3	RFL	3 – Flammable liquids	Fire, flammable vapors	

This chapter also includes the identification of hidden risks, which is also one of the training aspects for all persons involved in the transport of dangerous goods by air („Recognition of Undeclared Dangerous Goods“ or „Hidden Dangerous Goods). Ordinary commercial items, consumer goods, household personal items may be marked as potentially containing dangerous substances. For example:

- Household chemicals;
- Household goods;
- Refrigerators;
- Tool kits and machines;

- Camping equipment;
- Medical instruments, supplies, vaccines and pharmaceuticals;
- And others.

5. Exclusions from the shipment – Any airline, ground handling operator or freight-forwarder should in its methodological procedures define which classes, divisions or substances (named UN number of substances and Packing Group) will not be transported or manipulated. Companies must obey or tighten the provisions of the IATA DGR, based on their practices and experiences, technology and philosophy of the company (Table 2).

Table 2 Excerpt from the Exclusion card. Source: [5]

Class	IMP code	UN substances
1.1	REX	All UN substances excluded from transportation.
1.2	REX	All UN substances excluded from transportation.
1.3	RGX	All UN substances excluded from transportation.
	RCX	
	REX	
1.4	RXB	All UN substances excluded from transportation.
	RXC	
	RXD	
	RXE	
	RXG	
	REX	
	RXS	
1.5	REX	All UN substances excluded from transportation.
1.6	REX	All UN substances excluded from transportation.
2.1	RFG	UN1972, UN1060, UN1978, UN2571, UN3358...
2.2	RNG	UN2201, UN1073, UN3220, UN1078, UN1009...
2.2	RCL	All UN substances excluded from transportation.
2.3	RPG	All UN substances excluded from transportation.
3	RFL	UN1294, UN1305, UN1114, UN1991, UN1202...

6. Dangerous Goods Identification – All persons involved in the transport of dangerous goods, including packing and filling organizations, consignors and freight-forwarders, must be able to identify the dangerous goods correctly. It is therefore recommended to provide detailed explanations of the individual IATA DGR columns in the methodological procedures. It is also appropriate to clarify other ADR, ADN, RID, IMDG Code and other documents (Fig.2).

7. Packaging – Proper packaging of a dangerous goods is one of the prerequisites that organizations should control. Suggested structure of methodological procedures involves the explanation of the labeling of approved UN packaging for dangerous goods (Fig. 3).

UN/ ID no.	Proper Shipping Name/Description	Class or Div. (Sub Risk)	Hazard Label(s)	PG	Passenger and Cargo Aircraft						Cargo Aircraft Only		S.P. see 4.4	ERG Code	
					EQ see 2.6	Ltd Qty		Pkg Inst	Max Net Qty/Pkg	Pkg Inst	Max Net Qty/Pkg	Pkg Inst			Max Net Qty/Pkg
						Pkg Inst	Max Net Qty/Pkg								
A	B	C	D	E	F	G	H	I	J	K	L	M	N		
3376	4-Nitrophenylhydrazine with 30% or more water, by mass	4.1				Forbidden		Forbidden		Forbidden		A2	3L		
2608	Nitropropanes	3	Flamm. liquid	III	E1	Y344	10 L	355	60 L	366	220 L		3L		

Fig. 2 List of Dangerous Goods according to IATA DGR. Source: [5]

8. Handling and loading – High requirements for the safety of air cargo transport require proper and safe handling, loading and unloading. It is therefore appropriate to develop a „Loading plan“, a plan that would include all the information needed for handling, loading, fastening and other handling operations. It is also possible to incorporate the specific requirements of air carriers, the basic information needed for loading, procedures for detecting the damage and leaking of shipments, safety procedures, but in particular:

- Fast identification of shipments and an example of the correct labeling,
- Procedures for detecting substance leakage,
- Safety instructions,
- Transport exclusions table,
- Suitable ULD for transport, suitable handling equipment,
- Instructions for loading and unloading,
- Mixed loading (incompatibility of substances).

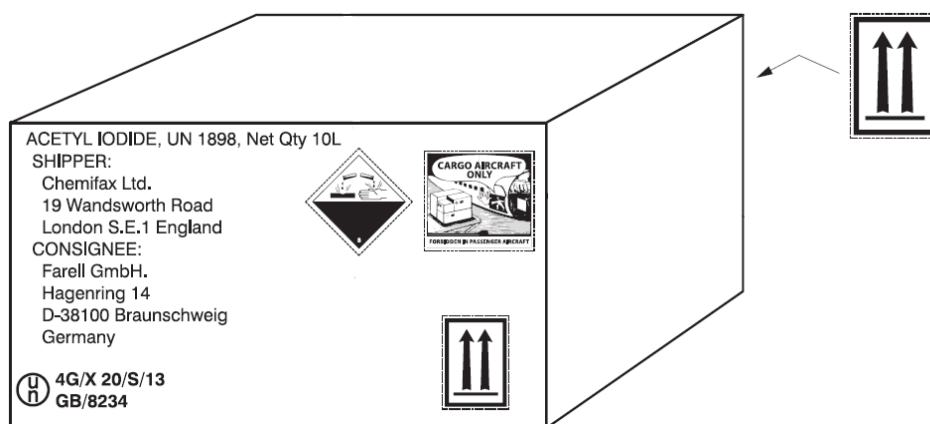


Fig. 3 Correct labeling of shipment containing dangerous goods. [5]

9. Documentation – The basic documents used for the transport of dangerous substances by air transport are:

- AWB – AirWay Bill;
- DGD – Shipper’s Declaration of Dangerous Goods;
- NOTOC – Special Load Notification to Captain.

In this chapter these documents should not only be explained, but also examples of correct completion of these documents should be provided.

Table 3 Example of instructions in the event of an incident with regard to dangerous goods classes.

Source: authors by [4,6]

<i>Class</i>	<i>Immediately perform</i>	<i>Basic instructions</i>	<i>First aid</i>
<i>1 – Explosives</i>	<i>Contact fire service Protect yourself from fire</i>	<i>No smoking and open fire</i>	<i>Treat injuries</i>
<i>2 – Gases</i>	<i>Contact fire service Protect yourself from fire Ventilate Keep min. 25 metres</i>	<i>Ensure adequate ventilation No smoking and open fire Wear protective equipment Handle with care</i>	<i>Ensure injured persons to fresh air Remove contaminated clothing If not breathing, revive Maintain normal body temperature Treat injuries</i>
<i>3 – Flammable liquids</i>	<i>Contact fire service Protect yourself from fire DO NOT extinguish with water in every circumstances</i>	<i>Isolate leaked substances with sand Avoid further leakage Often ventilate</i>	<i>Ensure injured persons to fresh air Remove contaminated clothing If not breathing, revive Treat injuries Wash out injury with water for at least 15 minutes</i>

10. Accidents and incidents – Procedures in the event of accidents and incidents must always be available at every workplace where dangerous goods are handled. ICAO Annex 14 – Airports, in particular Chapter 9 – Emergency and other services require that airport authorities must establish procedures to deal with emergencies related to dangerous goods matters. It is advisable to incorporate these instructions into methodological procedures, with reference to the ICAO Guidelines for Emergency Instructions for Air Accidents involving Dangerous Goods, commonly referred to as the Red Book. The proposed methodological procedures should include all these provisions, including safety cards with quick instructions for each workplace (Table 3).

4. Discussion

At present, the structure of the methodological procedures is not unified. Airline companies and handling agents therefore create them with different content, which may be difficult for the customer, shipper or other business partner to understand and further cooperate. Very different is the present transport of dangerous goods by the other modes of transport (Table 4). They differ not only in technology, but also in regulations governing such transport. Air transport is more difficult to process than the other modes of transport. Differences between modes and their regulations are primarily for Exempted and Limited quantities (or maximum quantity per unit).

With the publication of the agreements governing the transport of dangerous goods there may be a number of issues and problems in practice, especially when the company operates several modes of transport, mainly because of the training of staff and other conditions on staff and safety. The solution to this problem could be publishing updated methodological procedures annually, where all these differences will be taken in place. An annual publication of methodological procedures would not raise problems with updating existing regulations.

Table 4 Comparison of transport of dangerous goods by modes of transport. Source: authors

Mode of transport	Agreement	Conveyance	Personal training	Publication periodicity	Current issue
Air	IATA DGR	ULD	Every year	Every year	IATA DGR 59th (2018)
Road	ADR	Pallets, ISO containers, tank vehicles	Every 5 years	Every 2 years (6-month transition period)	ADR 2017
Rail	RID	Pallets, ISO containers, tank vehicles	Every 5 years	Every 2 years (6-month transition period)	RID 2017
Sea	IMDG code	ISO containers	Every 2 years	Every 2 years (both are valid between each issue)	IMDG 38-16
River	ADN	ISO containers	Every 5 years	Every 2 years (6-month transition period)	ADN 2017

If the company also provides intermodal transport, it is necessary to incorporate the conditions of use of this transport into methodological procedures as well. The advantage of using intermodal transport of dangerous goods consists mainly in:

- Transport costs reduction;
- Transport time reduction;
- Regular connections,
- Large capacity,
- Safety during the entire transport.

Methodological procedures should include all the information concerning such shipment, what transport means and equipment will be for such shipments used and under what conditions the transport of dangerous goods may be carried out by the intermodal transport system [7-11].

5. Conclusion

Air transport is a dynamically developing transport sector. This also applies to the transport of dangerous goods by air. At present time a number of manuals, guide books, methodological procedures, guidelines and other publications are being used for this specific shipping, which shall be followed and incorporated into internal regulations.

The aim of this article is to point out the issue of unconformed general methodological procedures used in the air transport of dangerous goods. Their release should be conditional on current legislation and also on consultations with business partners and other parties.

At present, there is a large amount of differences between individual publications regulating the transport of dangerous goods. Differences arise not only because of the different periods of publications, but also because of the different technologies used and organizations, that issuing these regulations.

The development of optimized methodological procedures with a unified structure is therefore a very complex and slow process. It should include conditions stated by international conventions, but also internal procedures and specific requirements of others. The procedures should be harmonized taking into account all types of transport so that they meet all the conditions of all conventions. The expected result of the streamlining of methodological procedures is to increase the safety and efficiency of the dangerous goods transport process.

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