

# AIR TRANSPORT OF DANGEROUS GOODS

## TRANSPORT LOTNICZY TOWARÓW NIEBEZPIECZNYCH

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### STRESZCZENIE

*W artykule skoncentrowano się na najnowszych trendach oraz roli organizacji i obsłudze transportu towarów niebezpiecznych drogą lotniczą.. Przybliżono uwarunkowania bazowe hubu powietrznego zwracając uwagę na szczególne uregulowania w zakresie ww. towarów oraz stosowane procedury, które są wynikiem zaleceń największych organizacji zajmujących się transportem lotniczym, jak i niektórych armatorów powietrznych. Rozpatrzono także współczesne przedsięwzięcia stosowane dla minimalizacji ryzyka dla ładunku i pasażerów pochodzącego wprost od ładunków obejmujących towary niebezpieczne, jak i ryzyka wynikającego z faktu, że transport osób i mienia obejmuje niejednokrotnie materiały niebezpieczne, z czego nie do końca zdajemy sobie sprawę. Z drugiej strony autor wskazuje na wiedzę bazową w zakresie istoty towaru niebezpiecznego. Rozpatrywany jest także rozwój istniejących procedur ze szczególnym uwzględnieniem alternatywnych działań rozpoznawczych i kontrolnych dla wykrycia i rozpoznania materiałów niebezpiecznych, które nie zostały zadeklarowane.*

### SUMMARY

*This paper mainly focuses on the newest trends, as well as basic roles of the organization and handling of the transport of dangerous goods by air. It brings closer an important part of the framework of the air hub. Paying attention on extraordinary regulations and procedures applied by the biggest air transport organizations, as well as some air transport companies. It takes also into consideration other means taken in order to overcome the current risks during air transport of freights and people regarding dangerous goods or hidden danger connected with the transport of goods as well as persons. On the one hand the article also takes into consideration the subject matter of dangerous goods as such. On the other hand reveals the development of existing procedures. It also respects search on control alternatives, especially in order to recognize undeclared dangerous goods.*

*Słowa kluczowe: towary niebezpieczne, transport powietrzny, bezpieczeństwo*

*Keywords: dangerous goods, air transport, safety*

### INTRODUCTION

There are plenty incidents such as the dangerous goods cargo fire incident on board of the Saudi Arabian Airlines plane on the 19. August 1980, which caused 301 casualties (see picture 1). Also wrongly packed dangerous goods (oxygen generators) on board of DC-9

Valu Jet on the 11. May 1996 caused in Miami 110 dead. The UPS cargo plane suffered on the 7. February 2006 fire in the cargo (see picture 2).

The following paper reveals the newest trends, as well as basic roles of the organization and handling of the transport of dangerous goods by air. It brings closer an important part of the framework of the air hub. Paying attention on extraordinary regulations and procedures applied by the biggest air transport organizations, as well as some air transport companies. It takes also into consideration other means taken in order to overcome the current risks during air transport of freights and people regarding dangerous goods or hidden danger connected with the transport of goods as well as persons. On the one hand the article also takes into consideration the subject matter of dangerous goods as such. On the other hand reveals the development of existing procedures. It also respects search on control alternatives, especially in order to recognize undeclared dangerous goods.

Because there are no significant research results connected with the phenomena regarding transport of dangerous goods onboard of planes, the scientific modus operandi of this paper is quite modest. The author analyze basically only sources like regulations, as well as conclude many times experiences made in person.

## **1. ORIGIN OF THE CURRENT REGULATIONS REGARDING TO AIR TRANSPORT OF DANGEROUS GOODS**

For the safe transport of dangerous goods (DG) by air regulations, recommendations and procedures are published by the United Nations (UN), International Civil Aviation Organization (ICAO), International Air Transport Association (IATA), International Atomic Energy Agency (IAEA), European Aviation Safety Agency (EASA), Federal Offices of Civil Aviation – FOCA (e. g. polish /pol./ Urząd Lotnictwa Cywilnego – ULC or german /ger./ Luftfahrt Bundesamt - LBA and other ones. Therefore, because of accidents connected with dangerous goods, we still need to follow and improve those rules and regulations.

All this situations (shown below and dozens of others ) testify that transport involving dangerous goods which are capable of posing a risk to health, safety, property or the environment, may turn out threat, so we need to: recognize, prevent and handle. It means simultaneously, that all personnel involved in processing, handling or transporting dangerous goods by air are required to participate in dangerous goods training depending their job function and responsibilities.



**Picture 1.** Wreck of the Saudi Arabian Airlines plane after dangerous goods cargo fire incident on the 19. August 1980  
Source: [www.iata.org](http://www.iata.org).



**Picture 2.** Burning cargo no board of the UPS cargo plane after the fire on the 7. February 2006  
Source: [www.iata.org](http://www.iata.org).

The basic regulations for transport of dangerous goods are founded by United Nations Organization, which means the so called Orange Book (see the picture below).



**Picture 3.** Transport of dangerous goods – UN Regulations

Source: Own elaboration based on UN Regulations – Transport of dangerous goods.

The next publishes regulations for the transport of dangerous goods are the Technical instructions (see the picture below) of International Civil Aviation Organisation (ICAO).



**Picture 4.** Transport of dangerous goods – ICAO Regulations

Source: Own elaboration based on ICAO Regulations – Transport of dangerous goods.

Also International Air Transport Association published the Dangerous Goods Regulations (DGR – see the picture below) as a guideline. Meanwhile became IATA also source of expertise regarding following other areas:

- law and regulations;
- civil aviation authorities;
- air navigation services;
- aviation performance and management;

- security and safety;
- financing and accounting;
- airline operations and quality;
- airline business management;
- airport planning, management and operations;
- travel and tourism;
- fares and ticketing.

The training centers of this agency are placed at 24 locations around the world. It has also 17 regional training partner.



**Picture 5.** Transport of dangerous goods – IATA Regulations

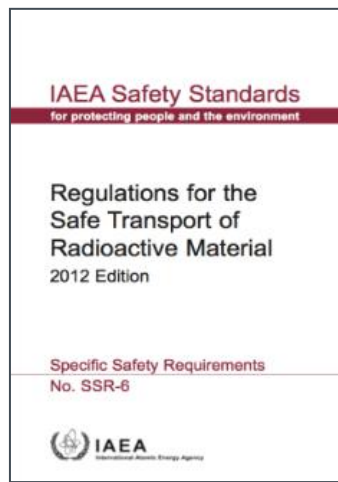
Source: Own elaboration based on IATA Regulations – Transport of dangerous goods.

Recommendations for the safe transport of radioactive material (see picture below) are prepared by IAEA.

The European aviation security legislation contains Commission regulation (EU) No 965/2012, which is laying down technical requirements and administrative procedures related to air operations. Early 2008 due to Commission regulation No 216/2008 was founded European Aviation Safety Agency. Till 2010 EASA got the status of European air authority involving all security aspects of civil aviation in Europe. Its mission is promotion in civil aviation of common security roles and environmental protection. Since 2012 the agency is busy with:

- design, production and certification of aviation products;
- keeping of flight ability;
- licensing of personal;

- conducting air operations;
- inspections of planes,
- supervision of airports;
- air traffic management (ATM), air traffic services (ATS);
- affairs of non European carrier and haulier;
- environmental protection;
- international cooperation.



**Picture 6.** Transport of dangerous (radioactive) goods – IAEA Regulations  
 Source: own elaboration based on IAEA Regulations – Transport of radioactive material.

Dangerous goods can be transported safely by air transport respective each country regulation and provisions. They are mainly based on previous mentioned regulations prepared by the UN, the ICAO, the IATA, the IAEA and the EU/EASA.. It means for example in Switzerland the Swiss Federal Air Transport Ordinance (deu.) Lufttransportverordnung - LTrV Art 16 - Beförderung gefährlicher Güter, which is the legal basis for the transportation of dangerous goods. In Germany, such legal basis is the LBA section B Operations: Transportation of dangerous goods. And in Poland (pol.) Ustawa Prawo Lotnicze. The national regulations contain details, which are peculiar for each country.

## 2. DANGEROUS GOODS IN GENERAL

In order to solve the problem of transportation of dangerous goods, we should know, what they are. Generally dangerous goods are articles or substances which are capable of posing a risk to health, safety, property or the environment. Some dangerous goods are too dangerous to be carried by aircraft. Others may only be carried on a cargo aircraft. Some dangerous goods are acceptable on both passengers and cargo aircraft. Some operators

have only the approval to transport DG accepted on passengers aircraft. The regulations include a detailed list<sup>1</sup> of individual articles and substances specifying the United Nations classification of each article or substance and their acceptability for air transport as well as the conditions for their transport. Since no listing can be complete, the list also includes many generic or `not otherwise specified entries to assist in the classification of those articles or substances not listed by name.

Dangerous goods forbidden under any circumstances on board of an air craft (in accordance with IATA DGR: 2.1.1) are any article or substance which, as presented for transport, is liable:

- to explode;
- to dangerously react;
- to produce a flame;
- to cause dangerous evolution of heat;
- to bring dangerous emission of toxic, corrosive or flammable gases or else vapors.

Such materials/goods like previous mentioned must not be carried on aircraft under any circumstances. Examples of forbidden dangerous goods are:

- fulminating silver;
- lead acide (dry);
- nitrogen trichloride.

But the problem exists, when general cargo and passenger baggage may contain hazardous articles which are not apparent. They are called hidden dangerous goods (in accordance with IATA DGR 2.2). Some examples from hidden dangerous goods would be chemicals which may contain items meeting many criteria for dangerous goods like flammable liquids, flammable solids, as well as toxic or corrosive substances. Also diagnostic specimens may contain infectious substances. Electrical equipment may contain magnetized material, mercury or wet batteries. And also regarding household goods may turn out, that they contain items meeting many criteria for dangerous goods. We can distinguish items like: paint, solvents, bleach, polishes or matches. Also instruments may contain mercury or wet batteries. Medical supplies may also contain a wide variety of dangerous goods like infectious

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<sup>1</sup> The IATA Dangerous Goods Regulations contains nowadays approximately 3000 articles and substances with dangerous properties, which are most likely to be shipped by air. The list is not intended to be all inclusive, therefore it contains several names of a general nature, known as N.O.S (not otherwise specified) names or entries, under which unlisted items may be transported.

substances, toxic, flammable or corrosive material. Ordinary refrigerators may contain liquefied gases of ammonia solution. Other similar ones are:

- samples for testing - may contain items meeting many criteria for dangerous goods;
- tool boxes – may contain compressed or flammable gases, aerosols, adhesives, corrosive liquids or mercury;
- aircraft spare parts/aircraft equipment – may contain explosives (flares or other pyrotechnics), cylinders of compressed gas, paint, adhesives, first aid kits, batteries or fuel;
- company material – similar to aircraft spare parts.

Passengers and even crew may carry with or without intention or knowing dangerous goods in their checked or carry-on baggage. Such dangerous goods (carried by passenger or crew) are listed in IATA DGR. It is also possible, that passengers and crew are allowed to carry dangerous goods under provision of list 2.3.A (see the table below).

Under all circumstances forbidden goods (IATA DGR 2.3.1) carried by passenger and crew are dangerous goods like:

- attache cases, cash boxes and bags with explosive charges;
- disabling devices;
- liquid oxygen devices;
- electro shock weapons;
- “strike anywhere” matches (non-safety matches);
- “blue flame” or „storm“ lighters.



**TABLE 2.3.A**  
**Provisions for Dangerous Goods Carried by Passengers or Crew**  
**(Subsection 2.3)**

**2**  
 23

Dangerous goods must not be carried in or as passengers or crew, checked or carry-on baggage, except as otherwise provided below. Dangerous goods permitted in carry-on baggage are also permitted 'on one's person', except where otherwise specified.

The pilot-in-command must be informed of the location				
Permitted in or as carry-on baggage				
Permitted in or as checked baggage				
The approval of the operator is required				
Alcoholic beverages, when in retail packaging, containing more than 24% but not more than 70% alcohol by volume, in receptacles not exceeding 5 L, with a total net quantity per person of 5 L.	NO	YES	YES	NO
Ammunition (cartridges for weapons), securely packaged (in Div. 1.4B, UN 0012 or UN 0014 only), in quantities not exceeding 5 kg gross weight per person for that person's own use. Allowances for more than one person must not be combined into one or more packages.	YES	YES	NO	NO
Avalanche rescue backpack, one (1) per person, containing a cartridge of compressed gas in Div. 2.2. May also be equipped with a pyrotechnic trigger mechanism containing no more than 200 mg net of Div. 1.4B. The backpack must be packed in such a manner that it cannot be accidentally activated. The airbags within the backpacks must be fitted with pressure relief valves.	YES	YES	YES	NO
Batteries, spare/loose, including lithium metal or lithium ion cells or batteries, for portable electronic devices must be carried in carry-on baggage only. Articles which have the primary purpose as a power source, e.g. power banks are considered as spare batteries. These batteries must be individually protected to prevent short circuits.	NO	NO	YES	NO
Camping stoves and fuel containers that have contained a flammable liquid fuel, with empty fuel tank and/or fuel container (see 2.3.3.5 for details).	YES	YES	NO	NO
Chemical Agent Monitoring Equipment, when carried by staff members of the Organization for the Prohibition of Chemical Weapons on official travel (see 2.3.4.4).	YES	YES	YES	NO
Disabling devices such as mace, pepper spray, etc. containing an irritant or incapacitating substance are forbidden on the person, in checked and carry-on baggage.	FORBIDDEN			
Dry ice (carbon dioxide, solid), in quantities not exceeding 2.5 kg per person when used to pack perishables not subject to these Regulations in checked or carry-on baggage, provided the baggage (package) permits the release of carbon dioxide gas. Checked baggage must be marked 'dry ice' or 'carbon dioxide, solid' and with the net weight of dry ice or an indication that there is 2.5 kg or less dry ice.	YES	YES	YES	NO
e-cigarettes (including e-cigs, e-pipes, other personal vaporizers) containing batteries must be individually protected to prevent accidental activation.	NO	NO	YES	NO
Electro shock weapons (e.g. Tasers) containing dangerous goods such as explosives, compressed gases, lithium batteries, etc. are forbidden in carry-on baggage or checked baggage or on the person.	FORBIDDEN			
△ Fuel cells containing fuel, powering portable electronic devices (e.g. cameras, cellular phones, laptop computers and camcorders), see 2.3.5.10 for details.	NO	NO	YES	NO
Fuel cell cartridges, spare for portable electronic devices, see 2.3.5.10 for details.	NO	YES	YES	NO
Gas cartridges, small, non-flammable containing carbon dioxide or other suitable gas in Division 2.2. Up to two (2) small cartridges fitted into a self-inflating safety device such as a life jacket or vest. Not more than one (1) device per passenger and up to two (2) spare small cartridges per person, not more than four (4) cartridges up to 50 mL water capacity for other devices (see 2.3.4.2).	YES	YES	YES	NO
Gas cylinders, non-flammable, non-toxic worn for the operation of mechanical limbs. Also, spare cylinders of a similar size if required to ensure an adequate supply for the duration of the journey.	NO	YES	YES	NO
Hair curlers containing hydrocarbon gas, up to one (1) per passenger or crew-member, provided that the safety cover is securely fitted over the heating element. These hair curlers must not be used on board the aircraft at any time. Gas refills for such curlers are not permitted in checked or carry-on baggage.	NO	YES	YES	NO
Heat producing articles such as underwater torches (diving lamps) and soldering irons (see 2.3.4.5 for details).	YES	YES	YES	NO
Insulated packages containing refrigerated liquid nitrogen (dry shipper), fully absorbed in a porous material containing only non-dangerous goods.	NO	YES	YES	NO
Internal combustion or fuel cell engines, must meet A70 (see 2.3.5.15 for details).	NO	YES	NO	NO
Lamps, energy efficient when in retail packaging intended for personal or home use.	NO	YES	YES	NO
Lithium Batteries: Security-type equipment containing lithium batteries (see 2.3.2.6 for details).	YES	YES	NO	NO

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**Picture 7.** All provisions for dangerous goods carried by passengers and crew (IATA DGR Table 2.3.A)  
 Source: IATA DGR.

All provisions for dangerous goods carried by passengers and crew contains IATA DGR table 2.3.A. Dangerous goods carried by passenger and crew accepted with operator's approval, as checked luggage only (IATA DGR 2.3.2) are (see the picture below) e. g. ammunition as described in IATA DGR table 2.3.A (see table above). It means only UN 0012 Cartridges, small arms, blank, as well as UN 0014 Cartridges for weapons, blank. Every article or substances should be so packed or designed that any hazardous effects arising from accidental functioning are confined within the package unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not significantly hinder or prohibit fire fighting or other emergency response efforts at the immediate vicinity of the package.

The pilot-in-command must be informed of the location	
Permitted in or as carry-on baggage	
Permitted in or as checked baggage	
The approval of the operator is required	

<b>Mobility Aids:</b> Battery-powered wheelchairs or other similar mobility devices with <b>non-spillable wet batteries or with batteries which comply with Special Provision A123 or A199</b> , (see 2.3.2.2).	YES	YES	NO	NO
<b>Mobility Aids:</b> Battery-powered wheelchairs or other similar mobility devices with <b>spillable batteries or with lithium batteries</b> (see 2.3.2.3 and 2.3.2.4 for details).	YES	YES	NO	YES
<b>Mobility Aids:</b> Battery-powered mobility aids with <b>lithium ion batteries (collapsible)</b> , lithium-ion battery must be removed and carried in the cabin (see 2.3.2.4(d) for details).	YES	NO	YES	YES

**Picture 8.** Dangerous goods carried by passenger and crew - goods accepted with operator approval (IATA DGR 2.3.2)  
Source: IATA DGR.

Transport of dangerous (radioactive) goods is limited by IAEA regulations.

Transport of dangerous goods by post or air mail is adjusted by IATA in DGR 2.4. The Universal Postal Union forbids the carriage of dangerous goods in mail excepts as permitted in IATA DGR 2.4.2, which means:

- infectious substances biological substance, Category B UN 3373 only (see IATA DGR 2.4.2 a);
- patient specimens as defined per regulations (see IATA DGR 2.4.2 b);
- radioactive material UN 2910 and UN 2911 only (see IATA DGR 2.4.2 c);
- lithium ion batteries contained in equipment (see IATA DGR 2.4.2. d);
- lithium metal batteries contained in equipment (see IATA DGR 2.4.2.e).

The procedure of designated postal operators for controlling the introductions of dangerous goods in mail into air transport are subject to review and approval by the civil aviation authority of the states where the mail is accepted. It means, that before the designated postal operator can introduce the acceptance of lithium batteries (as identified in IATA DGR 2.4.2 d and e) they must have received the specific approval from the civil aviation authorities. For example the Swiss postal service obtained the approval on the 20th Dec. 2013.

Due to regulations IATA DGR 2.5 (Dangerous goods in operator’s property) is also controlled aircraft equipment (IATA DGR 2.5.1.1). These are articles and substances which could otherwise be classified as dangerous goods but which are required to be aboard the aircraft in accordance with pertinent airworthiness requirements and operating regulations or that are authorized by the state of the operator to meet special requirements. Such aircraft equipment may contain explosives (flares or other pyrotechnics), cylinders of compressed gas,

paint, adhesives, first aid kits, batteries as well as fuel. We can also find on board consumer goods (IATA DGR 2.5.1.2) like aerosol, alcoholic beverages, perfumes and safety matches for use or sale during flight. All airlines and quite often passengers carry these type of DG on every flight. For example carbon dioxide (solid – “dry ice) in accordance with IATA DGR 2.5.1.3. It is used in food and beverage service on board the aircraft – in the cabin or the baggage compartment. There is also battery-powered electronic equipment (IATA DGR 2.5.1.4), such as electronic flight bags, personal entertainment devices, containing lithium metal or lithium ion cells or batteries and spare lithium batteries for such devices. Spare lithium batteries must be individually protected so as to prevent short circuits when not in use.

Dangerous load (we can not call them directly dangerous goods) can turn out also some items, which we call restricted articles<sup>2</sup>. The following are examples of items which passengers should not be allowed to bring on board, as they could constitute a threat to security of the aircraft or used to commit an act of violence. They are not allowed to be carried on an aircraft. There are fire arms, items that may cause injury, as well as items containing incapacitating substances. In this case we can distinguish such firearms like:

- shotguns, airguns, humane killers, bolt guns, flare pistols and starting pistols;
- ammunition, replica or imitation firearms and cross bows;
- toy guns, plastic or metal which may have the appearance of being genuine firearms.

Items that may cause injury are for example:

- knives, flick-knives, gravity catch knives, daggers;
- razors, scalpels, ice picks, swordsticks, harpoons, spears and arrows.

Items containing incapacitating substances include for instance:

- tear gas, mace and phosphorous acids;
- knuckle dusters, clubs, coshes and rice flails.

### **3. RESPONSIBILITIES REGARDING TO AIR TRANSPORT OF DANGEROUS GOODS**

The IATA Dangerous Goods Regulations Manual (based on ICEAO Technical instructions) is an easy to use tool that provides us information about for example:

- applicability: general philosophy;
- limitations: recognition of undeclared dangerous goods – provision for passengers and crew members;
- classification;

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<sup>2</sup> See: Ryanair operations manual, part A safety and emergency procedures, p. 15-15.

- identification: list of dangerous goods – emergency procedures;
- packing;
- packing specifications and performances tests;
- marking and labeling;
- documentation: e. g.: shippers declaration, consignment note<sup>3</sup> or pilot’s notification;
- handling: storage and loading procedures;
- transport of radioactive material.

Everybody will be available to find in IATA DGR important information.

Packaging is the essential component in the safe transport of dangerous goods by air. The IATA Dangerous Goods Regulations provide packing instructions for all dangerous goods acceptable for air transport with a wide range of options for inner, outer and single packagings. The packing instructions normally require the use of UN performance-tested specification packagings, however, these are not required when dangerous goods are shipped in limited quantities under the provisions of Limited Quantity “Y” Packing Instructions. The quantity of dangerous goods permitted within these packagings is strictly limited by the Regulations so as to minimize the risk should an incident occur. The shipper is responsible for all aspects of the packing of dangerous goods in compliance with the dangerous goods regulations. Each substance has an individual instruction, which is detailed in the DG manual.

When preparing each package of dangerous goods. the shipper must:

- comply with the set of packing requirements appropriate to the type of packaging used,
- use only the packagings permitted by the applicable packing instruction,
- restrict the overall quantity of the package to the amount allowed,
- assemble and secure all components of the packaging in the manner intended,
- ensure that his responsibilities for packing are completely fulfilled when the package is presented to the operator for shipment.

The shipper is also responsible for all necessary marking and labelling of each package of dangerous goods. Each package must be of such a size that there is adequate space to affix all required markings and labels. All markings must be placed on the packages so that they are not covered or obscured by any part of or attachment to the packaging or any other label or marking. The required markings must not be located with other package

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<sup>3</sup> A consignment note is a serially numbered document issued by the transporters (prepared by consignor and countersigned by the carrier/airline operator) as a proof of receipt of consignment for delivery/transport at the destination. Is used as an alternative to bill of lading. Shows also the details of goods that have been sent (eg. from a seller to the buyer). It is generally neither a contract of carriage nor a negotiable instrument.

markings that could substantially reduce their effectiveness. English must be used in addition to the language which may be required by the state of origin. For every package that requires labels the shipper must remove or obliterate any irrelevant labelling already on the package. The shipper must also use labels of durable quality and correct specification. It is the responsibility of the shipper to ensure that the criteria for labelling have been fulfilled before the package is presented to the operator for shipment. Warning labels and markings, such as the CHIP<sup>4</sup> labels (see the picture below) or GHS<sup>5</sup> labels, may be an indicator for dangerous goods. We can also distinguish handling labels. They have to be used either alone or with hazard labels and are indicated as e. g. follows: magnetized material, cargo aircraft only, cryogenic liquid, this way up and so one.



**Picture 9.** An example of limitations warning labeling - the CHIP label (by IATA DGR)  
Source: IATA DGR.

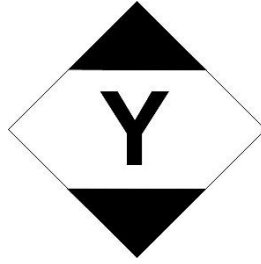
The Commission regulation EU no 965/2012 requires an operator to hold an approval (see the picture below) to carry dangerous goods. This is stated in the so called Air Operator's Certificate (AOC<sup>6</sup>). In special conditions states can grant an „Approval“ for the carriage of dangerous goods that are normally forbidden for carriage either on passenger aircrafts or cargo aircrafts (see: IATA DGR: 1.2.5 Approvals). Where specifically provided in the DGR Manual, the states concerned may grant an approval for transporting DG, provided that all levels of safety are achieved. For an approval the states concerned are the state of origin and the state of the operator.

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<sup>4</sup> Chemicals Hazard Information and Packaging (CHIP). The CHIP labels will be replaced by the European CLP Regulation

<sup>5</sup> As part of the hazard communication system for use and supply the United Nations introduced the Globally Harmonized System (GHS) for Classification.

<sup>6</sup> An air operator's certificate (AOC) is the approval granted by a national aviation authority (NAA) to an aircraft operator to allow it to use aircraft for commercial purposes. This requires the operator to have personnel, assets and system in place to ensure the safety of its employees and the general public. The certificate will list (see the picture) the aircraft types and registrations to be used, for what purpose and in what area – specific airports or geographic region.



**Picture 10.** An example of warning labeling – dangerous goods in limited quantities (by IATA DGR)

Source: IATA DGR.

Exemptions are also possible (see: IATA DGR: 1.2.6 Exemptions), which means that in extreme urgency or when other forms of transport are inappropriate, the states concerned may grant exemptions from these provisions provided that all levels of safety are achieved. For exemptions the states concerned are: the state of origin, the state of the operator, state of transit, the states of overflight and state of destination. In specific exceptions (see: IATA DGR: 1.2.7 Exceptions) the provision of these regulations do not apply to DG carried by an aircraft when these DG are:

- to provide medical aid to a patient during flight;
- to provide veterinary aid or a human killer for a animal during flight;
- for dropping during flight in connection with agricultural, horticultural, forestry, avalanche control, ice jam control, landslide clearance or pollution control activities;
- to provide aid connected to search and rescue;
- vehicle carried in aircraft designed to do so;
- dangerous goods that are required for the propulsion of the means of transport or the operation or its specialized equipment during transport;
- contained within items of excess baggage.

AOC: CH.AOC.1014	Operator Name: PrivatAir SA	Date: 25.03.2015	Signature: <i>[Signature]</i>	
Dba trading name:			Stephan Eder Head of section Operations of Complex Aircrafts	
Operations specifications: CH.OPSSPEC.1014.B733				
Aircraft Model:		BOEING 737 309		
Registration Marks:		HB-JJB, HB-JJC		
Commercial operations: <input checked="" type="checkbox"/>				
Area of operation: between 60 S and 73 N				
Special limitations:				
Specific approvals:	Yes	No	Specification	Remarks
Dangerous goods	<input checked="" type="checkbox"/>	<input type="checkbox"/>		



**Picture 11.** Examples of air operator`s certificates (AOC)

Source: Aeroflot, Privat Air.


Regarding General IATA DGR 1.4 (operator’s responsibilities) in transporting dangerous goods, an operator must comply with the following requirements:

- acceptance;
- storage;
- loading;
- inspection;
- provision of information, including emergency response information;
- reporting;
- retention of records;
- training.

Quite important is the provision of information to passengers regarding dangerous goods in their baggage. It means, that any operator and airport are required to provide information to passengers about the types of dangerous goods that are forbidden from transporting aboard before the ticket purchase latest at check-in. It will be done by written information, which will be spread and screened (see the pictures below).

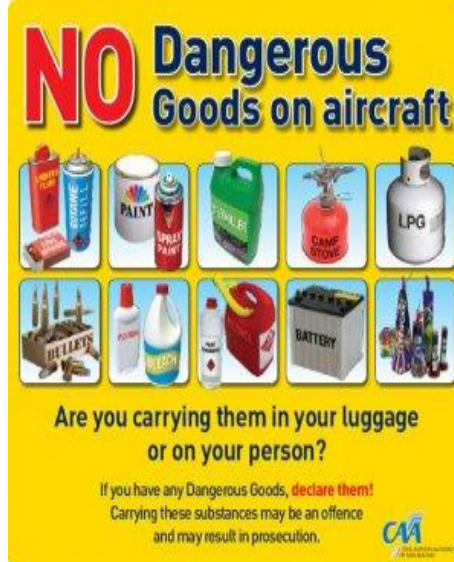
**Dangerous goods**

The laws of all countries prohibit the transportation of certain items in checked-in baggage or in hand luggage as these could endanger the aircraft.



For safety reasons the following items are not allowed on board:

- Briefcases with built-in alarm devices
- Explosives, fireworks, flares
- Pressurized containers containing irritant gases, self-defense sprays, camping gas
- Containers with flammable liquids such as lighter fuel, paint, varnish, cleaning agents
- Items that ignite easily, such as matches
- Substances that emit flammable gases upon contact with water
- Oxidizing substances, such as bleaching powder, peroxides
- Poisonous (toxic) and infectious substances, such as quicksilver, bacteria and virus cultures
- Radioactive materials and items
- Corrosive substances, such as acids, alkalis, wet cell batteries
- Strongly magnetic materials
- Petrol-operated equipment and tools that have contained minimal amounts of petrol (e.g. for test purposes)
- Electro shock weapons, such as tasers



**Picture 12.** Examples of leaflets with the information to passengers about dangerous goods  
Source: Lufthansa.

In order to recognize dangerous goods in passengers luggage, there are to organize several “layers of defense” to prevent passengers to get DG on board of planes. There are as follow:

- passenger check-in procedure (under surveillance by airport personal),

- baggage screening (under surveillance by airport personal),
- passenger and hand luggage screening (under surveillance by airport personal),
- boarding process (carried out by cabin crew),
- supervision (making by flight crew).

To make reliable the recognition of undeclared dangerous goods, it is essential that awareness and vigilance are maintained at all times when accepting baggage or for as cabin crew when stowing carry-on luggage. Great care should be taken to ensure that no dangerous goods are carried on board other than those permitted for passengers and crew (see the picture below).

Cargo and baggage that are offered as general cargo might have hazards that are not apparent. It may be that some consignments bearing UN numbers, proper shipping names or hazard labels are to be discovered within general cargo that have not been declared. To prevent undeclared DG from being loaded on an aircraft, confirmation should be sought from passengers and people who are loading cargo, about the content of any item which is suspicious of containing undeclared DG.



WHICH ITEMS ARE ALLOWED TO TRANSPORT IN A CARRY-ON BAGGAGE AND NOT ALLOWED IN THE CHECKED BAGGAGE?

<b>CARRY-ON BAGGAGE</b> ✓	<b>CHECKED BAGGAGE</b> ✗	<p>CARRY-ON BAGGAGE = CABIN COMPARTMENT ✓ CHECKED BAGGAGE = CARGO COMPARTMENT ✗</p>
ITEMS		
LITHIUM ION/METAL BATTERIES		
E-CIGARETTES		
<small>MOBILITY AIDS: BATTERY-POWERED MOBILITY AIDS WITH LITHIUM ION BATTERIES (COLLAPSIBLE)</small>	<small>MERCURY BAROMETER OR THERMOMETER</small>	

**Picture 13.** An example of leaflet with the information to passengers about dangerous goods in cabin baggage

Source: Privat Air.

In general, the personnel need to be aware of such aspects of the regulation like:

- general philosophy,
- limitations,
- marking and labels,
- recognition of undeclared dangerous goods,
- provisions for passengers and crew,
- emergency procedures.

Especially cabin crew should be alerted when:

- a package/baggage that has visible frost;
- package/baggage that indicates a spillage;
- any odour that could indicate spillage or leakage;
- rattling sound of aerosol canisters;

- package/baggage generating smoke or fumes;
- reused packages with DG labels and markings;
- package/baggage making noises;
- packages with pictures (ex: chain saw, camping stove etc.).

**TABLE 2.3.A**  
Provisions for Dangerous Goods Carried by Passengers or Crew  
(Subsection 2.3)

**2** Dangerous goods must not be carried in or as passengers or crew, checked or carry-on baggage, except as otherwise provided below. Dangerous goods permitted in carry-on baggage are also permitted 'on one's person', except where otherwise specified.

23

The pilot-in-command must be informed of the location				
Permitted in or as carry-on baggage				
Permitted in or as checked baggage				
The approval of the operator is required				
	NO	YES	YES	NO
Alcoholic beverages, when in retail packagings, containing more than 24% but not more than 70% alcohol by volume, in receptacles not exceeding 5 L, with a total net quantity per person of 5 L.	NO	YES	YES	NO
Ammunition (cartridges for weapons), securely packaged (in Div. 1.4B, UN 0012 or UN 0014 only), in quantities not exceeding 5 kg gross weight per person for that person's own use. Allowances for more than one person must not be combined into one or more packages.	YES	YES	NO	NO
Aviation rescue backpack, one (1) per person, containing a cartridge of compressed gas in Div. 2.2. May also be equipped with a pyrotechnic trigger mechanism containing no more than 200 mg net of Div. 1.4B. The backpack must be packed in such a manner that it cannot be accidentally activated. The airbags within the backpacks must be fitted with pressure relief valves.	YES	YES	YES	NO
Batteries, spare/loose, including lithium metal or lithium ion cells or batteries, for portable electronic devices must be carried in carry-on baggage only. Articles which have the primary purpose as a power source, e.g. power banks are considered as spare batteries. These batteries must be individually protected to prevent short circuits.	NO	NO	YES	NO
Camping gloves and fuel containers that have contained a flammable liquid fuel, with empty fuel tank and/or fuel container (see 2.3.2.5 for details).	YES	YES	NO	NO
Chemical Agent Monitoring Equipment, when carried by staff members of the Organization for the Prohibition of Chemical Weapons on official travel (see 2.3.4.4).	YES	YES	YES	NO
Disabling devices such as mace, pepper spray, etc. containing an irritant or incapacitating substance are forbidden on the person, in checked and carry-on baggage.			FORBIDDEN	
Dry ice (carbon dioxide, solid), in quantities not exceeding 2.5 kg per person when used to pack perishables not subject to these Regulations in checked or carry-on baggage, provided the baggage (package) permits the release of carbon dioxide gas. Checked baggage must be marked 'dry ice' or 'carbon dioxide, solid' and with the net weight of dry ice or an indication that there is 2.5 kg or less dry ice.	YES	YES	YES	NO
e-cigarettes (including e-cigs, e-pipes, other personal vaporizers) containing batteries must be individually protected to prevent accidental activation.	NO	NO	YES	NO
Electric shock weapons (e.g. Tasers) containing dangerous goods such as explosives, compressed gases, lithium batteries, etc. are forbidden in carry-on baggage or checked baggage or on the person.			FORBIDDEN	
Fuel cells containing fuel, powering portable electronic devices (e.g. cameras, cellular phones, laptop computers and camcorders), see 2.3.5.10 for details.	NO	NO	YES	NO
Fuel cell cartridges, spare for portable electronic devices, see 2.3.5.10 for details.	NO	YES	YES	NO
Gas cartridges, small, non-flammable containing carbon dioxide or other suitable gas in Division 2.2. Up to two (2) small cartridges fitted into a self-inflating safety device such as a life jacket or vest. Not more than one (1) device per passenger and up to two (2) spare small cartridges per person, not more than four (4) cartridges up to 50 mL water capacity for other devices (see 2.3.4.2).	YES	YES	YES	NO
Gas cylinders, non-flammable, non-toxic used for the operation of mechanical limbs. Also, spare cylinders of a similar size if required to ensure an adequate supply for the duration of the journey.	NO	YES	YES	NO
Hair curlers containing hydrocarbon gas, up to one (1) per passenger or crew-member, provided that the safety cover is securely fitted over the heating element. These hair curlers must not be used on board the aircraft at any time. Gas refills for such curlers are not permitted in checked or carry-on baggage.	NO	YES	YES	NO
Heat producing articles such as underwater torches (diving lamps) and soldering irons (See 2.3.4.6 for details).	YES	YES	YES	NO
Insulated packagings containing refrigerated liquid nitrogen (dry shipper), fully absorbed in a porous material containing only non-dangerous goods.	NO	YES	YES	NO
Internal combustion or fuel cell engines, must meet A70 (see 2.3.5.15 for details).	NO	YES	NO	NO
Lamps, energy efficient when in retail packaging intended for personal or home use.	NO	YES	YES	NO
Lithium Batteries: Security-type equipment containing lithium batteries (see 2.3.2.6 for details).	YES	YES	NO	NO

58th EDITION, 1 JANUARY 2017

**Picture 14.** An example of limitations (IATA DGR) regarding dangerous goods  
Source: IATA DGR.

A special category of cargo are aircraft spares (IATA DGR 2.5.2). Unless otherwise authorized by the state of the operator, such articles and substances intended as replacement for aircraft equipment (according to IATA DGR 2.5.11) must be transported in accordance with the provisions of the DG regulations.

We should distinguish the transport of dangerous goods in excepted quantities or limited quantities. It should be taken into consideration, that only a specific number of DG may be carried under the provisions for DG in excepted quantities (see Dangerous Goods in Excepted Quantities - IATA DGR 2.6). The list of such items can be found under 2.6.2.2 in the IATA DG manual and also in IATA DGR 4.2 in column F. It should be kept in mind, that

these dangerous goods (in excepted quantities) are not permitted in or as checked and carry-on baggage or in the mail. Other details can be found in documentation (IATA DGR 2.6.8) A shipper's declaration is not required. The dangerous goods in excepted quantities do not require:

- an acceptance checklist;
- to appear on the NOTOC<sup>7</sup>.

Many DG can be transported with a reduced hazard when they are:

- in a reasonable limited quantities;
- carried in quality packaging;
- packages meet the requirements;
- on a pax aircraft.

Such DG should meet the criteria of IATA DGR 2.7.2.1. The net quantity per package may not exceed the quantities in IATA DGR 4.2 column H. The Limited quantities of DG must be in accordance with the packing instructions indicated in IATA DGR 4.2 Column G. The GROSS weight must not exceed 30 kg. Regarding documentation IATA DGR 2.7.8 is in force. All packages shipped under limited quantities must meet all relevant documentation - requirements of section 8. NOTOC is also required. Further details about handling of dangerous goods we can find in IATA DGR 2.6.9. All packages shipped under limited quantities must meet all relevant handling requirements of section 9

It is important to mention, that states can impose further restrictions called States variations (see IATA DGR 2.8.1). Examples of state variations could be:

- in Switzerland: IATA DGR CHG-03, CHG-04 Transport of radioactive material;
- in Germany: IATA DGR DEG-01, DEG-02, DEG-03 Transport of radioactive material, and also DEG-04 Exemptions, DEG-05 UN 3077 & UN 3082.

Also operators can impose further restrictions called Operator variations (in accordance with IATA DGR 2.8.3). Examples of state variations could be:

- in Lufthansa: LH-01 until LH-09;
- in Saudi Arabian Airlines: SV-01 until SV-14.

Training is also an essential element in maintaining a safe regulatory regime. It is necessary for all individuals (see the picture below) in the preparation or transport of dangerous goods to be properly trained to carry out their responsibilities. Depending on job

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<sup>7</sup> In case of dangerous/special goods the captain (pilot in command) of the aircraft has to be notified of the load and its position of these shipments in the aircraft. So NOTOC is The Special load notification to captain, what contains information about characteristic and features of dangerous air mail.

function, this may only entail familiarisation training or may include more detailed training in the intricacies of the regulations. It is important to remember that dangerous goods are very unlikely to cause a problem when they are handled in compliance with the LATA Dangerous Goods Regulations.

**TABLE 1.5.A**  
**Minimum Requirements for Training Curricula (1.5.2)**

Aspects of transport of dangerous goods by air with which they should be familiar, as a minimum	Shippers and packers		Freight forwarders			Operators and ground handling agents						Security screeners
	Category											
	1	2	3	4	5	6	7	8	9	10	11	12
General philosophy	X	X	X	X	X	X	X	X	X	X	X	X
Limitations	X		X	X	X	X	X	X	X	X	X	X
General requirements for shippers	X		X			X						
Classification	X	X	X			X						X
List of dangerous goods	X	X	X			X				X		
General packing requirements	X	X	X			X						
Packing instructions	X	X	X			X						
Labelling and marking	X	X	X	X	X	X	X	X	X	X	X	X
Shipper's Declaration and other relevant documentation	X		X	X		X	X					
Acceptance procedures						X						
Recognition of undeclared dangerous goods	X	X	X	X	X	X	X	X	X	X	X	X
Storage and loading procedures					X	X		X		X		
Pilots' notification						X		X		X		
Provisions for passengers and crew	X	X	X	X	X	X	X	X	X	X	X	X
Emergency procedures	X	X	X	X	X	X	X	X	X	X	X	X

**Picture 15.** Requirements for personal (IATA DGR) regarding dangerous goods  
Source: IATA DGR.

Mainly, the dangerous goods period of validity for training from/to the calendar month is 24 months. This includes personal category 10: flight crew members, loadmaster, load planners and flight operations officers / flight dispatchers as well as personal category 11: crew members (other than flight crew members).

#### 4. CONCLUSIONS

There are a lot of regulations, but after publishing The Dangerous Goods Regulations (DGR) became The International Air Transport Association the main regulator of transport of dangerous goods all over the world. The regulations occurred a very good tool to complete safely the transport of those materials. Meanwhile became IATA also source of expertise regarding many other areas of air transport. In order to fulfill the mission of transport are also local (prepared in the EU and states) regulations quite important.

Very important is the basic knowledge about materials, which are or can turn out dangerous ones, as well as knowledge about their physical and chemical characteristics. But the most important is properly handling with such materials, as well as providing information about regulations and procedures during all stages of preparation for transportation or transportation as such.

## **LITERATURE**

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