

IMDG Code 2000 Edition

**International
Maritime
Dangerous
Goods
Code**

including Amendment 30-00

volume **1**



IMO
London, 2000

Contents

Volume 1

Page

PART 1 – GENERAL PROVISIONS, DEFINITIONS AND TRAINING

Chapter 1.1 General provisions

1.1.1 Application and implementation of the Code	3
1.1.2 Conventions	4
1.1.3 Transport of radioactive material	9
1.1.4 Dangerous goods forbidden from transport	11

Chapter 1.2 Definitions, units of measurement and abbreviations

1.2.1 Definitions	12
1.2.2 Units of measurement	17
1.2.3 List of abbreviations	23

Chapter 1.3 Training

Introductory note	25
-------------------------	----

PART 2 – CLASSIFICATION

Chapter 2.0 Introduction

2.0.0 Responsibilities	29
2.0.1 Classes, divisions, packing groups	29
2.0.2 UN Numbers and Proper Shipping Names	30
2.0.3 Classification of substances, mixtures and solutions with multiple hazards (precedence of hazard characteristics)	31
2.0.4 Transport of samples	33

Chapter 2.1 Class 1 – Explosives

2.1.0 Introductory notes	34
2.1.1 Definitions and general provisions	34
2.1.2 Compatibility groups and classification codes	35
2.1.3 Classification procedure	37

Chapter 2.2 Class 2 – Gases

2.2.0 Introductory notes	38
2.2.1 Definitions and general provisions	38
2.2.2 Class subdivisions	38
2.2.3 Mixtures of gases	39

Chapter 2.3 Class 3 – Flammable liquids

2.3.0 Introductory note	40
2.3.1 Definitions and general provisions	40
2.3.2 Assignment of packing group	40
2.3.3 Determination of flashpoint	41

	<i>Page</i>
Chapter 2.4 Class 4 – Flammable solids; substances liable to spontaneous combustion; substances which, in contact with water, emit flammable gases	
2.4.1 Definition and general provisions	43
2.4.2 Class 4.1 – Flammable solids, self-reactive substances and solid desensitized explosives	43
2.4.3 Class 4.2 – Substances liable to spontaneous combustion.	49
2.4.4 Class 4.3 – Substances which, in contact with water, emit flammable gases	50
Chapter 2.5 Class 5 – Oxidizing substances and organic peroxides	
2.5.0 Introductory note	52
2.5.1 Definitions and general provisions	52
2.5.2 Class 5.1 – Oxidizing substances.	52
2.5.3 Class 5.2 – Organic peroxides.	54
Chapter 2.6 Class 6 – Toxic and infectious substances	
2.6.0 Introductory notes	67
2.6.1 Definitions	67
2.6.2 Class 6.1 – Toxic substances.	67
2.6.3 Class 6.2 – Infectious substances	71
Chapter 2.7 Class 7 – Radioactive material	
2.7.1 Definition of class 7 – radioactive material	74
2.7.2 Definitions	74
2.7.3 Low specific activity (LSA) material, determination of groups	76
2.7.4 Provisions for special form radioactive material	77
2.7.5 Surface contaminated object (SCO), determination of groups.	78
2.7.6 Determination of transport index (TI) and criticality safety index (CSI)	79
2.7.7 Activity limits and material restrictions	79
2.7.8 Limits on transport index (TI), criticality safety index (CSI) and radiation levels for packages and overpacks	93
2.7.9 Provisions and controls for transport of excepted packages	94
2.7.10 Provisions for low dispersible radioactive material	95
Chapter 2.8 Class 8 – Corrosive substances	
2.8.1 Definition and properties	96
2.8.2 Assignment of packing groups.	96
Chapter 2.9 Class 9 – Miscellaneous dangerous substances and articles	
2.9.1 Definition	98
2.9.2 Assignment of packing groups to miscellaneous dangerous substances and articles	98
Chapter 2.10 Marine pollutants	
2.10.1 Definition	99
2.10.2 Properties	99
2.10.3 Classification of solutions, mixtures and isomers	99
2.10.4 Guidelines for the identification of harmful substances in packaged form (marine pollutants)	100

PART 3 – DANGEROUS GOODS LIST AND LIMITED QUANTITIES EXCEPTIONS

Chapter 3.1	General	
3.1.1	Scope and general provisions	3
3.1.2	Proper Shipping Names	4
3.1.3	Mixtures and solutions containing one dangerous substance	5
3.1.4	Segregation groups	5
Chapter 3.2	Dangerous Goods List	
3.2.1	Structure of the Dangerous Goods List	18
3.2.2	Abbreviations and symbols	20
Chapter 3.3	Special provisions applicable to certain substances, materials or articles	179
Chapter 3.4	Limited quantities	
3.4.1	General	192
3.4.2	Packing	192
3.4.3	Stowage	192
3.4.4	Segregation	192
3.4.5	Marking and labelling	192
3.4.6	Documentation	192
3.4.7	Exemptions	193
Chapter 3.5	Transport schedules for class 7 – radioactive material	
3.5.1	Transport schedules	194
3.5.2	Summary of approval and prior notification provisions for class 7.....	252

PART 4 – PACKING AND TANK PROVISIONS

Chapter 4.1	Use of packagings, including intermediate bulk containers (IBCs) and large packagings	
4.1.0	Definitions	103
4.1.1	General provisions for the packing of dangerous goods, other than goods of classes 2, 5.2 or 7, in packagings, including IBCs and large packagings	103
4.1.2	Additional general provisions for the use of IBCs	106
4.1.3	General provisions concerning packing instructions	106
4.1.4	List of packing instructions	108
	<i>Packing instructions concerning the use of packagings (except IBCs and large packagings)</i>	108
	<i>Packing instructions concerning the use of IBCs</i>	142
	<i>Packing instructions concerning the use of large packagings</i>	146
4.1.5	Special packing provisions for goods of class 1	148
4.1.6	Special packing provisions for class 2	149
4.1.7	Special packing provisions for organic peroxides (class 5.2) and self-reactive substances of class 4.1	151
4.1.8	Special packing provisions for infectious substances (class 6.2)	152
4.1.9	Special packing provisions for class 7	152
Chapter 4.2	Use of portable tanks	
4.2.0	Transitional provision	154
4.2.1	General provisions for the use of portable tanks for the transport of substances of classes 3 to 9	154
4.2.2	General provisions for the use of portable tanks for the transport of non-refrigerated liquefied gases	158
4.2.3	General provisions for the use of portable tanks for the transport of refrigerated liquefied gases of class 2	159
4.2.4	Portable tank instructions and special provisions	160
	<i>Portable tank instructions</i>	160
	<i>Portable tank special provisions</i>	169
4.2.5	Use of IMO type 4, 6 and 8 tanks	170
4.2.6	Use of portable tanks for the transport of solid dangerous goods	170
Chapter 4.3	Use of bulk packagings	
4.3.1	General	171
4.3.2	Special provisions for transport in bulk packagings, other than tanks	171

PART 5 – CONSIGNMENT PROCEDURES

Chapter 5.1	General provisions	
5.1.1	Application and general provisions	175
5.1.2	Use of overpacks and unit loads	175
5.1.3	Empty uncleaned packagings or units	175
5.1.4	Mixed packing	175
5.1.5	General provisions for class 7	176
5.1.6	Packages packed into a cargo transport unit	178

Chapter 5.2	Marking and labelling of packages including IBCs	
5.2.1	Marking of packages including IBCs	179
5.2.2	Labelling of packages including IBCs	181
Chapter 5.3	Placarding and marking of cargo transport units	
5.3.1	Placarding	187
5.3.2	Marking of cargo transport units	188
Chapter 5.4	Documentation	
5.4.1	Dangerous goods transport document	190
5.4.2	Container/vehicle packing certificate	194
5.4.3	Documentation required aboard the ship	194
5.4.4	Other required information and documentation	195
5.4.5	Multimodal Dangerous Goods Form	195
Chapter 5.5	Special provisions	
5.5.1	Special provisions applicable to the consignment of infectious substances	199
5.5.2	Documentation and identification of cargo transport units under fumigation	199

PART 6 – CONSTRUCTION AND TESTING OF PACKAGINGS, INTERMEDIATE BULK CONTAINERS (IBCs), LARGE PACKAGINGS, PORTABLE TANKS AND ROAD TANK VEHICLES

Chapter 6.1	Provisions for the construction and testing of packagings (other than for class 6.2 substances)	
6.1.1	Applicability and general provisions	203
6.1.2	Code for designating types of packagings	204
6.1.3	Marking	206
6.1.4	Provisions for packagings	208
6.1.5	Test provisions for packagings	217
Chapter 6.2	Provisions for the construction and testing of receptacles for gases	
6.2.1	Provisions for gas cylinders	223
6.2.2	Leakproofness test for aerosols and small receptacles for gas	225
Chapter 6.3	Provisions for the construction and testing of packagings for class 6.2 substances	
6.3.1	General	226
6.3.2	Test provisions for packagings	226
Chapter 6.4 – Provisions for the construction, testing and approval of packages and material of class 7		
6.4.1	[reserved]	229
6.4.2	General provisions	229
6.4.3	Additional provisions for packages transported by air	229
6.4.4	Provisions for excepted packages	230
6.4.5	Provisions for industrial packages	230
6.4.6	Provisions for packages containing uranium hexafluoride	231
6.4.7	Provisions for Type A packages	231
6.4.8	Provisions for Type B(U) packages	232
6.4.9	Provisions for Type B(M) packages	234
6.4.10	Provisions for Type C packages	234

	Page
6.4.11 Provisions for packages containing fissile material	234
6.4.12 Test procedures and demonstration of compliance	236
6.4.13 Testing the integrity of the containment system and shielding and evaluating criticality safety	237
6.4.14 Target for drop tests	237
6.4.15 Test for demonstrating ability to withstand normal conditions of transport	237
6.4.16 Additional tests for Type A packages designed for liquids and gases	238
6.4.17 Tests for demonstrating ability to withstand accident conditions of transport	238
6.4.18 Enhanced water immersion test for Type B(U) and Type B(M) packages containing more than 10^5 A ₂ and Type C packages	239
6.4.19 Water leakage test for packages containing fissile material.	239
6.4.20 Tests for Type C packages	239
6.4.21 Tests for packagings designed to contain uranium hexafluoride.	240
6.4.22 Approvals of package designs and materials	240
6.4.23 Applications for approval and approvals for radioactive material transport	240
6.4.24 Transitional measures for class 7.	246
 Chapter 6.5 Provisions for the construction and testing of intermediate bulk containers (IBCs)	
6.5.1 General provisions applicable to all types of IBCs	247
6.5.2 Marking	250
6.5.3 Specific provisions for IBCs	252
6.5.4 Test provisions for IBCs.	258
 Chapter 6.6 Provisions for the construction and testing of large packagings	
6.6.1 General	265
6.6.2 Code for designating types of large packagings.	265
6.6.3 Marking	265
6.6.4 Specific provisions for large packagings	266
6.6.5 Test provisions for large packagings	268
 Chapter 6.7 provisions for the design, construction, inspection and testing of portable tanks	
6.7.1 Application and general provisions	272
6.7.2 Provisions for the design, construction, inspection and testing of portable tanks intended for the transport of substances of classes 3 to 9	272
6.7.3 Provisions for the design, construction, inspection and testing of portable tanks intended for the transport of non-refrigerated liquefied gases of class 2.	285
6.7.4 Provisions for the design, construction, inspection and testing of portable tanks intended for the transport of refrigerated liquefied gases of class 2.	295

Chapter 6.8	Provisions for road tank vehicles	
6.8.1	General	305
6.8.2	Road tank vehicles for long international voyages for substances of classes 3 to 9	305
6.8.3	Road tank vehicles for short international voyages	305
Chapter 6.9	Special provisions relating to tanks for the transport of solid substances (such as powdery or granulated substances)	309

PART 7 – PROVISIONS CONCERNING TRANSPORT OPERATIONS

Chapter 7.1	Stowage	
7.1.1	General provisions	313
7.1.2	Stowage in relation to living quarters	314
7.1.3	Stowage in relation to undeveloped films and plates, and mailbags	315
7.1.4	Stowage of marine pollutants	315
7.1.5	Stowage in relation to foodstuffs	315
7.1.6	Stowage of solutions and mixtures	315
7.1.7	Stowage and handling of goods of class 1	315
7.1.8	Stowage of goods of class 2	320
7.1.9	Stowage of goods of class 3	321
7.1.10	Stowage of goods of classes 4.1, 4.2 and 4.3	321
7.1.11	Stowage of goods of class 5.1	323
7.1.12	Stowage of goods of class 5.2	323
7.1.13	Stowage of goods of class 6.1	323
7.1.14	Stowage of goods of class 7	324
7.1.15	Stowage of goods of class 8	326
7.1.16	Stowage of goods of class 9	326
Chapter 7.2	Segregation	
7.2.1	General	329
7.2.2	Segregation of packages	332
7.2.3	Segregation of cargo transport units on board container ships	333
	<i>Illustrations of segregation of cargo transport units on board container ships</i>	334
	<i>Illustrations of segregation of cargo transport units on board hatchless container ships</i>	342
7.2.4	Segregation of cargo transport units on board roll-on/roll-off ships	356
7.2.5	Segregation in shipborne barges and on board barge-carrying ships	363
7.2.6	Segregation between bulk materials possessing chemical hazards and dangerous goods in packaged form	363
7.2.7	Segregation of goods of class 1	364
7.2.8	Segregation provisions for goods of class 4.1 and class 5.2	366
7.2.9	Segregation for goods of class 7	366
Chapter 7.3	Special provisions in the event of an incident and fire precautions involving dangerous goods	
7.3.1	General	372
7.3.2	General provisions in the event of incidents	372
7.3.3	Special provisions for incidents involving infectious substances	372
7.3.4	Special provisions for incidents involving radioactive material	372

	<i>Page</i>
7.3.5 General fire precautions	373
7.3.6 Special fire precautions for class 1	373
7.3.7 Special fire precautions for class 2	374
7.3.8 Special fire precautions for class 3	374
7.3.9 Special fire precautions and fire fighting for class 7	374
Chapter 7.4 Transport of cargo transport units on board ships	
7.4.1 Applicability	375
7.4.2 General provisions for cargo transport units	375
7.4.3 Cargo transport units transported under fumigation	376
7.4.4 Stowage of cargo transport units in cargo spaces other than ro-ro cargo spaces	376
7.4.5 Stowage of cargo transport units in ro-ro cargo spaces	377
7.4.6 Transport of dangerous goods of class 1 in cargo transport units	378
Chapter 7.5 Packing of cargo transport units	
7.5.1 General provisions for cargo transport units	379
7.5.2 Packing of cargo transport units	379
7.5.3 Empty cargo transport units	379
Chapter 7.6 Transport of dangerous goods in shipborne barges on barge-carrying ships	
7.6.1 Applicability	380
7.6.2 Definitions	380
7.6.3 Permitted shipments	380
7.6.4 Barge loading	381
7.6.5 Stowage of shipborne barges	381
7.6.6 Ventilation and condensation	381
7.6.7 Fire protection	381
7.6.8 Transport of goods of class 1 in shipborne barges	382
Chapter 7.7 Temperature control provisions	
7.7.1 Preamble	383
7.7.2 General provisions	383
7.7.3 Methods of temperature control	384
7.7.4 Special provisions for self-reactive substances (class 4.1) and organic peroxides (class 5.2)	385
7.7.5 Special provisions for vehicles transported on ships	385
7.7.6 Exemptions	385
Chapter 7.8 Transport of wastes	
7.8.1 Preamble	386
7.8.2 Applicability	386
7.8.3 Transboundary movements under the Basel Convention	386
7.8.4 Classification of wastes	386
Chapter 7.9 Competent authority approval	388

Part 3 – Dangerous Goods List and limited quantities exceptions

Chapter 3.2
Dangerous Goods List

UN No.	Proper Shipping Name (PSN)	Class or division (3)	Subsidiary risk(s) (4)	Packing group (5)	Special provisions (6)	Limited quantities (7)	Packing		IBC		Tank instructions			ErS	Stowage and segregation (16)	Properties and observations (17)	UN No. (18)
							Instruc-tions (8)	Provisions (9)	Instruc-tions (10)	Provisions (11)	IMO (12)	UN (13)	Provisions (14)				
1613	HYDROCYANIC ACID, AQUEOUS SOLUTION (HYDROGEN CYANIDE, AQUEOUS SOLUTION) with not more than 20% hydrogen cyanide	6.1	P	I	900	None	P601	-	-	-	T10	T14	TP2 TP13	6.1-01	Category D. Clear of living quarters.	Colourless liquid evolving extremely toxic vapour with a bitter almond odour. Miscible with water. Highly toxic if swallowed, by skin contact or by inhalation.	1613
1689	SODIUM CYANIDE, SOLUTION	6.1	P	I	-	None	P001	-	IBC07	B1	T10	T14	TP2 TP13	6.1-03	Category B. "Separated from" acids.	White, deliquescent crystals or lumps. Miscible or soluble in water. Reacts with acids or acid fumes, evolving hydrogen cyanide, a highly toxic and flammable gas. Highly toxic if swallowed, by skin contact or by dust inhalation.	1689
1052	HYDROGEN FLUORIDE, ANHYDROUS	8	6.1	I	-	None	P200	-	-	-	-	T10	TP2	8-03	Category D. Clear of living quarters.	Colourless, fuming and highly volatile liquid with an irritating and pungent odour. Highly corrosive to metals and glass in the presence of moisture. Boiling point: 20 °C. Toxic if swallowed, by skin contact or by inhalation. Causes severe burns to skin, eyes and mucous membranes.	1052
1790	HYDROFLUORIC ACID solution with not more than 60% hydrofluoric acid	8	6.1	II	-	500 ml	P001	PP50	IBC02	B11	-	TB	TP2 TP12	8-03	Category D. Keep as cool as reasonably practicable. Clear of living quarters.	See entry above.	1790

Chapter 4.2

Use of portable tanks

4.2.1.9.6 Portable tanks should not be offered for transport:

- .1 with a degree of filling, for liquids having a viscosity less than 2,680 mm²/s at 20°C or at the maximum temperature of the substance during transport in the case of a heated substance, of more than 20% but less than 80% unless the shells of portable tanks are divided, by partitions or surge plates, into sections of not more than 7,500 ℓ capacity;
- .2 with residue of goods previously transported adhering to the outside of the shell or service equipment;
- .3 when leaking or damaged to such an extent that the integrity of the portable tank or its lifting or securing arrangements may be affected; and
- .4 unless the service equipment has been examined and found to be in good working order.

For certain dangerous substances, a lower degree of filling may be required.

4.2.4.2.6 Portable tank instructions

T1 – T22		PORTABLE TANK INSTRUCTIONS			T1 – T22	
These portable tank instructions apply to liquid and solid substances of classes 3 to 9. The general provisions of 6.7.2 should be met.						
Portable tank instruction	Minimum test pressure (bar)	Minimum shell thickness (in mm – reference steel) (see 6.7.2.4)	Pressure-relief provisions (see 6.7.2.8)	Bottom opening provisions (see 6.7.2.6)		
T1	1.5	See 6.7.2.4.2	Normal	See 6.7.2.6.2		
T2	1.5	See 6.7.2.4.2	Normal	See 6.7.2.6.3		
T3	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.2		
T4	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.3		
T5	2.65	See 6.7.2.4.2	See 6.7.2.8.3	Not allowed		
T6	4	See 6.7.2.4.2	Normal	See 6.7.2.6.2		
T7	4	See 6.7.2.4.2	Normal	See 6.7.2.6.3		
T8	4	See 6.7.2.4.2	Normal	Not allowed		
T9	4	6 mm	Normal	Not allowed		
T10	4	6 mm	See 6.7.2.8.3	Not allowed		
T11	6	See 6.7.2.4.2	Normal	See 6.7.2.6.3		
T12	6	See 6.7.2.4.2	See 6.7.2.8.3	See 6.7.2.6.3		
T13	6	6 mm	Normal	Not allowed		
T14	6	6 mm	See 6.7.2.8.3	Not allowed		
T15	10	See 6.7.2.4.2	Normal	See 6.7.2.6.3		
T16	10	See 6.7.2.4.2	See 6.7.2.8.3	See 6.7.2.6.3		
T17	10	6 mm	Normal	See 6.7.2.6.3		
T18	10	6 mm	See 6.7.2.8.3	See 6.7.2.6.3		
T19	10	6 mm	See 6.7.2.8.3	Not allowed		
T20	10	8 mm	See 6.7.2.8.3	Not allowed		
T21	10	10 mm	Normal	Not allowed		
T22	10	10 mm	See 6.7.2.8.3	Not allowed		

Chapter 6.7

Provisions for the design, construction, inspection and testing of portable tanks *

6.7.2.1 Definitions

For the purposes of this section:

Portable tank means a multimodal tank having a capacity of more than 450 ℓ used for the transport of substances of classes 3 to 9. The portable tank includes a shell fitted with service equipment and structural equipment necessary for the transport of dangerous substances. The portable tank should be capable of being filled and discharged without the removal of its structural equipment. It should possess stabilizing members external to the shell, and should be capable of being lifted when full. It should be designed primarily to be lifted onto a transport vehicle or ship and should be equipped with skids, mountings or accessories to facilitate mechanical handling. Road tank-vehicles, rail tank-wagons, non-metallic tanks and intermediate bulk containers (IBCs) are not considered to fall within the definition for portable tanks;

Shell means the part of the portable tank which retains the substance intended for transport (tank proper), including openings and their closures, but does not include service equipment or external structural equipment;

Service equipment means measuring instruments and filling, discharge, venting, safety, heating, cooling and insulating devices;

Structural equipment means the reinforcing, fastening, protective and stabilizing members external to the shell;

Maximum allowable working pressure (MAWP) means a pressure that should be not less than the highest of the following pressures measured at the top of the shell while in operating position:

- .1 the maximum effective gauge pressure allowed in the shell during filling or discharge; or
- .2 the maximum effective gauge pressure to which the shell is designed, which should be not less than the sum of:
 - .1 the absolute vapour pressure (in bar) of the substance at 65°C (at the highest temperature during filling, discharge or transport for elevated-temperature substances transported over 65°C), minus 1 bar; and
 - .2 the partial pressure (in bar) of air or other gases in the ullage space, being determined by a maximum ullage temperature of 65°C and a liquid expansion due to an increase in mean bulk temperature of $t_r - t_f$ (t_f = filling temperature, usually 15°C; t_r = 50°C, maximum mean bulk temperature).

Design pressure means the pressure to be used in calculations required by a recognized pressure-vessel code. The design pressure should be not less than the highest of the following pressures:

- .1 the maximum effective gauge pressure allowed in the shell during filling or discharge; or
- .2 the sum of:
 - .1 the absolute vapour pressure (in bar) of the substance at 65°C, minus 1 bar;
 - .2 the partial pressure (in bar) of air or other gases in the ullage space, being determined by a maximum ullage temperature of 65°C and a liquid expansion due to an increase in mean bulk temperature of $t_r - t_f$ (t_f = filling temperature, usually 15°C; t_r = 50°C, maximum mean bulk temperature); and
 - .3 a head pressure determined on the basis of the dynamic forces specified in 6.7.2.2.12, but not less than 0.35 bar.
- .3 two thirds of the minimum test pressure specified in the applicable portable tank instruction in 4.2.4.2.6;

Test pressure means the maximum gauge pressure at the top of the shell during the hydraulic pressure test, equal to not less than 1.5 times the design pressure. The minimum test pressure for portable tanks intended for specific substances is specified in the applicable portable tank instruction in 4.2.4.2.6;

Leakproofness test means a test using gas, subjecting the shell and its service equipment to an effective internal pressure of not less than 25% of the MAWP;

Maximum permissible gross mass (MPGM) means the sum of the tare mass of the portable tank and the heaviest load authorized for transport;

Reference steel means a steel with a tensile strength of 370 N/mm² and an elongation at fracture of 27%;

Mild steel means a steel with a guaranteed minimum tensile strength of 360 N/mm² to 440 N/mm² and a guaranteed minimum elongation at fracture conforming to 6.7.2.3.3.3;

Design temperature range for the shell should be –40°C to 50°C for substances transported under ambient conditions. For substances handled under elevated-temperature conditions, the design temperature should be not less than the maximum temperature of the substance during filling, discharge or transport. More severe design temperatures should be considered for portable tanks subjected to severe climatic conditions.

6.7.2.2.1 Shells should be designed and constructed in accordance with the provisions of a pressure-vessel code recognized by the competent authority. Shells should be made of metallic materials suitable for forming. The materials should, in principle, conform to national or international material standards. For welded shells, only a material whose weldability has been fully demonstrated should be used. Welds should be skillfully made and afford complete safety. When the manufacturing process or the materials make it necessary, the shells should be suitably heat-treated to guarantee adequate toughness in the weld and in the heat-affected zones. In choosing the material, the design temperature range should be taken into account with respect to risk of brittle fracture, to stress corrosion cracking and to resistance to impact. When fine grain-steel is used, the guaranteed value of the yield strength should be not more than 460 N/mm² and the guaranteed value of the upper limit of the tensile strength should be not more than 725 N/mm² according to the material specification. Aluminium may only be used as a construction material when indicated in a portable tank special provision assigned to a specific substance in the Dangerous Goods List or when approved by the competent authority. When aluminium is authorized, it should be insulated to prevent significant loss of physical properties when subjected to a heat load of 110 kW/m² for a period of not less than 30 minutes. The insulation should remain effective at all temperatures less than 649°C and should be jacketed with a material with a melting point of not less than 700°C. Portable tank materials should be suitable for the external environment in which they may be transported.

6.7.2.3.2 Shells should be designed and constructed to withstand a hydraulic test pressure not less than 1.5 times the design pressure. Specific provisions are laid down for certain substances in the applicable portable tank instruction indicated in the Dangerous Goods List and described in 4.2.4 or by a portable tank special provision indicated in column 13 of the Dangerous Goods List. The minimum shell thickness should not be less than that specified for these tanks in 6.7.2.4.1 to 6.7.2.4.10.

6.7.2.4.2 The cylindrical portions, ends (heads) and manhole covers of shells not more than 1.80 m in diameter should be not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells more than 1.80 m in diameter should be not less than 6 mm thick in the reference steel or of equivalent thickness in the metal to be used, except that for powdered or granular solid substances of packing group II or III the minimum thickness requirement may be reduced to not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used.

6.7.2.4.6 The equivalent thickness of a metal other than the thickness prescribed for the reference steel in 6.7.2.4.3 should be determined using the following equation:

$$e_1 = \frac{21.4 \times e_o}{\sqrt[3]{R_{m1} \times A_1}}$$

where:

e_1 = required equivalent thickness (in mm) of the metal to be used;

e_o = minimum thickness (in mm) of the reference steel specified in the applicable portable tank instruction identified in the Dangerous Goods List and described in 4.2.4.2.6 or by a portable tank special provision indicated in the Dangerous Goods List;

R_{m1} = guaranteed minimum tensile strength (in N/mm²) of the metal to be used (see 6.7.2.3.3);

A_1 = guaranteed minimum elongation at fracture (in %) of the metal to be used according to national or international standards.