



SPECIFICATIONS FOR THE TRANSPORT OF DANGEROUS GOODS BY AIR

Peter KOŠČÁK*, Dorota LIPTÁKOVÁ, Zuzana ŠUSTEROVÁ

Faculty of Aeronautics, Technical University of Kosice, Department of Air Transport Management,
Rampová 7, 041 21 Kosice, Slovakia

*E-mail: peter.koscak@tuke.sk

Abstract. The aim of this article is to show for the transport of dangerous substances and the legislation for it. Emphasis is conveyed to determine the handling of dangerous substances in the process of their manipulation and the requirements on transport of dangerous substances by air transport complements. It showed lack of equipment and competent authorities for the timely detection of illegal import of hazardous substances and lack of institutional capacity. Improvement more sophisticated technical equipment and specifically trained personnel and services for transportation and handling of dangerous substances is recommended.

Keywords: dangerous goods, air transports, requirements for technical guidelines, aircraft.

1. INTRODUCTION

Airport Fire and Rescue Service units are sometimes called upon to deal with cargo carried in aircraft that either have crashed or have crashed and caught fire. Fire Service units also have to deal with incidents concerning cargo which is in an airport warehouse or on board an aircraft. Some of the cargo carried by air presents an inherent risk to health, safety, property or the environment and it has to be properly handled at all times. Items of such cargo are called dangerous goods, they are regularly and routinely carried by air on both fixed wing airplanes and helicopters and there are very strict requirements prescribed for their transport. Provided they are correctly dealt with in the transport chain - from the shipper to the consignee, via the operator – they will not cause a problem unless they are involved in some other occurrence, for instance, a fire. Incidents arising from dangerous goods usually happen because of non-compliance with the requirements - e.g. they are wrongly packed or mishandled.

2. DANGEROUS GOODS

Articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in the technical instructions or which are classified according to those instructions.

For air transport, the International Civil Aviation Organization is now responsible for producing the requirements and the standards and recommended practices are in Annex 18 to the Chicago Convention. Compliance with them, which is what Contracting States of ICAO are required to ensure, gives world-wide compatibility of the requirements for air transport.

Annex 18 contains a number of standards and recommended practices that apply to Contracting States, the main ones are to:

- achieve compliance with the Technical Instructions
- have inspection, surveillance and enforcement procedures
- record and investigate dangerous goods accidents and incidents

- have penalties for violations of legislation

Table 1 Dangerous goods classification

Class		Articles or substances
1	Explosives	from substances and articles which have a mass explosion hazard, projection hazard but not a mass explosion hazard to extremely insensitive articles which do not have a mass explosion hazard
2	Gases	Flammable gases, except for aerosols, are restricted to cargo aircraft, non-flammable, non-toxic gases can be carried on both passenger and cargo aircraft and toxic gases are normally forbidden on both passenger and cargo aircraft.
3	Flammable Liquids	Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (eg paints), which give off a flammable vapour at temperatures of not more than 60.5°C closed-cup test or not more than 65.6°C open-cup test
4	Flammable solids and Reactive Substances	Flammable solids, substances liable to spontaneous combustion and substances which, in contact with water, emit flammable gas. Many of the substances in this Class are not permitted in air transport in normal circumstances, however, some of them do not present a significant hazard
5	Oxidisers and Organic Peroxides	Oxidising substances and organic peroxides, for examples chemical oxygen generators and ammonium nitrate fertiliser or thermally unstable substances which may undergo exothermic, selfaccelerating decomposition
6	Toxic and Infectious Substances	Toxic substances and infectious substances - liable to cause death or injury or to harm human health if swallowed, if inhaled or by skin contact and which reasonably expected to cause infectious disease in humans or animals
7	Radio-active Materials	Air transport is commonly used for radioactive materials since many of them they have a relatively short half-life; almost all those carried by air are radioisotopes for medical use for diagnosis and treatment or industrial sources; common radionuclides are Iodine 125 (I-125), Iridium 192 (Ir-192) and Caesium 137 (Cs-137).
8	Corrosives	Corrosive substances can cause severe damage by chemical action when in contact with living tissue, or can materially damage freight or the means of transport.
9	Miscellaneous Dangerous Goods	They include liquids or solids which have narcotic or noxious properties that could affect the crew of an aircraft in the event of a leakage.

2.1. International requirements

The basic condition is to comply with ICAO Doc 9284 - Technical Guidelines for the Safe Transport of Dangerous Goods by Air. These are very comprehensive; among other things, they require operators to have an approval to carry dangerous goods, which is not a requirement of the Annex but is seen as an aid to enforcement. They also both generally and specifically require that dangerous goods be carried in accordance with the Technical Instructions.

The air transport of dangerous goods is an international activity with road/rail transport likely at either end of the journey. To facilitate the consignment of dangerous goods there is a need for the air transport requirements to be the same throughout the world and for the road/rail requirements to be sufficiently similar to those in air transport to enable goods to be consigned from shipper to consignee without intermediate re-classification, re-packing, etc.

The guidance in these two documents (Annex 18) form the basis for the requirements in all the modes of Transport.

Table 2 Regulation of dangerous goods transport

Air transport	ICAO	International Civil Aviation Organization (Technical Instructions for the Safe Transport of Dangerous Goods by Air)
Sea transport	IMO	International Maritime Organization (International Maritime Dangerous Goods Code)
Road transport in Europe	ECE (RID)	ECE (ADR) Economic Commission for Europe (Regulations Concerning the International Carriage of Dangerous Goods by Road)
Rail transport in Europe	ECE (RID)	Economic Commission for Europe (Regulations Concerning the International Carriage of Dangerous Goods by Rail – annex 1 to CIM)

They apply to everyone who may come into contact with dangerous goods whilst carrying out their duties or travelling by air, i.e.:

- shippers
- freight agents
- handling agents
- operators
- members of the Post Office
- couriers
- passengers

In Europe there are now Commission Regulation (EC) No 8/2008 as regards common technical requirements and administrative procedures applicable to commercial transportation by airplane.

There are Dangerous Goods Inspectors who are authorized persons under the Air Navigation Order. As such they have powers to inspect, open and seize packages, analyze the contents of suspicious packages, inspect and seize documents, inspect, open and seize the contents of passengers’ baggage and have those contents analyzed.

3. INCIDENTS RECORDING AND INVESTIGATION

Unfortunately there have been and probably always will be some incidents that arise through carrying dangerous goods by air; the most frequent concerns dangerous goods found undeclared or wrongly packed but there are some leakages from packages. Accidents that are attributable to dangerous goods are, fortunately, extremely rare. In the UK investigation of these is likely to be the responsibility of the Air Accidents Investigation Branch. Investigating occurrences is to establish what has happened, not to apportion blame, so as to correct any weakness or loophole in the requirements.

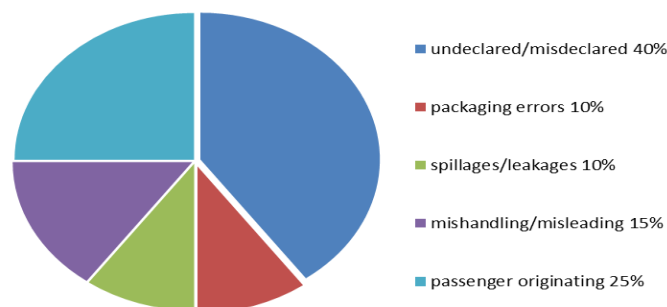


Figure 1 Graph of areas and percentages about international dangerous goods accidents and incidents

ICAO recommends co-operation between States to exchange information about international dangerous goods accidents and incidents.

The number of incidents reported in the UK each year is steadily increasing. Generally, they fall into distinct areas and whilst the numbers may change the percentage of each area to the total has not changed very much in recent years, the areas and percentages are at Figure 1.

Also generally, those initially causing the incidents fall into three distinct groups and again their percentage to the total has not changed much in recent years.

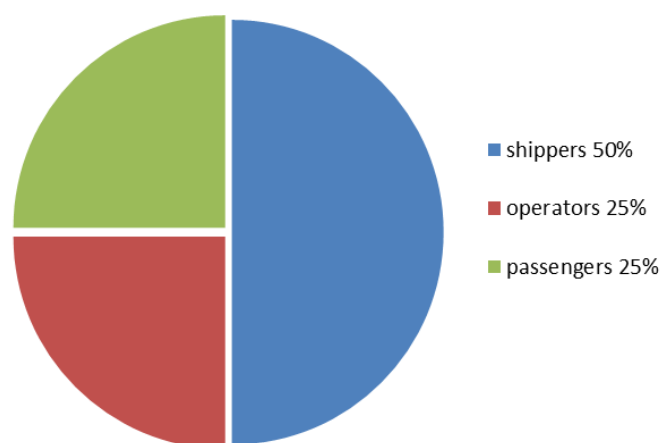


Figure 2 Graph of causing the incidents fall

The times when the Fire Services are deployed to deal with an incident is not always included in a report and so the statistics may not be accurate but from incident reports it appears that the Fire Services may be involved in dealing with incidents about 6% of the time.

4. PRINCIPLES OF DANGEROUS GOODS IN AIR TRANSPORT

Annex 18 makes frequent references to the "Technical Instructions". These are a very comprehensive set of requirements covering: applicability and limitations, training, classification, identification, packing and packaging, marking and labelling, documentation, acceptance for carriage, loading and stowage, information, actions in emergencies and provisions for passengers.

Annex 18 contains a standard which requires States to incorporate the Technical Instructions into national legislation; and this means the Technical Instructions are regarded as the only "source of the legal rules". In practice, however, the document which is usually used is the International Air Transport Association's Dangerous Goods Regulations. Despite the title they are not a set of regulations but a field document produced by the operators; although they conform to the Technical Instructions in all essential areas. This presentation will only cover those areas of the Instructions that are of interest to Fire Services.

Dangerous goods in air transport are subject to very stringent and detailed requirements. Most of them can be carried on both passenger and cargo aircraft; however, some are restricted to cargo aircraft only, some are forbidden on all aircraft except in specialized circumstances when specific permission has been granted and some are totally forbidden in all circumstances. It is recognized that the safety of dangerous goods in transport is provided by their packaging and being correctly prepared.

In air transport, dangerous goods in most circumstances are packaged - i.e. they are in boxes, drums, etc.

In addition the maximum quantity in a package is limited to:

- Passenger aircraft: 1 litre / 1 kg to 60 litre / 100 kg
- Cargo aircraft: 1 litre / 15 kg to 220 litres / 200 kg

The differing quantities recognise that dangerous goods have different degrees of hazard. For some

dangerous goods which have a particular hazard on aircraft (eg: a high hazard corrosive liquid) the maximum net quantity per package may be less than 1 litre on a passenger aircraft.

When dangerous goods are offered for air transport they must be accompanied by a dangerous goods transport document (which is usually known as the Shipper's Declaration). It has two different layouts, to aid completion either manually or by computerised means and both of them have red hatching down each side for easy identification of the document.

For each item of dangerous goods it shows:

- whether it is for carriage on passenger aircraft or for cargo aircraft only
- the proper shipping name (including the technical name, if applicable)
- the Class or Division
- the UN number
- the packing group
- any subsidiary risk(s)
- the net quantity, the type of packaging and the number of packages
- the packing instruction number

Air Waybills

Air Waybills are documents referred to in the Warsaw Convention; they are not always required for consignments of dangerous goods, depending on how they are to be carried. If issued they will state when the consignment contains dangerous goods and a copy accompanies the consignment on the aircraft. The Air Waybill number is quoted on the dangerous goods transport document/shipper's declaration and is the only link between them; apart from this Air Waybills have no useful information on them to aid identification of the goods in emergencies.

Safety Data Sheets

Safety Data Sheets are not legally required to accompany dangerous goods but increasingly they are with consignments. They may be on/in a package or with the shipper's papers. They are likely to show the hazard of the goods and the actions for dealing with emergencies (ie: spillages and fires). Operators or their handling agents may not know if there are safety data sheets with a consignment, particularly if they are in a package.

Cargo manifests

Cargo manifests are required by Annex 9 (Facilitation) and have nothing to do with the requirements for carrying dangerous goods on an aircraft. They may make reference to the fact that dangerous goods are in the cargo for a flight but this may be in code; apart from this there is no information that is of assistance in an emergency.

4.1. Loading and aircraft types

The shipper's responsibilities cease once the dangerous goods arrive at the premises of the operator or handling agent; from that point it is the responsibility of the operator (or his handling agent) to ensure that the goods are correctly prepared for transport. On arrival the goods and their documents are subjected to an acceptance check, which is designed to confirm that as far as can be ascertained all applicable requirements have been met by the shipper and that packages are in a fit state for carriage.

There are a number of principles used in loading and stowing dangerous goods on an aircraft; these include:

- not stowing them in the passenger cabin or on the flight deck, except when in baggage
- not carrying those identified as being for cargo aircraft on passenger aircraft
- keeping upright those packages with orientation markings
- stowing packages for carriage on cargo aircraft only so they are accessible in flight, except for radioactive material, toxic and infectious substances, flammable liquids of packing group III without subsidiary risk and miscellaneous dangerous goods in Class 9
- securing packages to prevent movement in flight, particularly for radioactive materials to

- ensure that the distance between persons and the materials cannot change significantly
- ensuring damaged packages are not loaded and that those found damaged on an aircraft are
- removed and de-contamination undertaken, if necessary.

Dangerous goods are carried on all aircraft types; although some are more suited for this than others.



Figure 3 Dangerous goods in aircraft

4.2. Cargo Aircraft

These aircraft are designed or modified for the carriage of only cargo, both in the underfloor holds and on the main deck. Some were never designed for the carriage of passengers (eg Antonov 124 and the Hercules); some are variants of passenger aircraft (eg B 747F, MD-11F and DC8F) and some have been used in the past to carry passengers but have been modified permanently to now carry all cargo (eg DC-3 and L-188).

Aircraft specifically designed to carry cargo often have nose opening or tail opening cargo doors, to facilitate the loading of large or specialist cargoes. Other cargo aircraft have large main cabin freight doors usually positioned aft of the nose area on the port side. Dangerous goods may be carried on cargo aircraft either in the underfloor holds or on the main deck, those in the underfloor holds must be in passenger aircraft quantities, whilst those on the main deck are often "cargo aircraft only" items.

4.3. Passenger Aircraft with only Underfloor Holds

These aircraft are designed primarily for carrying passengers. Cargo (and baggage) will be carried in holds which are below the main deck (underfloor). Examples of this type of aircraft are Boeing 737, 747, MD-11, A 330, A 340. An example of a DC10 is shown below, with a cross section of the aircraft to show the underfloor hold area.

The introduction of wide-bodied passenger carrying aircraft, such as the DC10, has meant that there is a great deal of capacity in the underfloor holds for carrying cargo and over the years this has resulted in a reduction of services to some parts of the world by all cargo aircraft. Dangerous goods may be carried in the underfloor holds in passenger aircraft quantities. In flight these holds are inaccessible, so that should a problem occur it has to be dealt with using standard aircraft drills, with a possible emergency landing.

4.4. Passenger Aircraft with Holds on the Same Deck as Passengers (Combi Aircraft)

These aircraft have also been designed primarily for carrying passengers and they have become known as 'combi' aircraft.

There are two types:

- a) those where the only hold(s) are on the same deck as the passengers; e.g. ATR42/72 and
- b) those with hold(s) on the main deck and under floor.

On some aircraft, main deck holds may be little more than areas of the cabin separated from the passengers by curtaining; whilst in others they may be formed by sealed bulkheads with access only from outside the aircraft or through doors in the cabin which are inaccessible to passengers during flight. Some combi aircraft are variants of standard passenger aircraft where the main deck has been extensively modified to form a cargo hold of considerable size, possibly bigger than the available space for passengers. This hold may be forward or aft of the passengers.

4.5. Convertible Aircraft (Quick Change)

There are a number of aircraft which are designed to be converted reasonably quickly, so that during the day they carry passengers and at night they carry cargo. These QC variants have seats, galleys and, sometimes, toilets fixed to pallets so they can be easily removed from the aircraft; this then allows it to be operated in a cargo role. Aircraft developed as quick change are primarily the B727 QC and B737 QC; a B727-100 QC can be converted in less than 30 minutes.

5. CONCLUSION

Dangerous substances are substances whose the nature of composition or properties in the transportation, loading and unloading and similar manipulations can lead to phenomena that are harmful and dangerous for the environment. The requirements for the carriage of dangerous goods by air are very comprehensive and complex. As can also be seen, incidents and accidents happen because of a failure to comply with all the applicable requirements, so a final quote from the Technical Instructions. Dangerous goods are very unlikely to cause a problem when they are prepared and handled in compliance with the Technical Instructions.

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