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Technical Instructions for the Safe Transport of Dangerous Goods by Air

2021-2022 Edition

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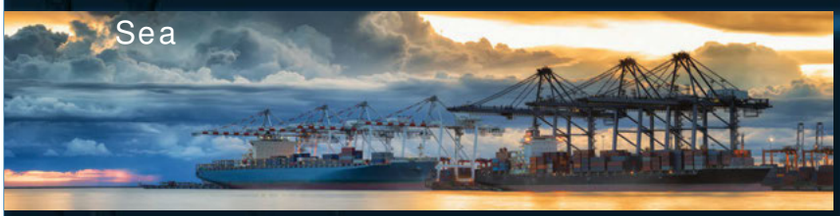

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FOREWORD

RELATIONSHIP TO ANNEX 18 TO THE CHICAGO CONVENTION

The broad principles governing the international transport of dangerous goods by air are contained in Annex 18 to the Convention on International Civil Aviation — *The Safe Transport of Dangerous Goods by Air*. These Technical Instructions amplify the basic provisions of Annex 18 and contain all the detailed instructions necessary for the safe international transport of dangerous goods by air. Interested persons may purchase copies of Annex 18 from ICAO at the following address:

International Civil Aviation Organization
Customer Services Unit
999 Robert-Bourassa Boulevard, Montréal, Quebec, Canada, H3C 5H7
Tel.: +1 514-954-8219
Fax: +1 514-954-6769
Email: sales@icao.int
Internet home page: www.icao.int

VARIATIONS FROM THE TECHNICAL INSTRUCTIONS

In accordance with the provisions of Annex 18, 2.5, Contracting States are required to notify ICAO of those cases where they have adopted provisions different from those contained in these Instructions. The variations which have been notified by States are listed in Attachment 3, together with notified variations from airline operators.

UPDATING PROCEDURE

It is intended that the Technical Instructions be kept up to date by an ICAO body of experts. For this purpose, the ICAO Dangerous Goods Panel will continue to meet periodically to review comments received from States and interested international organizations, to consider any changed recommendations of the United Nations Subcommittee of Experts on the Transport of Dangerous Goods or the International Atomic Energy Agency, and to prepare revised editions of the Technical Instructions. Amendments recommended by the Dangerous Goods Panel will be reviewed by the Air Navigation Commission. The Council of ICAO will then consider, with a view to approval, the amended version of the Technical Instructions and authorize its publication. Amendments will be made available on www.icao.int/safety/dangerousgoods.

OPERATIONAL USE OF THE TECHNICAL INSTRUCTIONS

≠ This edition of the Technical Instructions is required to be used for operations from 1 January 2021 and will remain valid until 31 December 2022 or until such later time as a new edition becomes valid.

GENERAL PRINCIPLES USED IN DEVELOPING THE PROVISIONS OF THE TECHNICAL INSTRUCTIONS

Dangerous goods can be carried safely by air transport providing certain principles are adopted. These principles have been used in developing these Technical Instructions and are set out below; they are intended to facilitate transport while giving a level of safety such that dangerous goods can be carried without placing an aircraft or its occupants at risk, providing all the requirements are fulfilled. They try to ensure that should an incident occur it cannot lead to an accident.

In general, dangerous goods are divided into various classes or divisions according to the hazard they present. A detailed list of individual commodities is shown which indicates the class or division into which each commodity falls as well as its acceptability for transport by air and under what conditions. Since such a list cannot be exhaustive, it also includes various generic or "not otherwise specified" entries to assist in the transport of those commodities not specifically listed by name.

Some dangerous goods are identified as too dangerous ever to be carried on any aircraft; some are forbidden in normal circumstances but may be carried with specific approval from the States concerned; some are restricted to carriage only on all-cargo aircraft; but most may be carried on both passenger and all-cargo aircraft, subject to meeting the required conditions. Those restricted to all-cargo aircraft are either in larger quantities than allowed on passenger aircraft or are forbidden on such aircraft; their transport is permitted due to their being usually accessible in flight and to the ability of the flight crew to consider a greater range of actions in an emergency than is possible on passenger aircraft.

The provisions are based on material produced by the United Nations, which is contained in the Recommendations on the Transport of Dangerous Goods (ST/SG/AC.10/1), the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria (ST/SG/AC.10/11), and, for radioactive materials, the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material, 2012 Edition, IAEA Safety Standards Series No. SSR–6, IAEA, Vienna 2012. Using a United Nations system ensures compatibility between the international modes of transport so a consignment may be carried by more than one mode without intermediate reclassification and repacking. Modifications are made to the system to take account of the peculiarities of air transport, while keeping in mind the need to ensure modal compatibility.

There are packing requirements of a general nature and packing instructions which, together, are intended to ensure that the safety of dangerous goods in air transport is assured by their packagings and the way in which they are packed. The packing requirements apply in almost all circumstances; the packing instructions mostly use UN packagings but sometimes these are not required, for instance when dangerous goods are in limited quantities. There is usually a wide choice of inner and outer packagings and single packagings are often permitted; sometimes, however, very restrictive packagings or only one or two types are permitted, or triple packagings are required. Generally, the quantity which can be put into an inner packaging and a complete package is strictly controlled. This is to minimize the inherent risk presented by the dangerous goods so that if an incident should occur, the situation would not produce an unacceptable hazard or lead to injury or major property damage.

After dangerous goods have been packed, the packages are marked with essential information, including the proper shipping name and UN number, and labels depicting all the potential hazard(s) of the contents are affixed. This is to ensure packages containing dangerous goods can be recognized and warning given of the potential hazard(s) without relying on information on accompanying documents. A dangerous goods transport document accompanies most consignments to provide detailed information about the goods so that, if required, there is a separate means of identifying the contents of packages.

There is generally no restriction on the number of packages of dangerous goods which can be loaded on an aircraft but there are provisions for their stowage. Incompatible dangerous goods are segregated and most are separated from passengers. The pilot-in-command is informed of what is on board an aircraft since, among other things, in an emergency the dangerous goods need to be considered when deciding on action. If an in-flight emergency does occur, the pilot-in-command needs to convey information to the air traffic services, in order to aid the response to such an accident or incident. In the event of an accident or incident, information is provided by the operator to the relevant authority as quickly as possible so as to ensure that any hazard arising from damage to the dangerous goods is minimized.

Dangerous goods accidents and incidents have to be reported so that an investigation by a relevant authority can establish the cause and take action to prevent a recurrence, wherever possible. In particular, any weakness or error in the Technical Instructions has to be identified.

Training is an important aid to achieving an understanding of the philosophy and requirements of the Technical Instructions. There is a need for everyone concerned to receive training on the subject either for general familiarization or to provide detailed knowledge, so that the responsibilities of the individual can be met. Dangerous goods are very unlikely to cause a problem when they are prepared and handled in compliance with the Technical Instructions.

USE OF THE TECHNICAL INSTRUCTIONS

The Technical Instructions are divided into eight Parts and five Attachments, with each Part and Attachment divided into Chapters and each Chapter divided into paragraphs and subparagraphs.

Within each Chapter, the Chapter number is incorporated into all of the paragraph numbers; thus, in Chapter 3, paragraph 2 carries the number “3.2”. When referring to a paragraph, it is necessary to identify the appropriate Part or Attachment; if the above example were located in Part 2, the reference to it would be shown as “2;3.2” (that is, Part 2; Chapter 3, paragraph 3.2). If the above example were located in Attachment 3, the reference would be shown as “A3;3.2” (that is, Attachment 3; Chapter 3, paragraph 3.2).

Figures and Tables are numbered sequentially within the Part or Attachment in which they appear. Thus, the second figure appearing in Part 5 is identified as “Figure 5-2” and the first table appearing in Part 3 is identified as “Table 3-1”. The first table appearing in the Attachments is identified as “Table A-1”.

Use of the Technical Instructions will be facilitated by reference to the detailed Index in Attachment 5.

The detailed content of the Technical Instructions gives all the necessary provisions to enable a consignment of dangerous goods to be correctly prepared for air transport. However, to assist the user of this document, the following step-by-step procedure is given for guidance to ensure all the applicable requirements for classifying, packing, labelling, marking and documenting are met.

It should be noted that the information given below is for guidance only and the relevant sections should be checked to ascertain their relevance to each consignment.

1. Determine the correct technical name or composition of the substance or the description of the article.

2. Ascertain whether the name or composition of the substance or article appears in Table 3-1 and if so what is the proper shipping name.

3. If the substance or article does not appear in Table 3-1, determine the class or division into which it falls by comparing its known properties with the definitions for the various classes, which are given in Part 2, Chapters 1 to 9. If the properties are not known, tests should be carried out to determine the appropriate class or division. If the article or substance is not listed by name in Table 3-1 and does not meet the definition of any of the classes, it is not subject to these requirements for the transport of dangerous goods. For substances or articles with multiple hazards, the provisions of Part 2, Introductory Chapter should be followed. Once all the properties of the substance or article are known, determine whether it is forbidden for transport under any circumstance according to the provisions of 1;2.1. If the substance or article does not come within the provisions of 1;2.1, determine the proper shipping name from the most appropriate of the n.o.s. entries in Table 3-1. Information on n.o.s. entries is given in Part 2, Introductory Chapter.

4. If it is desired to transport the substance or article under the provisions for excepted quantities, all the requirements of 3;5 must be met. The substance or article will then not be subject to any of the other requirements of the Technical Instructions other than those listed in 3;5.1.1.

5. If it is desired to transport the substance or article under the provisions for limited quantities, all the requirements of 3;4 must be met and also all the applicable requirements of the Technical Instructions, except where otherwise provided for in 3;4.

6. If the substance or article is not to be transported as an excepted quantity or a limited quantity, determine whether it is desired to transport it on passenger or cargo aircraft.

7. From the information given in columns 10 to 13 of Table 3-1, ascertain whether or not the substance or article is forbidden for transport on passenger aircraft or on both passenger and cargo aircraft.

≠ 8. If the substance or article is shown as forbidden for transport on either passenger aircraft or both passenger and cargo aircraft, ascertain whether it could be subject to an exemption under the provisions of 1;1.1.3, by consulting the appropriate national authority. If the substance or article is forbidden for transport on passenger aircraft, determine whether it can be transported on cargo aircraft.

9. If it is desired to transport the substance or article on passenger aircraft and this is not forbidden and the quantity per package does not exceed the permitted maximum net quantity per package given in column 11 of Table 3-1, determine the packing instruction number, quantity limitation, special provisions and any State or operator variations as shown in Tables 3-1 and 3-2 and Attachment 3.

10. If it is desired to transport the substance or article on a cargo aircraft or if it can only be carried on such aircraft, determine the packing instruction number, quantity limitation, special provisions and any State or operator variations as shown in Tables 3-1 and 3-2 and Attachment 3.

11. Determine the packing details from the relevant information or packing instruction in Part 4 and any special requirements from Part 2, Chapters 1 to 9 and Part 5, Chapter 1.

12. Select, where permitted, a method of packing from the packing instruction, or ascertain the provisions of the instruction and ensure the packagings to be used meet all the relevant requirements of Part 4, Chapter 1 and Part 6.

13. Prepare the consignment in accordance with all the relevant requirements of paragraphs 9 to 12 above.

14. Ensure all the appropriate labels and markings are affixed to or printed on the packages according to Part 5, Chapters 2 and 3.

15. Make any appropriate advance arrangements in accordance with Part 5, Chapter 1.

16. Prepare the transport documents and complete and sign the dangerous goods transport document in accordance with Part 5, Chapter 4.

17. Offer the complete consignment for transport by air.

THE SUPPLEMENT TO THE TECHNICAL INSTRUCTIONS

A Supplement to the Technical Instructions provides information on the safe transport of dangerous goods by air that is primarily of interest to States. Publishing this information in a separate document eliminates from the Technical Instructions material which the average user has neither the need nor the desire to know. The size and complexity of the Technical Instructions is thereby reduced and its comprehensibility enhanced. Examples of the subjects dealt with in the Supplement are guidance for the issue of certain exemptions or approvals by States and the reporting of dangerous goods accidents and incidents to ICAO by Contracting States.

The Supplement is published at the same time as the Technical Instructions and is distributed to the aviation administrations of all the Contracting States of ICAO. However, it is recognized that there may be occasions when the information in the Supplement might be helpful to other readers. Copies can be purchased from the Regional Offices of ICAO or from the Headquarters of ICAO using the following address:

International Civil Aviation Organization
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999 Robert-Bourassa Boulevard, Montréal, Quebec, Canada, H3C 5H7
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Email: sales@icao.int
Internet home page: www.icao.int

≠ **THE 2021-2022 EDITION**

The Technical Instructions have been amended to make them as up to date as possible and to clarify, where necessary, the intent of the requirements. Account has been taken of comments received from users throughout the world. This has resulted in numerous minor changes in all parts of the book.

≠ It is intended, for the time being, to continue issuing new versions of the Technical Instructions biennially. This is the seventeenth biennial edition of the Technical Instructions and it will be valid for two years, i.e. from 1 January 2021 to 31 December 2022 or until such later time as a new edition becomes valid.

≠ The requirements have been amended so as to align them, as far as possible, with the Twenty-first Revised Edition of the United Nations *Recommendations on the Transport of Dangerous Goods* and the *International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material,* as incorporated therein.

The amendments include the following:

- revisions to radioactive material provisions to align with the International Atomic Energy Agency Regulation for the Safe Transport of Radioactive Material including replacement of references to “radiation level” with “dose rate” throughout the Instructions;

- revisions to provisions for marking of packages to ensure marks are not folded or wrapped around multiple sides of a package (3;4, 3;5, 5;2.2 and Packing Instructions 650 and 659);

- revisions to general provisions including:

  - addition of new exception for dangerous goods used to preserve tissues or organs intended for use in transplantation (1;1.1.5.1 a));
  - addition of new exception for dangerous goods used for pest management activities (1;1.1.5.1 c));
  - clarification of provisions for designated postal operators (DPOs) to offer mail articles containing dry ice as a refrigerant for infectious substances assigned to Category B (UN 3373) (1;2.3.2);
  - replacement of definition for “radiation level” with new definition for “dose rate” (1;3);
  - revision to definitions for self-accelerating decomposition temperature (SADT), self-accelerating polymerization temperature (SAPT), transport index (TI) assigned to a package, overpack or freight container and UN number (1;3);
  - revision to training provisions to support a competency-based approach to training and assessment (1;4);
  - addition of new entries to the indicative list of high consequence dangerous goods (Table 1-7);

- revision to classification criteria including:

  - addition of new provisions for solid medical waste of Category A transported for disposal (2;6.3);
  - revisions to radioactive material criteria to align with the International Atomic Energy Agency Regulation for the Safe Transport of Radioactive Material; (2;7);
  - revision to corrosive substances criteria for packing group assignment (2;8.3);
  - addition of a categorized list of substances and articles assigned to Class 9 (Table 2-16);

- addition of new entries in Table 3-1 including:

  - **Detonators, electronic** programmable for blasting (UN 0511);
  - **Detonators, electronic** programmable for blasting (UN 0512);
  - **Detonators, electronic** programmable for blasting (UN 0513);
  - **Dangerous goods in articles** (UN 3363);
  - **Medical waste, Category A, affecting humans**, solid (3549);
  - **Medical waste, Category A, affecting animals** only, solid (UN 3549);

- renaming of **2-Dimethylaminoethyl methacrylate** to **2-Dimethylaminoethyl methacrylate, stabilized** for UN 2522 in Table 3-1;

- revision to special provisions including:

  - Special Provision A88: addition of new requirement for an approval to be granted from the appropriate authority of the State of the Operator, in addition to the State of Origin;

- Special Provision A99: addition of new requirement for an approval to be granted from the appropriate authority of the State of the Operator in addition to the State of Origin;
- Special Provision A107: revised to take into account the new entry in Table 3-1 for UN 3363 — **Dangerous goods in articles**;
- Special Provision A145: revised to incorporate waste gas cartridges and waste receptacles, small containing gases, making them forbidden for transport by air, and to except from the Instructions those that were filled with gases of Division 2.2 and pierced;
- Special Provision A154: addition of guidance to ensure that a lithium cell or battery is not damaged or defective;
- Special Provisions A176 and A214: revised to take into account the assignment of the special provision to UN 3529;
- Special Provision A185: revised to clarify classification criteria for lithium batteries installed in cargo transport units;
- Special Provision A201: revised to allow transport in certain conditions of UN 3480 or UN 3090, when necessary for urgent medical need, on a passenger aircraft with the prior approval of the State of Origin and the operator;
- Special Provision A213: revision to clarify lithium content and total capacity limits for batteries containing both lithium metal and lithium ion cells;

— addition of the following new special provisions:

- Special Provision A215: new provision allowing a proper shipping name from Table 3-1 as the technical name for UN 3077 — **Environmentally hazardous substance, solid, n.o.s.** and UN 3082 — **Environmentally hazardous substance, liquid, n.o.s.**;
- Special Provisions A216 and A217: new provisions requiring additional tests to ensure stability of nitrocellulose;
- Special Provision A218: new provision to clarify what can be classified as UN 3549 — **Medical waste, Category A, affecting humans** and **Medical waste, Category A, affecting animals;**
- Special Provision A219: criteria for the transport of UN 2216 — **Fish meal, stabilized**;

— revision to packing requirements including:

- new provision allowing packagings to conform to more than one successfully tested design type and to bear more than one UN specification mark (4;1.1.2 and 6;2.1.15);
- revision to the list of dangerous goods that do not need to be considered in the calculation of the “Q” value (4;1.1.9 e) 3));
- updates to references to ISO provisions that must be met for cylinders and closed cryogenic receptacles (4;4);
- revision to test period for periodic inspection of cylinders containing fire extinguishing agents assigned to UN 3500 (Packing Instruction 218);
- addition of an exception from the requirement to ensure complete drainage of flammable liquid fuel tanks for machinery that can only be handled in an upright position (Packing Instruction 378);
- revisions to packagings for the sake of alignment with the UN Model Regulations and other packing instructions contained in the Instructions (Packing Instructions 457, 462-463, 464-465, 470-471, 478-479, 480-482, 487-491, 492, 553-555, 620, 870, 871, 872, 957);
- renumbering of Packing Instruction 622 to 621 for sake of alignment with corresponding packing instruction in the UN Model Regulations;
- revision to the criteria allowing dangerous goods of Class 3, 8 or 9 to be packed in the same packaging as Division 6.2 substances (Packing Instruction 650);
- addition of provisions for the transport of UN 2216 — **Fish meal, stabilized** (Packing Instruction 956);
- revisions to account for addition of alternate proper name for UN 3363 (Packing Instruction 962);
- clarification of provisions for dry ice as a refrigerant packed in a ULD containing ID 8000 — Consumer commodities (Packing Instruction Y963);
- addition of a requirement to Section II of Packing Instructions 965 to 970 for undeclared or misdeclared lithium ion cells or batteries discovered in cargo or mail to be reported in accordance with 7;4.5 (Packing Instructions 965 to 970);
- addition of an alternate compliance statement on an air waybill for lithium batteries packed in accordance with Section II of multiple packing instructions (Packing Instructions 965 to 970);
- addition of an exception from the requirement to ensure complete drainage of liquid fuel tanks for machinery that can only be handled in an upright position (Packing Instruction 972);
- addition of a requirement for undeclared or misdeclared dangerous goods discovered in cargo or mail, for which exceptions from the Instructions apply, to be subject to the reporting requirements of 7;4.5 (Packing Instructions 650, 659, 965, 966, 967, 968, 968, 969);

— revision to marking and labelling requirements including:

- clarification of minimum height marking requirements for the UN number and the letters “UN” or “ID” (5;2.4.1);
- revision to the permitted dimensions for the lithium battery mark (5;2.4.16);

— revision to packaging requirements and tests including:

- clarification of minimum height requirements for marks required on packagings other than inner packagings (6;2.1.1 and 6;6.4.1);
- revision to the provisions for marking of the date of manufacture on packagings of types 1H and 3H (6;2.1.1 e));
- new provision for packagings conforming to more than one design type (6;2.1.15);
- addition of compatibility requirement for drums (6;3.1.2 and 6;3.1.3);
- revision to capacity limits for non-refillable metal aerosols and non-refillable receptacles containing gas (6;3.2.7);
- revision to ISO references for construction and testing of UN cylinders and closed cryogenic receptacles (6;5.2);
- clarification of marking provision for cylinders, closed cryogenic receptacles and metal hydride storage systems (6;5.2);

— revisions to operator responsibilities including:

  — revisions to safety risk assessment provisions (7;1.7);
  — revisions to provisions for the loading of battery-powered mobility aids carried to include dry and nickel-metal hydride batteries (7;2.13);
  — revision to the provisions for reporting of dangerous goods occurrences (7;4.6);

— revisions to provisions for dangerous goods carried by passengers and crew:

  — addition of provisions for nickel-metal hydride and dry batteries (Table 8-1, Item 2);
  — revision to provisions for battery-powered mobility aids (Table 8-1, Item 4);
  — revision to provisions for cartridges of Division 2.2 (Table 8-1, Item 12).

ABBREVIATIONS AND SYMBOLS

The abbreviations and symbols in the following table are used throughout the Instructions, or in the particular sections indicated, and have the meanings shown below.

Abbreviation or symbol	*Meaning*
A/m	amperes per metre
Bq	becquerel
cm	centimetre
°C	degree Celsius
g	gram
G	gross mass as prepared for transport (as used in column 11 of Table 3-1)
g/m^2	grams per square metre
Gy	gray
Hz	hertz
IAEA	International Atomic Energy Agency
IP	inner packaging
ISO	the International Organization for Standardization
J/g	joules per gram
J/kg	joules per kilogram
K	kelvin
kg	kilogram
kgf	kilogram-force
kPa	kilopascal
L	litre
LC	lethal concentration
LD	lethal dose
L/kg	litres per kilogram
m	metre
mL	millilitre
mm	millimetre
mS/m	millisiemens per metre
N	newton
n.o.s.	not otherwise specified
Ω/m	ohm per metre
SI	the International System of Units developed by the General Conference of Weights and Measures (Système international d'unités)
Sv	sievert
UN	the United Nations Committee of Experts on the Transport of Dangerous Goods
W/m^2	watts per square metre
W/m/K	Watts per metre per Kelvin
µm	micrometre
≠	this symbol indicates changed text
+	this symbol indicates new or relocated text
>	this symbol indicates deleted text
≈	this symbol is used in Table 3-2 to indicate wording in a special provision that is related to but not equivalent to that in the UN Model Regulations