BCH CODE

Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk

1993 Edition

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Foreword

This publication contains the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCh1 Code) and a number of documents closely related to that Code. The Code was originally adopted in 1971 and was altered by a series of amendments between 1972 and 1983 before this amended version was adopted by the Marine Environment Protection Committee (MEPC) in 1985 and by the Maritime Safety Committee (MSC) in 1986. There have been further amendments, the most recent of which were adopted by the MEPC by resolution MEPC.56(33) in October 1992 and by the MSC by resolution MSC.29(61) in December 1992. These are expected to come into force on 1 July 1994.

Amendments adopted by the MSC and the MEPC in 1990, relating to the harmonized system of survey and certification and by which changes would be made to section 1.6 and to the Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, have not been included in this edition; the date of implementation of the harmonized system cannot be accurately forecast until sufficient States have accepted it.

Under the provisions of Annex II of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73j78), chemical tankers constructed before I July 1986 must comply with this Code; those built on or after that date must comply with the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) for the purposes of MARPOL 73/78 and the international Convention for the Safety of Life at Sea (SOLAS 74).

Chapters VI and VII of this edition of the BCH Code are much shorter than in previous editions because they refer the user to chapters 17 and 18 of the IBC Code. This edition also incorporates a new chapter, chapter VIII, relating to the transport of liquid chemical wastes.

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Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code)

Preamble

1 The purpose of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code) is to provide an international standard for the safe carriage of dangerous and noxious chemicals in bulk by prescribing the constructional features of ships, regardless of their tonnage, involved in such carriage and the equipment they should carry so as to minimize the risk to the ship, to its crew and to the environment, having regard to the nature of the products involved.

2 The basic philosophy is to assign to each chemical tanker one of the ship types according to the degree of the hazards of the products carried by such ship. Each of the products may have one or more hazard properties, which include flammability, toxicity and reactivity as well as the hazard they may present to the environment if accidentally released.

3 Throughout the development of the Code it was recognized that it must be based upon sound naval architectural and engineering principles and the best understanding available as to the hazards of the various products covered; furthermore that chemical tanker design technology is not only a complex technology but is rapidly evolving and that the Code should not remain static. Therefore the International Maritime Organization (IMO) will periodically review the Code, taking into account both experience and technical development.

4 Amendments to the Code involving requirements for new products and their conditions of carriage will be circulated from time to time as recommendations, on an interim basis, when adopted by the Maritime Safety Committee (MSC) and the Marine Environment Protection Committee (MEPC) of the Organization, in accordance with the provisions of article 16 of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), pending the entry into force of these amendments.

5 The Code primarily deals with ship design and equipment. In order to ensure the safe transport of the products, the total system must, however, be appraised. Other important facets of the safe transport of the products, such as training, operation, traffic control and handling in port, are being or will be examined further by the Organization.

6 Chapter VI of the Code, dealing with operational requirements of chemical tankers, highlights the regulations in other chapters that are applicable and mentions those other important safety features that are peculiar to chemical tanker operation. The summary of minimum requirements of the products covered by the Code is set out in chapter 17 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code). Cross-references to the IBC and BCH Codes are provided in chapter VI of this publication.

Chapter 1 - General

1.1 Purpose

The purpose of the Code is to recommend suitable design criteria, construction standards and other safety measures for ships transporting dangerous and noxious chemical substances in bulk so as to minimize the risk to the ship, its crew and the environment. For the purposes of MARPOL 73/78, the Code applies only to chemical tankers as defined in regulation 1(1) of Annex II thereof which are engaged in the carriage of noxious liquid substances falling into category A, B or C and identified as such by an entry of A, 8 or C in column c of chapter 1 7 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code)

1.2 Scope

1.2.1 Products: The Code applies to bulk cargoes of dangerous and noxious chemical substances, other than petroleum or similar flammable products, as follows:

(a) Products having significant fire hazards in excess of those of petroleum products and similar flammable products.

(b) Products having significant hazards in addition to or other than flammability.

(c) Products which may present a hazard to the environment, if accidentally released.

The Code is at present limited to the liquids shown in the summary of minimum requirements in chapter 17 of the IBC Code. Products that have been reviewed and determined not to present safety and pollution hazards to such an extent as to warrant application of the Code are found in chapter 18 of the IBC Code.

1.2.2 Ships: The Code is at present limited to tankships

1.3 Hazards

1.3.1 Hazards of chemicals and other substances relating to human life considered in this Code are:

(a) Fire hazard defined by flashpoint, boiling point, explosion limit range and auto-ignition temperature of the chemical.

(b) Health hazard defined by:

(i) irritant or toxic effect on the skin or on the mucous membranes of the eyes, nose, throat and lungs in the gas or vapour state combined with vapour pressure; or

(ii) irritational effects on the skin in the liquid state; or

(iii) toxic effect via skin absorption, taking into account values of LC_{50}, LD_{50} (oral), and LD_{50} (skin).

(c) Water pollution hazard defined by human toxicity, water solubility, volatility, odour or taste, and specific gravity.

(d) Air pollution hazard defined by:

(i) emergency exposure limit (EEL) or LC_{50};

(ii) vapour pressure;

(iii) solubility in water;

(iv) specific gravity of liquid;

(v) relative density of vapour.

(e) Reactivity hazard defined by reactivity with:

(i) other chemicals, or

(ii) water, or

(iii) the chemical itself (including polymerization).

1.3.2 Hazards of chemicals and other substances relating to the marine environment considered by this Code are:

(a) bioaccumulation with attendant risk to aquatic life or human health or causing tainting to seafood;

(b) damage to living resources;

(c) hazards to human health; and

(d) reduction of amenities.

1.4 Definitions

1.4.1 *Liquids covered by this Code* are those having a vapour pressure not exceeding 2.8 kp/cm^2 at a temperature of 37.8°C.

1.4.2 *Vapour pressure* is equilibrium pressure of the saturated vapour above the liquid expressed in kp/cm^2 or mmHg absolute at a specified temperature.

1.4.3 *Flashpoint* is the temperature in degrees Celsius at which a liquid will give off enough flammable vapour to be ignited. Values given in this Code are both "open-cup" and "closed-cup", which indicate two different types of test equipment.

1.4.4 *Boiling point* is the temperature at which a liquid exhibits a vapour pressure equal to the atmospheric barometric pressure.

1.4.5 *Explosive range* is the range of gas or vapour concentrations (per cent by volume in air) which will burn or explode if an ignition source is present.

1.4.6 *Specific gravity* is the ratio of the weight of a certain volume of a substance to the weight of an equal volume of water. For liquids of limited solubility, the specific gravity will predict whether the product will sink or float in water.

1.4.7 *Vapour density* is the relative density or the ratio of the weight of a vapour or gas (with no air present) to the weight of an equal volume of air at the same pressure and temperature. Values less than 1 indicate that the vapour or gas is lighter than air, while values greater than 1 show that the gas is heavier than air.

1.4.8 *Viscosity* is the shearing resistance of a liquid film which separates two horizontal plates, one of which is being moved across the other. The absolute viscosity of a substance is the force in dynes which will move 1 cm^2 of a plane surface with a speed of 1 cm/s relative to another parallel plane surface from which it is separated by a layer of the substance 1 cm thick. The kinematic viscosity of a substance is the ratio of the absolute viscosity to the density of the substance at the temperature of measurement.

1.4.9 *Corrosive aggression* is the property of a substance having a destructive effect on the environment by entering into an electrochemical reaction with it.

1.4.10 *Cargo pump-rooms* are spaces containing pumps and their accessories for the handling of products covered by the Code.

1.4.11 *Pump-rooms* are spaces, located in the cargo-tank area, containing pumps and their accessories for the handling of ballast and fuel oil.

1.4.12 *Cargo-tank area* is that part of the ship that contains cargo tanks and cargo pump-rooms and includes cofferdams, void spaces and deck spaces adjacent to and above all such spaces.

1.4.13 *Separate* means that a cargo piping system or cargo vent system, for example, is not connected to another cargo piping or cargo vent system. This separation may be achieved by the use of design or operational methods. Operational methods should not be used within a cargo tank and should consist of one of the following types:

(a) removing spool-pieces or valves and blanking the pipe ends;

(b) arrangement of two spectacle flanges in series, with provisions for detecting leakage into the pipe between the two spectacle flanges.

1.4.14 *Independent* means that a piping or venting system, for example, is in no way connected to another system and that there are no provisions available for the potential connection to other systems.

1.4.15 For the purpose of propylene oxide and ethylene oxide/propylene oxide mixtures with an ethylene oxide content of not more than 30% by weight (section 4.7), reference temperature means the temperature corresponding to the vapour pressure of the cargo at the set pressure of the pressure-relief valve.

1.4.16 *Toxicity limits*

(a) LD_{50} (oral): a dose which is lethal to 50% of the test subjects when administered orally;

(b) LD_{50} (skin): a dose which is lethal to 50% of the test subjects when administered to the skin;

(c) LC_{50}: the concentration which is lethal by inhalation to 50% of the test subjects.

1.4.16A *Noxious liquid substance* means any substance referred to in Appendix II of Annex II of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) or provisionally assessed under the provisions of regulation 3(4) of that Annex as falling into category A, B, C or D.

1.4.16B *Standards for Procedures and Arrangements* means the Standards for Procedures and Arrangements for the Discharge of Noxious Liquid Substances, called for by Annex II of MARPOL 73/78, adopted by the Marine Environment Protection Committee at its twenty-second session by resolution MEPC.18(22) and as may be amended by the Organization.

1.4.16C The *IBC Code* means the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk adopted by the Maritime Safety Committee and the Marine

Environment Protection Committee of the Organization by resolutions MSC.4(48) and MEPC.19(22) respectively, as amended.

1.4.17 Where reference is made in the Code to a main paragraph, all the provisions of the subparagraphs of that designation should apply.

1.5 Equivalents

1.5.1 Where the Code requires that a particular fitting, material, appliance or apparatus, or type thereof, should be fitted or carried in a ship, or that any particular provision should be made, the Administration may allow any other fitting, material, appliance or apparatus, or type thereof, to be fitted or carried, or any other provision to be made in that ship, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance or apparatus or type thereof, or provision, is at least as effective as that required by the Code.

1.5.2 When the Administration so allows any fitting, material, appliance, apparatus, item of equipment, or type thereof, or provision, procedure, or arrangement, or novel design or application to be substituted hereafter, it should communicate to IMO the particulars thereof together with a report on the evidence submitted so that the Organization may circulate the same to other Parties to MARPOL 73/78 and other participating Governments for the information of their officers.

1.6 Survey requirements

1.6.1 The structure, equipment, fittings, arrangements and material (other than items in respect of which a Cargo Ship Safety Construction Certificate, Cargo Ship Safety Equipment Certificate and Cargo Ship Safety Radiotelegraphy Certificate or Cargo Ship Safety Radiotelephony Certificate are issued) of a chemical tanker should be subjected to the following surveys:

.1 An initial survey before the ship is put in service or before the Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk is issued for the first time, which should include a complete examination of its structure, equipment, fittings, arrangements and material in so far as the ship is covered by the Code. This survey should be such as to ensure that the structure, equipment, fittings, arrangements and material fully comply with the applicable provisions of the Code.

.2 A periodical survey at intervals specified by the Administration, but not exceeding five years, which should be such as to ensure that the structure, equipment, fittings, arrangements and material comply with the applicable provisions of the Code.

.3 A minimum of one intermediate survey during the period of validity of the Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk. In cases where Only one such intermediate survey is carried out in any one certificate validity period, it should be held not before six months prior to, nor later than six months after, the half-way date of the certificate's period of validity. Intermediate surveys should be such as to ensure that the safety equipment, and other equipment, and associated pump and piping systems comply with the applicable provisions of the Code and are in good working order. Such surveys should be endorsed in the Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

.4 An annual survey within three months before or after the anniversary date of the Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk which Should include a general examination to ensure that the structure, equipment, fittings, arrangements and materials remain in all respects satisfactory for the service for which the ship is intended. Such a survey should be endorsed in the Certificate of Fitness for the Carnage of Dangerous Chemicals in Bulk.

.5 An additional survey, either general or partial, according to the circumstances, should be made when required after an investigation prescribed in 1.6.2.3, or whenever any important repairs or renewals are made. Such a survey should ensure that the necessary repairs or renewals have been effectively made, that the material and workmanship of such repairs or renewals are satisfactory, and that the ship is fit to proceed to sea without danger to the ship or persons on board.

1.6.2 Maintenance of conditions after survey

1.6.2.1 The conditions of the ship and its equipment should be maintained to conform with the provisions of the Code to ensure that the ship will remain fit to proceed to sea without danger to the ship or persons on board.

1.6.2.2 After any survey of the ship under this section has been completed, no change should be made in the structure, equipment, fittings, arrangements and material covered by the survey, without the sanction of the Administration, except by direct replacement.

1.6.2.3 Whenever an accident occurs to a ship or a defect is discovered, either of which affects the safety of the ship or the efficiency or completeness of its life-saving appliances or other equipment, the master or owner of the ship should report this at the earliest opportunity to the Administration, the nominated surveyor or recognized organization responsible for issuing the relevant certificate, who should cause investigations to be initiated to determine whether a survey, as required by 1.6.1.5, is necessary.

1.6.3 Issue of a Certificate of Fitness

1.6.3.1 A certificate called a Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, the model form of which is set out in the appendix, should be issued after an initial or periodical survey to a chemical tanker engaged in international voyages which complies with the relevant requirements of the Code.

1.6.3.2 The certificate issued under provisions of this section should be available on board for inspection at all times.*

* Any relaxation from full compliance allowed by 1.7.3 and/or any special dispensation allowed and the nature of the alternative measures taken under 2.2.5 should be noted under paragraph 4 of the Certificate of Fitness. Administrations may also refer to other matters, e.g. such as covered by 1.5.1, as may be desirable.

1.6.4 Issue or endorsement of certificate by another Government

1.6.4.1 A Government may, at the request of another Government, cause a ship entitled to fly the flag of the other Government to be surveyed and, if satisfied that the requirements of the Code are complied with, issue or authorize the issue of the certificate to the ship and, where appropriate, endorse or authorize the endorsement of the certificate on the ship in accordance with the Code. Any certificate so issued should contain a statement to the effect that it has been issued at the request of the Government of the State the flag of which the ship is entitled to fly.

1.6.5 Duration and validity of the certificate

1.6.5.1 A Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk should be issued for a period specified by the Administration which should not exceed five years from the date of the initial survey or the periodical survey.

1.6.5.2 No extension of the five-year period of the certificate should be permitted.

1.6.5.3 The certificate should cease to be valid:

.1 if the surveys are not carried out within the periods specified by 1.6.1;

.2 upon transfer of the ship to the flag of another Government. A new certificate should only be issued when the Government issuing the new certificate is fully satisfied that the ship is in compliance with the requirements of 1.6.2.1 and 1.6.2.2. Where a transfer occurs to the flag of another State, the Government of the State whose flag the ship was formerly entitled to fly may, if requested within 12 months after the transfer has taken place, as soon as possible transmit to the Administration copies of the certificates carried by the ship before the transfer and, if available, copies of the relevant survey reports.

1.7 Effective date

1.7.1 The effective date of the Code is 12 April 1972 (six months after the Code was adopted by the IMO Assembly with resolution A.212(VII)).

1.7.2 The Code is applicable to vessels whose keel was laid or which were at a similar stage of construction or to vessels whose conversion was begun on or after the effective date. This conversion provision does not apply to the modification of a ship referred to in regulation 1(12) of Annex II of MARPOL 73%78.

1.7.3 The Code should also be applicable to existing ships carrying cargoes covered by the Code. Existing ships should comply with the provisions of the Code for the cargoes to be carried, except as follows:

(a) Tanks for cargoes required to be carried in type 1 ships should comply with 2.2.4(a)(iii); however, small departures from the distances specified in 2.2.2(a)(ii) and 2.2.2(b)(iii) may be accepted by the Administration.

(b) Tanks for cargoes required to be carried in type 2 ships should be located outside the extent of minor side damage specified in 2.2.2(c), subject to such minor relaxation as may be acceptable by the Administration.

(c) Compliance with 2.2.4(b)(ii) and 2.2.4(c) would not be required.

(d) Compliance with the intent of 2.2.4(b)(iii) would be expected but relaxations from the required side and bottom distances may be allowed provided that cargo tanks on existing type 2 ships are located at least 760 mm above the bottom shell.

(e) When an existing chemical tanker is converted from a type 3 ship to a type 2 ship the full requirement of 2.2.4 should be met except that the ability to survive damage in the machinery space should be determined by the Administration.

(f) Full compliance with 2.7.1 would not be expected.

1.8 New products

Where it is proposed to carry in bulk dangerous liquid chemicals and noxious liquid substances of category A, B or C, either of which may be considered to come within the scope of the Code but are not at present designated in the summary of minimum requirements in chapter VI, the Administrations involved in such carriage should establish suitable conditions of carriage based on the principles of the Code and notify such conditions to the Organization. In this connection, the Criteria for Hazard Evaluation of Bulk Chemicals (see page 77) should provide guidance. During the periodical review of the Code these submissions will be considered for inclusion.

Chapter II - Cargo containment

A* - PHYSICAL PROTECTION (SITING OF CARGO TANKS; FLOATABILITY AND DAMAGE STABILITY)

* The provisions of chapter 2 of the IBC Code, if satisfied in their entirety, may be applied as an alternative to Part A.

2.1 General

The probability of damage resulting from collision, stranding or other circumstances to a ship carrying a dangerous chemical in bulk leading, sooner or later, to uncontrolled release of the cargo cannot be discounted. Therefore, the siting of the cargo tanks in relation to the ship's side and bottom (which would afford a degree of protection from external damage to the cargo containment) and the extent to which the ship should be capable of remaining afloat subsequent to such damage should be related to the extent to which escape of that cargo, taking into account the nature and severity of its hazard to the environment, could be tolerated.

2.1.1 Three degrees of physical protection are employed. The highest standard of such protection - type 1 - is required for the substances considered to have the greatest environmental hazard, with reduced standards - types 2 and 3 - for substances of progressively lesser hazard.

2.1.2 The required degrees of physical protection for the transport of individual substances are shown in column e of the summary of minimum requirements in chapter VI.

2.1.3 Where it is intended to transport more than one substance, the requirements for ship survival of damage should correspond to the most dangerous substance, but the cargo containment need only conform to the specified minimum requirements for the chemicals taken individually.

2.2 Ship types

2.2.1 General: Ships subject to this Code may be assigned the minimum freeboard permitted by the International Convention on Load Lines, 1966. The additional requirements in 2.2.4, taking into account any empty or partially filled tank as well as the specific gravities of cargoes to be carried, however, should govern the allowed operating draught for any actual condition of loading. To this end, all ships engaged in the transport of chemicals in bulk should be supplied with loading and stability manuals for the information and guidance of the master. These manuals should contain details concerning the loaded conditions of full and empty or partially empty tanks, the position of these tanks in the ship, the specific gravities of the various parcels of cargoes carried, and any ballast arrangements in critical conditions of loading. Provisions for evaluating other conditions of loading should be contained in the manuals.

2.2.2 Damage assumption: In establishing criteria in regard to siting of cargo tanks and ship stability, it is necessary to define the assumed damages and to state the conditions of survival and of cargo containment. The following main assumed damage conditions will apply. In those cases where the machinery space is to be treated as a floodable compartment, a permeability of 0.85 is to be assumed therein. The permeability of other spaces subject to flooding should be so determined as to reflect the limitations of cargo, fuel or ballast loaded. Such limitations should be included in the information to be supplied to the master.

(a) *Collision damage*

(i) Longitudinal extent: $\frac{L^{2/3}}{3}$ or 14.5 m, whichever is less

(ii) Transverse extent B

(inboard from the ship's side at right angles to the centre-line at the level of the load line):	5 or 11.5 m, whichever is less
(iii) Vertical extent:	from the baseline upwards without limit

(b) *Stranding*

	For 0.3*L* from the forward perpendicular of ship	Any other part of ship
(i) Longitudinal extent:	$\frac{L}{10}$	$\frac{L}{10}$ or 5 m, whichever is less
(ii) Transverse extent:	$\frac{B}{6}$ or 10.0 m, whichever is less	5 m
(iii) Vertical extent from the baseline:	$\frac{B}{15}$ - or 6 m, whichever is less	

where: *L* and *B*, in metres, for any part of the ship and perpendicular are as defined in regulation 3 of the International Convention on Load Lines, 1966

(c) *Minor side damage*

Damage from tugs, piers, etc., should be taken as:

Transverse extent (inboard from the ship's side at right angles to the centre-line at the level of the deepest load line):	760 mm

2.2.3 Survival assumption: The ship is considered to survive the conditions of damage specified for each ship type (see 2.2.4) if she remains afloat in a condition of stable equilibrium and satisfying the following stability criteria:

(a) The stability in the final condition of flooding may be regarded as sufficient if the righting lever curve has a minimum range of 20° beyond the position of equilibrium in association with a residual righting lever of at least 100 mm. The unflooded volume of the poop superstructure around the machinery-space casing, provided the machinery casing is watertight at this level, may be taken into consideration, in which case the damage waterline should not be above the after end of the top of the poop superstructure deck at the centreline,

(b) The angle of heel in the final condition of flooding should not exceed 15°, except that, if no part of the deck is immersed, an angle of heel up to 17° may be accepted. For ships less than 150 m in length, the Administration may accept an angle of heel not exceeding 25° provided it is positively shown that a lesser limit is not reasonably obtainable, and that all other provisions stated in 2.2.3(a) are complied with.

2.2.4 Ship type requirements

(a) *Type 1 ship*

(i) *General*
A type 1 ship is designed to transport products which require maximum preventive measures to preclude escape of such cargo.

(ii) *Ship capability*
The ship should be capable of sustaining anywhere in her length collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) and surviving as specified in 2.2.3.

(iii) *Cargo tank location*
Tanks intended for the carriage of cargoes which are required to be transported in a type I ship should be located outside the extent of the damage specified in 2.2.2(a)(ii) and 2.2.2(b)(iii) and should nowhere be closer to the ship's shell than 760 mm.

This requirement does not apply to tanks for diluted slops arising from the tank washing.

(b) *Type 2 ship*

(i) *General*
A type 2 ship is designed to transport products which require significant preventive measures to preclude the escape of such cargo.

(ii) *Ship capability*

(1) A ship of 150 m in length or less should be capable of sustaining collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) anywhere in her length except involving either of the bulkheads bounding a machinery space located aft and surviving as specified in 2.2.3.

(2) A ship of more than 1.50 m in length should be capable of sustaining collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) anywhere in her length and surviving as specified in 2.2.3.

(iii) *Cargo tank location*
Tanks containing cargoes which are required to be transported in a type 2 ship should be located outside the extent of damage specified in 2.2.2(b)(iii) and 2.2.2(c) and should nowhere be closer to the ship's shell than 760 mm (30 inches).

This requirement does not apply to the tanks for diluted slops arising from the tank washing.

(c) *Type 3 ship*

(i) General
A type 3 ship is designed to carry products of sufficient hazard to require a moderate degree of containment to increase survival capability in a damaged condition.

(ii) *Ship capability*

(1) A type 3 ship of 125 m in length and over should be capable of sustaining collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) anywhere in her length except involving either of the bulkheads bounding a machinery space located aft and surviving as specified in 2.2.3.

(2) A type 3 ship below 125 m in length should be capable of sustaining collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) anywhere in her length and surviving as specified in

2.2.3 with the exception of damage to the machinery space. In addition to the foregoing, the ability to survive flooding of the machinery space should be determined by the Administration.

(iii) *Cargo tank location*

No special requirements.

2.2.5 Special considerations for small ships: In the case of small ships intended for the carriage of cargoes requiring type 1 or type 2 containment which do not comply in all respects with the requirements in 2.2.4(a)(ii) and 2.2.4(b)(ii) above, special dispensations may only be considered by the Administration where alternative measures can be taken which maintain the same degree of safety. In the approval of the design of a ship for which a dispensation has been granted, the nature of the alternative measures prescribed should be clearly stated and be available to the Administration in the countries the ship will visit and any such dispensation should be duly noted on the certificate (1.6).

B - TANK TYPES

2.3 Installation

2.3.1 Integral tank: A cargo-containment envelope which forms part of the ship's hull and may be stressed in the same manner and by the same loads which stress the contiguous hull structure. An integral tank is essential to the structural completeness of the ship's hull.

2.3.2 Independent tank: A cargo-containment envelope which is not a contiguous part of the hull structure. An independent tank is built and installed so as to eliminate whenever possible (or in any event, to minimize) its stressing as a result of stressing or motion of the adjacent hull structure. An independent tank is not essential to the completeness of its ship's hull.

2.4 Design and construction

Gravity tank: Tanks having a design pressure not greater than 0.7 kp/cm^2 at the top of the tank. Gravity tanks may be independent or integral. Gravity tanks should be constructed and tested according to the standards of the Administration.

2.5 Requirements for individual substances

Tank type requirements (covering both installation and design) for individual substances are shown in column *f* of the summary of minimum requirements in chapter VI.

C - SHIP ARRANGEMENTS

2.6 Cargo segregation

2.6.1 A cargo subject to the provisions of the Code should be segregated from machinery and boiler spaces, accommodation and service spaces and drinking water and stores for human consumption by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, fuel tank or other similar space, except where otherwise excluded by the Code.

2.6.2 Cargoes, residues of cargoes or mixtures containing cargoes which react in a hazardous manner with other cargoes, residues or mixtures, should:

(a) be segregated from such other cargoes by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, or a mutually compatible cargo;

(b) have separate pumping and piping systems which should not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and

(c) have separate tank vent systems.

2.6.3 Cargo piping should not pass through any accommodation or machinery space, other than cargo pump-rooms or pump-rooms.

2.6.4 A cargo subject to the provisions of the Code should not be stowed either in the fore or aft peak tanks.

2.7 Accommodation spaces

2.7.1 No accommodation spaces should be located over cargo tanks or pump-rooms and no cargo tanks should be aft of the forward end of accommodation.*

* See the Recommendation on uniform Interpretation of the Application of 2.7.7 and 2.73 of the Bulk Chemical Code to Existing Chemical Tankers (p. 87).

2.7.2 In order to guard against the danger of hazardous vapours, due consideration should be given to the location of air intakes and openings into accommodation and machinery spaces in relation to cargo piping and tank vent systems.

2.7.3 Doors and air ports in the accommodation should be located on the house sides at least *L*/25 ** and not less than 3 m aft of the forward end of the house and the cargo-tank area. This distance, however, need not exceed 5 m. Port lights located on the forward bulkhead or along the house sides within the limits specified above should be of the fixed type. Wheelhouse windows and wheelhouse doors may be located within the above limits; however, they are to be so designed that a rapid and efficient gas and vapour tightening of the wheelhouse can be ensured. Bolted plates for the removal of machinery may be fitted within the limits specified above.

** *L* = length of the ship.

2.8 Cargo pump-rooms

2.8.1 Cargo pump-rooms should be so arranged as to ensure unrestricted passage at all times from any ladder platform and from the floor.

2.8.2 Permanent arrangements should be fitted for hoisting an unconscious person with a rescue line whilst avoiding any projecting obstacles.

2.8.3 Cargo pump-rooms should be so arranged as to ensure unrestricted access to all valves necessary for cargo handling for a person wearing the required personnel protective equipment.

2.8.4 Guard railings should be installed on all ladders and platforms.

2.8.5 Normal access ladders should not be fitted vertically, and should incorporate platforms at suitable intervals.

2.8.6 Arrangements should be installed to deal with drainage and any possible leakage from cargo pumps and valves in cargo pump-rooms. The bilge system serving the cargo pump-room should be operable from outside the cargo pump-room. One or more slop tanks for storage of contaminated bilge water or tank washings should be provided. A shore connection with a standard coupling or other facilities should be provided for transferring contaminated water to onshore slop tanks.

2.8.7 Pump discharge pressure gauges should be provided outside the cargo pump-room.

2.8.8 For cargo pump requirements for certain products see column *m* of the summary of minimum requirements in chapter VI.

2.9 Access to void spaces, cargo tanks and other spaces in the cargo-tank area

2.9.1 Arrangements for void spaces, cargo tanks and other spaces in the cargo-tank area should be such as to ensure adequate access for complete inspection.

2.9.2 Access to the cargo tanks should be direct from the open deck.

2.9.3 For access through horizontal openings, hatches or manholes the dimensions should be sufficient to allow a person wearing a breathing apparatus to ascend or descend any ladder without obstruction and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening should be not less than 600 mm x 600 mm.

2.9.4 For access through vertical openings, or manhole providing passage through the length and breadth of the space, the minimum clear opening should be not less than 600 mm x 800 mm at a height of not more than 600 mm from the bottom shell plating unless gratings or other footholds are provided.

2.9.5 Smaller dimensions may be approved by the Administration in special circumstances.

D - CARGO TRANSFER

2.10 Piping arrangements *

* Where bow or stern loading and unloading arrangements are allowed by the Administration the provisions of section 3.7 of the IBC Code may be used for guidance.

Cargo piping systems should be designed, arranged and fabricated in accordance with the standards of the Administration, taking into account the following provisions.

2.10.1 All piping systems components should have a pressure rating not less than the maximum pressure to which the system may be subjected. Piping which is not protected against overpressure by a pressure-relief valve, or which can be isolated from its relief valve, should be designed to withstand the greatest pressure the piping would experience in service, taking into consideration:

(a) cargo vapour pressure at 4oC;

(b) pressure rating of the cargo tank;

(c) maximum discharge pressure of the associated pump and its relief-valve setting; and

(d) maximum hydrostatic pressure that could be generated in the piping during normal operations.

2.10.2 Piping connections to tanks should be protected against mechanical damage and tampering. Other than for approved connections to shutoff valves and expansion joints, cargo piping should be joined by welding.

2.10.3 Cargo piping should not be installed under deck between the outboard side of the cargo containment spaces and the skin of the ship unless clearances required for damage protection (see 2.1 and 2.2) are maintained; but such distances may be reduced where damage to the pipe would not cause release of cargo, provided that the clearance required for inspection purposes is maintained.

2.10.4 Runs of cargo piping located below the main deck may run from the tank they serve and penetrate tank bulkheads or boundaries common to adjacent (longitudinally or transversally) cargo tanks, ballast tanks, empty tanks, cargo pump-rooms or pump-rooms, provided that inside the tank they serve they are fitted with a stop valve operable from the weather deck and provided cargo compatibility is assured in the event of piping failure. As an exception, where a cargo tank is adjacent to a car-go pump-room, the stop valve operable from the weather deck may be situated on the tank bulkhead on the cargo pump-room side, provided an additional valve is fitted between the bulkhead valve and the cargo pump.

The Administration may, however, accept a totally enclosed hydraulically operated valve located outside the cargo tank, provided that the valve is:

(a) designed to preclude the risk of leakage;

(b) fitted on the bulkhead of the cargo tank which it serves;

(c) suitably protected against mechanical damage;

(d) fitted at a distance from the shell, as required for damage protection; and

(e) operable from the weather deck.

2.10.5 In any cargo pump-room where a pump serves more than one tank, a stop valve should be fitted in the line to each tank.

2.10.6 Runs of cargo piping installed in pipe tunnels should also comply with the requirements of 2.10.4 and 2.10.5. Pipe tunnels should satisfy all tank requirements for construction, location and ventilation and electrical hazard requirements. Cargo compatibility should be assured in the event of a piping failure. The tunnel should not have any other openings except to the weather deck and cargo pump-room or pump-room.

2.10.7 Runs of cargo piping through bulkheads should be arranged so as to preclude excessive stresses at the bulkhead and should not utilize flanges bolted through the bulkhead.

2.11 Cargo-transfer control systems

2.11.1 For the purpose of adequately controlling the cargo, cargo-transfer systems should be provided with the following:

(a) One stop valve capable of being manually operated on each tank filling and discharge line, located near the tank penetration; if individual deepwell pumps are used to discharge the contents of each cargo tank, a stop valve at the tank is not required on the discharge line.

(b) One stop valve at each cargo hose connection.

(c) Remote shutdown devices for all cargo pumps and similar equipment.

2.11.2 The controls necessary during transfer and/or transport of cargoes covered by the Code other than in pump-rooms which have been dealt with elsewhere in the Code should not be located below the weather deck.

2.11.3 For certain products, additional cargo-transfer control requirements are shown in column *m* of the summary of minimum requirements in chapter VI.

2.12 Cargo hoses carried aboard the ship

Transfer hoses for liquid and vapour cargoes should be constructed of suitable material resistant to the action of the cargoes. Design, construction and testing of hoses should be to the standards of the Administration but in no case should the burst pressure of the hose be less than five times its service pressure.

E - TANK VENT SYSTEMS

2.13 General

2.13.1 (a) All cargo tanks should be provided with a venting system appropriate to the cargo being carried. Tank vent systems should be so designed as to minimize the possibility of cargo vapour accumulating about the decks, entering accommodation and machinery spaces and, in the case of flammable vapours, other spaces containing sources of ignition. They should also be designed to minimize possible spraying onto the decks. Vent outlets should be arranged to prevent entrance of water into the cargo tanks, and, at the same time, should direct the vapour discharge upwards in the form of unimpeded jets. Provision should be made to ensure that the liquid head of any tank does not exceed the test head of that tank; suitable high-level alarms, overflow-control systems or spill valves, together with gauging devices and tank filling procedures, may be accepted for this purpose.

(b) Where the means of limiting cargo-tank overpressure is based on high-level alarms or automatic closing valves, section 4.14 is applicable.

2.13.2 For a tank equipped with closed or restricted gauging, the vent system should be sized, allowing for flame screens, if fitted, to permit loading at the design rate without overpressuring the tank. Specifically, under conditions in which a saturated cargo vapour is discharged through the venting system at the maximum anticipated loading rate, the pressure differential between the cargo tank vapour space and the atmosphere should not exceed 0.2 kp/cm2 or, for independent tanks, the maximum working pressure of the tank.

2.13.3 Any flame screens fitted to the discharge openings of vent systems should be easily accessible and removable for cleaning.

2.13.4 Suitable provision should be made for drainage of vent lines.

2.13.5 Tank vent piping connected to cargo tanks of corrosion-resistant material, or which are lined or coated to handle special cargoes as required by the Code, should be similarly lined or coated, or constructed of corrosion resistant material.

2.14 Types of tank vent systems

2.14.1 Open venting: An open venting system is one which offers no restriction, except for friction losses and flame screens, if fitted, to the free flow of cargo vapour to and from the cargo tanks during normal operations and should only be used for those cargoes with a flashpoint above 60°C and not offering a significant inhalation health hazard. An open venting system may consist of individual vents from each tank, or such individual vents may be combined into a common header or headers, with due regard for cargo segregation. However, in no case should shutoff valves be fitted either to the individual vents or to the header.*

* Reference to the use of shutoff valves in the vent lines should be interpreted to extend to all other means of stoppage, including spectacle blanks and blank flanges.

2.14.2 Controlled venting: A controlled venting system is one in which pressure/vacuum-relief valves are fitted to each tank to limit the pressure or vacuum in the tank and should be used for cargoes other than those for which open venting is permitted. A controlled venting system may consist of individual vents from each tank, or such individual vents, on the pressure side only, as may be combined into a common header or headers with due regard for cargo segregation. In no case should shutoff valves be fitted either above or below pressure/vacuum-relief valves but provision may be made for bypassing the pressure/vacuum-relief valves under certain operating conditions. The heights of vent exits should not be less than 4 m above the weather deck or above the fore-and-aft gangway if fitted within 4 m of the gangway. The vent height may be reduced to 3 m above the deck or fore-and-aft gangway, as applicable, provided high-velocity vent valves of a type approved by the Administration, directing the vapour-air mixture upwards in an unimpeded jet with an exit velocity of at least 30 m/s, are fitted. The vent exits should also be arranged at a distance of at least 10 m from the nearest air intake or openings to accommodation and service spaces and ignition sources. Flammable vapour outlets should be provided with readily renewable and effective flame screens or safety heads of an approved type. Due attention should be paid in the design of PV valves, flame screens and vent heads to the possibility of the blockage of these devices by the freezing of cargo vapour or by icing up in adverse weather conditions.

2.14.3 Open gauging and restricted gauging should be allowed only when:

(a) open venting is allowed by the Code, or

(b) means are provided for relieving tank pressure before the gauge is operated.

2.14.4 Venting requirements for individual substances are shown in columns *g* and *m* of the summary of minimum requirements in chapter VI.

F - CARGO TEMPERATURE CONTROL

2.15 General

2.15.1 When provided, cargo heating or cooling systems should be constructed, fitted and tested to the satisfaction of the Administration. Materials used in the construction of temperature-control systems should be suitable for use with the cargo to be carried.

2.15.2 Heating or cooling media should be approved for use with the specific cargo. Consideration should be given to the surface temperature of heating coils or ducts to avoid dangerous reactions from localized overheating of cargo. See also 4.10.6.

2.15.3 Heating or cooling systems should be provided with valves to isolate the system for each tank and to allow manual regulation of flow.

2.15.4 In any heating or cooling system, means should be provided to ensure that, when in any condition other than an empty condition, a higher pressure is maintained within the system than the maximum pressure head that could be exerted by the cargo-tank contents on the system.

2.15.5 (a) Means should be provided for measuring the cargo temperature. When overheating or overcooling could result in a dangerous condition, an alarm system which monitors the cargo temperature should be provided.

(b) The means for measuring the cargo temperature should be of restricted or closed type, respectively, when a restricted or closed gauging device is required for individual substances as shown in column *j* of the summary of minimum requirements in chapter VI.

(c) A restricted temperature-measuring device is subject to the definition for a restricted gauging device in 3.9(b), e.g. a portable thermometer lowered inside a gauge tube of the restricted type.

(d) A closed temperature-measuring device is subject to the definition for closed gauging device in 3.9(c), e.g. a remote-reading thermometer of which the sensor is installed in the tank.

2.15.6 Where products with a significant toxic vapour hazard are being heated or cooled, the heating or cooling medium should operate:

(a) in a circuit independent of other ship's services, except for another cargo heating or cooling system, and not enter the engine-room; or

(b) in a circuit external to the toxic cargo tank *; or

* Not applicable for ships built before 27 September 1979.

(c) in a circuit where the medium is sampled to check for the presence of cargo before it is recirculated to other ship's services or into the engine-room. The sampling equipment should be located within the cargo-tank area and be capable of detecting the presence of any toxic cargo being heated or cooled. The provisions of 5.6 should also be observed before and after heating or cooling a toxic cargo.

2.16 Additional requirements

For certain products, additional requirements are shown in column *m* of the summary of minimum requirements in chapter VI.

G - MATERIALS OF CONSTRUCTION

2.17 General

Structural materials used for tank construction, together with associated piping, pumps, valves, vents and their jointing materials, should be suitable at the carriage temperature and pressure for the cargo to be carried to the satisfaction of the Administration. Steel is assumed to be the normal material of construction. Where applicable, the following should be taken into account in selecting the material of construction:

(a) notch ductility at the operating temperature;

(b) corrosive effect of the cargo;

(c) possibility of hazardous reactions between the cargo and the material of construction; and

(d) suitability of linings and coatings.

2.18 Additional requirements

For certain products, additional requirements are shown in column m of the summary of minimum requirements in chapter VI.

H - ENVIRONMENTAL CONTROL OF VAPOUR SPACE IN CARGO TANKS AND VOID SPACES SURROUNDING SUCH TANKS

2.19 General

2.19.1 Vapour spaces within cargo tanks, and in some cases spaces surrounding cargo tanks, r-nay require to have specially controlled atmospheres. 2.19.2 Four different types of control are:

(a) Inerting - by filling and maintaining the cargo tank and associated piping systems and, where specified in chanter IV, the spaces surrounding the cargo tanks, with a gas or vapour which would not support combustion and which would not react with the cargo.

(b) Padding - by filling and maintaining the cargo tank and associated piping system (and, where necessary, the spaces surrounding the tanks) with a liquid, gas or vapour which separates the cargo from the air.

(c) Drying - by filling and maintaining the cargo tank and associated piping system with moisture-free gas or vapour which will prevent the access of water or water vapour to the cargo. For the purposes of this paragraph, "moisture-free" gas or vapour is that which has a dewpoint of -40°C or below at atmospheric pressure.

(d) Ventilation - forced or natural.

2.19.3 Arrangements required in connection with 2.19.2(a), (b) and (c) are:

(a) An adequate supply of inert gas for use in filling and discharging should be carried or should be manufactured on board unless a shore supply is available. In addition, sufficient inert gas should be available on the ship to compensate for normal losses during transportation.

(b) The inert gas system on board the ship should be able to maintain at least 0.07 kp/cm^2 pressure within the containment system at all times. In addition, the inert gas system should not raise the cargo tank pressure to more than the tank's relief-valve setting.

(c) Where padding is used, similar arrangements for supply of the padding medium should be made as required for inert gas in (a) and (b) of this paragraph.

(d) Means should be provided for monitoring ullage spaces containing a gas blanket to ensure that the correct atmosphere is being maintained.

(e) Inerting and/or padding arrangements, where used with flammable cargoes, should be such as to minimize the creation of static electricity during the admission of the inerting media.

(f) Where drying is used and dry nitrogen is used as the medium, similar arrangements for supply of the drying medium should be made as required in (a), (b) and (e) above. Where drying agents are used as the drying medium on all air inlets to the tank, sufficient media should be carried for the duration of the voyage, taking into consideration the diurnal temperature range and the expected humidity.

2.20 Environmental control requirements for individual substances

The necessity for environmental control for certain products is shown in column *h* of the summary of minimum requirements in chapter VI.

2.21 Ballast tank arrangements

2.21.1 Pumps, ballast lines, vent lines and other similar equipment serving permanent ballast tanks should be independent of similar equipment serving cargo tanks and from cargo tanks themselves. Discharge arrangements for permanent ballast tanks sited immediately adjacent to cargo tanks should be outside engine-room and accommodation spaces. Filling arrangements may be in the engine-room provided that such arrangements ensure filling from tankdeck level and nonreturn valves are fitted.

2.21.2 Filling of ballast in cargo tanks may be arranged from deck level by pumps serving permanent ballast tanks, provided that the filling line has no permanent connection to cargo tanks or piping and that non return valves are fitted.

2.22 Bilge pumping arrangements from spaces within the cargo tank area

Bilge pumping arrangements for cargo pump-rooms, pump-rooms, void spaces, slop tanks, double-bottom tanks and similar spaces should be situated entirely within the cargo-tank area except for void spaces, double-bottom tanks and ballast tanks where such spaces are separated from tanks containing cargo or residues of cargo by a double bulkhead.

2.23 Pump and pipeline identification

Provisions should be made for the distinctive marking of pumps, valves and pipelines to identify the service and tanks which they serve.

Chapter III - Safety equipment and related considerations

A - VENTILATION IN CARGO-HANDLING SPACES

3.1 Spaces normally entered during cargo-handling operations

3.1.1 General

Cargo pump-rooms and other closed spaces which contain cargo-handling equipment and similar spaces in which work is performed on the cargo should be fitted with mechanical ventilation systems which should be capable of being controlled from outside such spaces. Provision should be made to ventilate such spaces prior to entering the compartment and operating the equipment.

3.1.2 Mechanical ventilation systems

(a) Mechanical ventilation inlets and outlets should be arranged to ensure sufficient air movement through the space to avoid the accumulation of toxic and/or flammable vapours (taking into account their vapour densities) and to ensure sufficient oxygen to provide a safe working environment, but in no case should the ventilation system have a capacity of less than 30 changes of air per hour, based upon the total volume of the space. For certain products, increased ventilation rates for cargo pumprooms are prescribed in 4.13.

(b) Ventilation systems should be permanent and should normally be of the extraction type. Extraction from above and below the floor plates should be possible. In rooms housing motors driving cargo pumps, the ventilation should be of the positive-pressure type.

(c) Ventilation exhaust ducts from gas-dangerous spaces should discharge upwards in locations at least 10 m in the horizontal direction from ventilation intakes and openings to accommodation, service and control station spaces and other gas-safe spaces.

(d) Ventilation intakes should be so arranged as to minimize the possibility of recycling hazardous vapours from any ventilation discharge opening.

(e) Ventilation ducts should not be led through engine-rooms, accommodation, working spaces or other similar spaces.

(f) Ventilation fans should be approved by the Administration for operation in explosive atmospheres when flammable cargoes are carried aboard the ship.

(g) Sufficient spare parts should be carried for each type of fan on board.

(h) Protection screens of not more than 13 mm square mesh should be fitted in outside openings of ventilation ducts.

3.2 Spaces not normally entered

Double bottom, cofferdams, duct keels, pipe tunnels, spaces containing cargo tanks and other spaces where cargo may accumulate should be capable of being ventilated to ensure sufficient air to avoid the accumulation of toxic and/ or flammable vapours and to ensure sufficient oxygen to provide a safe environment prior to entry. Where a permanent ventilation system is not provided for such spaces, approved portable means of mechanical ventilation should be provided.

B - ELECTRICAL REQUIREMENTS IN RESPECT OF FLAMMABLE CARGOES

3.3 General

Electrical installations should be such as to minimize the risk of fire and explosion from flammable cargoes. Care should be taken to exclude sources of ignition from areas where flammable vapours may be present.

3.4 Installations in spaces containing cargo tanks or pipes

3.4.1 Generally, no electrical installations should be permitted in spaces containing cargo tanks or pipes.

3.4.2 Only gauging and monitoring equipment of intrinsically safe design should be used in cargo tanks or in spaces containing cargo tanks or pipes. Consideration to the use of submerged motors and pumps may be given by the Administration.

3.4.3 Only lighting equipment of explosion-proof design should be used in a cargo pump-room.

3.5 Installations in enclosed spaces immediately aft of, forward of, or above the cargo-tank area

3.5.1 Any electrical gauging or monitoring equipment should be of intrinsically safe design.

3.5.2 Electrical equipment of explosion-proof design may be used in spaces where forced ventilation is fitted.

3.5.3 Electrical equipment of enclosed ventilated design may be used provided the spaces may be regarded as non-hazardous, and to which entrances and ventilation openings are situated at a safe distance from gas vents, exhaust outlets, etc.

3.6 Installations on open decks

3.6.1 Electrical equipment of explosion-proof design only should be used on the cargo deck.

3.5.2 Electrical equipment of enclosed ventilated design may be used on decks other than the cargo deck provided the equipment is situated at a safe distance from gas vents, exhaust outlets, tank openings, pipe flanges or cargo valves and at a safe height above the deck.

3.7 Bonding

Independent cargo tanks should be electrically bonded to the hull.

3.8 Electrical requirements for individual substances

Electrical requirements for individual substances are shown in column *i* of the summary of minimum requirements in chapter VI.

C - GAUGING

3.9 General

Cargo tanks should be fitted with one of the following types of gauging devices:

(a) *Open device* which makes use of an opening in the tank and may expose the gauger to the cargo or its vapour. An example of this is the ullage opening.

(b) *Restricted device* which penetrates the tank and which, when in use, permits a small quantity of cargo vapour or liquid to be exposed to the atmosphere. When not in use, the device is completely closed. The design should ensure that no dangerous escape of tank contents (liquid or spray) can take place in opening the device.

(c) *Closed device* which penetrates the tank, but which is part of a closed system and keeps tank contents from being released. Examples are the float-type systems, electronic probe, magnetic probe and protected sight-glass.

(d) *Indirect device* which does not penetrate the tank shell and is independent of the tank. An indirect measurement for determining the amount of cargo is used such as weighing of cargo, pipe flow meter, etc.

Gauging devices should be independent of the equipment required under 4.14.2 except far ships constructed prior to 27 September 1982 where the requirements of 4.14.2 are met by a shutdown valve which operates automatically.

3.10 Gauging for individual substances

Types of gauging for individual substances are shown in column *j* of the summary of minimum requirements in chapter VI.

D - VAPOUR DETECTION

3.11 General *

" When toxic-vapour-detection equipment is not available for some substances for which such detection is required by the summary of minimum requirements, an Administration may exempt the ship from the requirement provided an appropriate entry is made in the Certificate of Fitness. When granting such an exemption, Administrations should recognize the necessity for additional breathing air supply and an entry should be made on the Certificate of Fitness drawing attention to the provisions of 5.4.1(b).

3.11.1 Ships carrying toxic and/or flammable cargoes should be equipped with at least two instruments designed and calibrated for testing for the specific vapours in question. If such instruments are not capable of testing for both toxic concentrations and flammable concentrations, then two separate sets of instruments should be provided.

3.11.2 Vapour-detection instruments may be portable or fixed. If a fixed system is installed, at least one portable instrument should be provided.

3.12 Requirements for individual substances

Vapour-detection requirements for individual substances are shown in column *k* of the summary of minimum requirements in chapter VI.

E - FIRE PROTECTION

Fire-extinguishing media determined to be effective for certain products are listed in column *I* in the table of chapter VI.

3.13 Fire safety arrangements**

** Ships as defined in regulations II-2/1.1 and 1.2 of the 1974 SOLAS Convention, as amended, are to comply with this revised section 3.13. All other chemical tankers are to comply with section 3.13 of the 1980 edition of this Code.

3.13.1 The requirements for tankers in chapter II-2 of the 1974 SOLAS Convention, as amended, should apply to ships covered by the Code, irrespective of tonnage, including ships of less than 500 gross tonnage, except that:

(a) regulations 60, 61, 62 and 63 should not apply;

(b) regulation 56.2, i.e. the requirements for location of the main cargo-control station, need not apply;

(c) regulation 4 as applicable to cargo ships and regulation 7 should apply as they would apply to tankers of 2,000 gross tonnage and over;

(d) the provisions of 3.14 should apply in lieu of regulation 61; and (e) the provisions of 3.13.3 and 3.13.4 should apply in lieu of regulation 63.

3.13.2 Notwithstanding the provisions of 3.13.1, ships engaged solely in the carriage of caustic potash solution, phosphoric acid or sodium hydroxide solution need not comply with part D of chapter II-2 of the 1974 SOLAS Convention, as amended, provided that they comply with part C of that chapter, except that regulation 53 need not apply to such ships and 3.13.3, 3.13.4 and 3.14 hereunder need not apply.

3.13.3 The cargo pump-room of any ship should be provided with a fixed fire extinguishing system as follows:

(a) a carbon dioxide system as specified in regulation II-2/5.1 and 5.2 of the 1474 SOLAS Convention, as amended. A notice should be exhibited at the controls stating that the system is only to be used for fire extinguishing and not for inerting purposes, due to the electrostatic ignition hazard. The alarms referred to in regulation II-2/5.1.6 of the 1974 SOLAS Convention, as amended, should be safe for use in a flammable cargo vapour-air mixture. For the purpose of this requirement, an extinguishing system should be provided which would be suitable for machinery spaces. However, the amount of gas carried should be sufficient to provide a quantity of free gas equal to 45% of the gross volume of the cargo pumproom in all cases; or

(b) a halogenated hydrocarbon system as specified in regulation II-2/5.1 and 5.3 of the 1974 SOLAS Convention, as amended. A notice should be exhibited at the controls stating that the system is only to be used for fire extinguishing and not for inerting purposes due to the electrostatic ignition hazard. The alarms referred to in regulation II-2/5.1.6 of the 1981 SOLAS amendments should be safe for use in a flammable cargo vapour-air mixture. For the purpose of this requirement an extinguishing system should be provided which would be suitable for machinery spaces but utilizing the following minimum design quantities, based on the gross volume of the cargo pump-room:

halon 1301	7%
halon 1211	5.5%
halon 2402	0.3 kg/m3

Cargo pump-rooms of ships which are dedicated to the carriage of a restricted number of cargoes should be protected to the satisfaction of the Administration.

3.13.4 A fire-extinguishing system consisting of either a fixed pressure water spray system or a high-expansion foam system could be provided for the cargo pump-room if it can be adequately demonstrated to the Administration that cargoes will be carried which are not suited to extinguishment by carbon dioxide or halogenated hydrocarbons. The Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk should reflect this conditional requirement.

3.14 Fire-extinguishing arrangements for cargo-tank areas*

* Ships constructed on or after 20 May 1981 should comply with this section. All other ships should comply with the 1977 edition of the Code.

3.14.1 All ships, irrespective of size, should be fitted with a fixed deck foam fire-extinguishing system in accordance with the following requirements. However, ships which are dedicated to the carriage of specific cargoes ** should be protected by alternative provisions to the satisfaction of the Administration when they are equally effective for the products concerned as the deck foam system required for the generality of flammable cargoes.

** The term ships which are dedicated to the carriage of specific cargoes means ships which are dedicated to the carriage of a restricted number of cargoes.

3.14.2 Only one type of foam concentrate should be supplied, and it should be effective for the maximum possible number of cargoes intended to be carried. For other cargoes for which foam is not effective or is incompatible, additional arrangements to the satisfaction of the Administration should be provided. Regular protein foams should not be used.

3.14.3 The arrangements for providing foam should be capable of delivering foam to the entire cargo-tank area as well as into any cargo tank, the deck of which is assumed to be ruptured.

3.14.4 The deck foam system should be capable of simple and rapid operation. The main control station for the system should be suitably located outside the cargo-tank area, adjacent to the accommodation spaces and readily accessible and operable in the event of fires in the areas protected.

3.14.5 The rate of supply of foam solution should be not less than the greater of the following:

(a) 2 l/min per square metre of the cargo-deck area, where cargo-deck area means the maximum breadth of the ship times the total longitudinal extent of the cargo-tank spaces;

(b) 20 l/min per square metre of the horizontal sectional area of the single tank having the largest such area;

(c) 10 l/min per square metre of the area protected by the largest monitor, such area being entirely forward of the monitor, but not less than 1,250 l/min. For ships of less than 4,000 tons deadweight, the minimum capacity of the monitor should be to the satisfaction of the Administration.

3.14.6 Sufficient foam concentrate should be supplied to ensure at least 30 minutes of foam generation when using solution rates stipulated in 3.14.5(a), (b) and (c).

3.14.7 Foam from the fixed foam system should be supplied by means of monitors and foam applicators. At least 50% of the foam rate required in 3.14.5(a) or (b) should be delivered from each monitor. The capacity of any monitor should be at least 10 l/min of foam solution per square metre of deck area protected by that monitor, such area being entirety forward of tile monitor. Such capacity should be not

less than 1,250 l/min. For ships of less than 4,000 tons deadweight, the minimum capacity of the monitor should be to the satisfaction of the Administration.

3.14.8 The distance from the monitor to the farthest extremity of the protected area forward of that monitor should be not more than 75% of the monitor throw in still air conditions.

3.14.9 A monitor and hose connection for a foam applicator should be situated both port and starboard at the poop front or at the accommodation spaces facing the cargo tank.

3.14.10 Applicators should be provided for flexibility of action during firefighting operations and to cover areas screened from the monitors. The capacity of any applicator should be not less than 400 l/min and the applicator throw in still air conditions should be not less than 15 m. The number of foam applicators provided should be not less than four. The number and disposition of foam-main outlets should be such that foam from at least two applicators can be directed to any part of the cargo-deck area.

3.14.11 Valves should be provided in the foam main, and in the fire main where this is an integral part of the deck foam system, immediately forward of any monitor position to isolate damaged sections of those mains.

3.14.12 Operation of a deck foam system at its required output should permit the simultaneous use of the minimum required number of jets of water at the required pressure from the fire main.

3.14.13 Suitable portable fire-extinguishing equipment for the products to be carried should be provided and kept in good operating order.

3.14.14 All sources of ignition should be excluded from spaces where flammable vapours may be present.

3.15 Fire protection for ships built prior to 20 May 1980*

* The MSC at its forty-second session invited Administrations concerned to consider the improvement of the fire-extinguishing arrangements in cargo-tank areas of ships covered by 3.15 of the ninth set of amendments to the BCH Code as far as reasonable and practicable, having regard to the requirements set out in 3.73 and 3.14 of the Code as amended by the ninth set of amendments. In particular, where dry chemical extinguishing media cannot be replaced by foam, Administrations should consider an increase in the amount of dry chemicals.

3.15.1 Ships for which the building contract was placed prior to 20 May 1980 or, in the absence of a building contract, the keel of which was laid or which was at a similar stage of construction before 20 November 1980 or the delivery date of which was before 20 May 1984 should comply with the requirements of this section.

3.15.2 All ships, irrespective of tonnage, subject to this Code should also be subject to regulation II-2/52 of the 1974 SOLAS Convention. Furthermore cargo pump-rooms should be protected by a fire-extinguishing system approved by the Administration for cargoes to be carried, **

** Not applicable to ships built on or after 14 June 1983.

3.15.3 All sources of ignition should be excluded from spaces where flammable vapours may be present.

3.15.4 Suitable fire-extinguishing equipment for all products to be carried should be provided and kept in good operating order.

3.15.5 For products evolving flammable vapours, such equipment should include a fixed fire-extinguishing system approved by the Administration for the cargoes to be carried. CO_2 and steam smothering systems should be avoided unless due consideration is given to the danger of static electricity.

F - PERSONNEL PROTECTION

3.16 Requirements

3.16.1 For the protection of crew members who are engaged in loading and discharging operations, the ship should have on board suitable protective equipment consisting of large aprons, special gloves with long sleeves, suitable footwear, coveralls of chemical-resistant material, and tight-fitting goggles and/ or face shields, The protective clothing and equipment should cover all skin so that no part of the body is unprotected.

3.16.2 Work clothes and protective equipment should be kept in easily accessible places and in special lockers. Such equipment should not be kept within accommodation spaces with the exception of new, unused equipment and equipment which has not been used since undergoing a thorough cleaning process. The Administration may, however, approve storage rooms for such equipment within accommodation spaces if adequately segregated from living spaces such as cabins, passageways, messrooms, bathrooms, etc.

3.16.3 Protective equipment should be used in any operation which may entail danger to personnel.

3.16.4 Ships carrying toxic cargoes should have on board sufficient complete sets of safety equipment, but not less than three complete sets, each permitting personnel to enter a gas-filled compartment and perform work there for at least 20 minutes. Such equipment should be in addition to that required by regulation 11-2117 of the 1974 SOLAS Convention, as amended.*

3.16.5 One complete set of safety equipment should consist of:

(a) one self-contained air-breathing apparatus (not using stored oxygen);

(b) protective clothing, boots, gloves and tight-fitting goggles;

(c) steel-cored rescue line with belt; and

(d) explosion-proof lamp.

3.16.6 Air supplies

(a) For all ships, the following should be carried:

either

(i) one set of fully charged spare air bottles for each breathing apparatus required by 3.16.4;

(ii) a special air compressor suitable for the supply of high-pressure air of the required purity;

(iii) a charging manifold capable of dealing with sufficient spare breathing-apparatus cylinders for the breathing apparatus required by 3.16.4;

or

(iv)* fully charged spare air bottles with a total free air capacity of at least 6,000l for each breathing apparatus on board in excess of requirements of regulation II-2/17 of the 1974 SOLAS Convention, as amended.

* This provision applies to ships constructed on or after 14 June 1983.

(b) All ships with a cargo pump-room carrying cargoes which are assigned a 4.13.2 entry in column *m* of chapter VI or cargoes for which toxic-vapour detection equipment is required but is not available should have:

either

(i) a low-pressure line system to the pump-room with hose connections suitable for use with the breathing apparatus required by 3.16.4; this system should be limited by pressure-reduction devices to sufficient high-pressure air capacity to enable two men to work in a gas-dangerous space for at least one hour without using the cylinders of the breathing apparatus. Means should be provided for recharging the fixed air bottles from the special air compressor;

or

(ii) an equivalent quantity of spare bottled air in lieu of the low pressure air line.

3.16.7 At least one set of safety equipment as required in 3.16.5 should be kept in a suitable clearly marked locker in a readily accessible place near the cargo pump-room. The other sets of safety equipment should also be kept in clearly marked, easily accessible, suitable places.

3.16.8 The compressed-air equipment should be inspected at least once a month by a responsible officer. At least once a year the equipment should be inspected and tested by an expert.

3.16.9 A stretcher which is suitable for hoisting an injured person up from spaces such as a cargo pump-room should be placed in a readily accessible location.

3.16.10 Ships intended for the carriage of cargoes which are assigned a 4.17 entry in column *m* of the summary of minimum requirements in chapter VI should be provided with suitable respiratory and eye protection sufficient for every person on board for emergency escape purposes, subject to the following:

(a) filter-type respiratory protection is unacceptable;

(b) self-contained breathing apparatus should normally have at least a duration of service of 15 minutes;

(c) emergency escape respiratory protection should not be used for fire-fighting or cargo-handling purposes and should be marked to that effect.

3.16.11 The ship should have on board medical first-aid equipment, including oxygen resuscitation equipment and antidotes for cargoes carried.*

* Refer to the Medical First Aid Guide for Use in Accidents involving Dangerous Goods (MFAG) and to the index of Dangerous Chemicals Carried in Bulk, prepared by the Organization, which include the MFAG numbers of the chemicals covered by the Code and the emergency procedures to be applied in the event of any incident.

3.16.12 Suitably marked decontamination showers and an eyewash should be available on deck in convenient locations. The showers and eyewash should be operable in all ambient conditions.

G - TANK FILLING

3.17 General

Tanks carrying liquids at ambient temperatures should be so loaded as to avoid the tank becoming liquid-full during the voyage, having due regard to the highest temperature which the cargo may reach.

Chapter IV - Special requirements

The provisions of this chapter are applicable where specific reference is made in column *m* of the summary of minimum requirements in chapter VI

4.1 Carbon disulphide

4.1.1 Provisions should be made to maintain a water pad in the cargo tank during loading, unloading and transit. In addition, an inert gas pad should be maintained in the ullage space during transit.

4.1.2 All openings should be in the top of the tank above the deck.

4.1.3 Loading lines should terminate near the bottom of the tank.

4.1.4 A standard ullage opening should be provided for emergency sounding.

4.1.5 Cargo piping and vent lines should be independent of piping and vent lines used far other cargo.

4.1.6 Pumps may be used for discharging cargo provided they are of the deepwell or submersible types. The means of driving a deepwell pump should not present a source of ignition for carbon disulphide and should not employ equipment that may exceed a temperature of 80°C. Submersible pumps should be electrically interlocked so that the motor is de-energized before it could present a source of ignition to the cargo-vapour space.

4.1.7 If a cargo-discharge pump is used, it should be inserted through a cylindrical well extending from the tank top to a point near the tank bottom. A blanket of water should be formed in this well before attempting pump removal unless the tank has been certified as gas-free.

4.1.8 Water or inert gas displacement may be used for discharging cargo provided the cargo system is designed for the expected pressure and temperature.

4.1.9 Safety relief valves should be of stainless steel construction.

4.1.10 Because of its low ignition temperature and close clearances required to arrest its flame propagation, carbon disulphide requires safeguards beyond those provided by normal explosion-proof electrical equipment.

4.2 Diethyl ether

4.2.1 Unless inerted, natural ventilation should be provided for the voids around the cargo tanks while the vessel is under way. If a mechanical ventilation system is installed, all blowers should be of non-sparking construction. Mechanical ventilation equipment should not be located in the void spaces surrounding the cargo tanks.

4.2.2 Pressure-relief-valve settings should not be less than 0.2 kp/cm^2 for gravity tanks.

4.2.3 Inert gas displacement may be used for discharging cargo from pressure-vessel tanks provided the cargo system is designed for the expected pressure.

4.2.4 No electrical equipment except for approved lighting fixtures should be installed in enclosed spaces adjacent to cargo tanks. Lighting fixtures should be approved for use in diethyl ether vapours, The installation of electrical equipment on the weather deck should comply with the requirements of this Code.

4.2.5 In view of the fire hazard, provisions should be made to avoid any ignition source and/or heat generation in the cargo area.

4.2.6 Pumps may be used far discharging cargo provided that they are of a type designed to avoid liquid pressure against the shaft gland or are of a submerged type and are suitable for use with the cargo.

4.2.7 Provisions should be made to maintain the inert gas pad in the cargo tank during loading, unloading and transit.

4.3 Sulphur (molten)

4.3.1 Cargo-tank ventilation

(a) Cargo-tank ventilation should be provided to maintain the concentration of H_2S below one half of its lower explosive limit throughout the cargo-tank vapour space for all conditions of carriage, i.e. below 1.85% by volume.

(b) Where mechanical ventilation systems are used for maintaining low gas concentrations in cargo tanks, an alarm system should be provided to give warning if the system fails.

(c) Ventilation systems should be designed and arranged to preclude depositing of sulphur within the system.

4.3.2 Void spaces

(a) Openings to void spaces adjacent to cargo tanks should be designed and fitted to prevent the entry of water, sulphur or cargo vapour.

(b) Connections should be provided to permit sampling and analysing of vapour in void spaces.

4.3.3 Cargo temperature controls should be provided to ensure that the temperature of the sulphur does not exceed '155°C.

4.4 Acetone cyanohydrin and lactonitrile solution (80% or less)

Acetone cyanohydrin and lactonitrile solution should be stabilized with an inorganic acid to prevent decomposition. A certificate of stabilization should be provided by the manufacturer specifying:

(a) name and amount of stabilizer added;

(b) date stabilizer was added and duration of effectiveness;

(c) any temperature (imitations qualifying the stabilizer's effective lifetime;

(d) the action to be taken should the length of voyage exceed the effective lifetime of the stabilizer.

4.5 Phosphorus, yellow or white

4.5.1 Phosphorus should, at all times, be loaded, carried and discharged under a water pad of 760 mm minimum depth. During discharge operations, arrangements should be made to ensure that water occupies the volume of phosphorus discharged. Any water discharged from a phosphorus tank should be returned only to a shore installation.

4.5.2 Tanks should be designed and tested to a minimum equivalent water head of 2.4 m above the top of the tank under designed loading conditions, taking into account the depth, specific gravity and method of loading and discharge of the phosphorus.

4.5.3 Tanks should be so designed as to minimize the interfacial area between the liquid phosphorus and its water pad.

4.5.4 A minimum ullage space of 1 % should be maintained above the water pad. The ullage space should be filled with inert gas or naturally ventilated by two cowled standpipes terminating at different heights but at least 6 m above the deck and at least 2 m above the pump-house top.

4.5.5 All openings should be at the top of cargo tanks and fittings and joints attached thereto should be of materials resistant to phosphorus pentoxide.

4.5.6 Phosphorus should be loaded at a temperature not exceeding 60°C.

4.5.7 Tank heating arrangements should be external to tanks and have a suitable method of temperature control to ensure that the temperature of the phosphorus does not exceed 60°C. A high-temperature alarm should be fitted.

4.5.8 A water drench system acceptable to the Administration should be installed in all void spaces surrounding the tanks. The system should operate automatically in the event of an escape of phosphorus.

4.5.9 Void spaces referred to in 4.5.8 should be provided with effective means of mechanical ventilation which should be capable of being sealed off quickly in any emergency.

4.5.10 Loading and discharge of phosphorus should be governed by a central system on the ship which, in addition to incorporating high-level alarms, should ensure that no overflow of tanks is possible and that such operations can be stopped quickly in an emergency from either ship or shore.

4.5.11 During cargo transfer, a water hose on deck should be connected to a water supply and kept flowing throughout the operation so that any spillage of phosphorus may be washed down with water immediately.

4.5.12 Ship-to-shore loading and discharge connections should be approved by the Administration.

4.6 Motor fuel anti-knock compounds (containing lead alkyls)

4.6.1 Tanks used for these cargoes should not be used for the transportation of any other cargo except those commodities to be used in the manufacture of motor fuel anti-knock compounds containing lead alkyls.

4.6.2 If a cargo pump-room is located on deck level according to 4.13.2, the ventilation arrangements should be in compliance with 4.13.1.

4.6.3 Entry into cargo tanks used for the transportation of these cargoes is not permitted unless approved by the Administration.

4.6.4 Air analysis should be made for lead content to determine if the atmosphere is satisfactory prior to allowing personnel to enter the cargo pumproom or void spaces surrounding the cargo tank.

4.7 Propylene oxide and mixtures of ethylene oxide/ propylene oxide with an ethylene oxide content of not more than 30% by weight

4.7.1 Products transported under the provisions of this section should be acetylene-free.

4.7.2 (a) Unless cargo tanks are properly cleaned, these products should not be carried in tanks which have contained as one of the three previous cargoes any products known to catalyse polymerization, such as:

(i) mineral acids (e.g. sulphuric, hydrochloric, nitric);

(ii) carboxylic acids and anhydrides (e.g. formic, acetic);

(iii) halogenated carboxylic acids (e.g. chloracetic);

(iv) sulphonic acids (e.g. benzenesulphonic);

(v) caustic alkalis (e.g. sodium hydroxide, potassium hydroxide);

(vi) ammonia and ammonia solutions;

(vii) amines and amine solutions;

(viii) oxidizing substances.

(b) Before loading, tanks should be thoroughly and effectively cleaned, to remove all traces of previous cargoes from tanks and associated pipework, except where the immediately prior cargo has been propylene oxide or ethylene oxide/propylene oxide mixtures. Particular care should be taken in the case of ammonia in tanks made of steel other than stainless steel.

(c) In all cases, the effectiveness of cleaning procedures for tanks and associated pipework should be checked by suitable testing or inspection, to ascertain that no traces of acidic or alkaline material remain that might create a hazardous situation in the presence of these products.

(d) Tanks should be entered and inspected prior to each initial loading of these products to ensure freedom from contamination, heavy rust deposits and visible structural defects. When cargo tanks are in continuous service for these products, such inspections should be performed at intervals of not more than two years.

(e) Tanks for the carriage of these products should be of steel or stainless steel construction.

(f) Tanks for the carriage of these products may be used for other cargoes after thorough cleaning of tanks and associated pipework systems by washing or purging.

4.7.3 (a) All valves, flanges, fittings and accessory equipment should be of a type suitable for use with the products and should be constructed of steel or stainless steel or other material acceptable to the Administration. The chemical composition of all material used should be submitted to the Administration for approval prior to fabrication. Discs or disc faces, seats and other wearing parts of valves should be made of stainless steel containing not less than 11 % chromium.

(b) Gaskets should be constructed of materials which do not react with, dissolve in, or lower the autoignition temperature of these products, and which are fire-resistant and possess adequate mechanical behaviour. The surface presented to the cargo should be polytetrafluoroethylene (PTFE), or materials giving a similar degree of safety by their inertness. Spirally wound stainless steel, with a filler of PTFE or similar fluorinated polymer, may be accepted by the Administration.

(c) Insulation and packing, if used, should be of a material which does not react with, dissolve in, or lower the autoignition temperature of these products.

(d) The following materials are generally found unsatisfactory for gaskets, packing and similar uses in containment systems for these products and would require testing before being approved by the Administration:

(i) Neoprene or natural rubber, if it comes into contact with the products.

(ii) Asbestos, or binders used with asbestos.

(iii) Materials containing oxides of magnesium, such as mineral wools.

4.7.4 Threaded joints should not be permitted in the cargo liquid and vapour lines,

4.7.5 Filling and discharge piping should extend to within 100 mm of the bottom of the tank or any sump pit.

4.7.6 (a) The containment system for a tank containing these products should have a valved vapour-return connection.

(b) The products should be loaded and discharged in such a manner that venting of the tanks to atmosphere does not occur. If vapour return to shore is used during tank loading, the vapour-return system connected to a containment system for the product should be independent of all other containment systems.

(c) During discharging operations, the pressure in the cargo tank must be maintained above 0.07 kp/cm^2 gauge.

4.7.7 The cargo may be discharged only by deepwell pumps, hydraulically operated submerged pumps, or inert gas displacement. Each cargo pump should be arranged to ensure that the product does not heat significantly if the discharge line from the pump is shut off or otherwise blocked.

4.7.8 Tanks carrying these products should be vented independently of tanks carrying other products. Facilities should be provided for sampling the tank contents without opening the tank to atmosphere.

4.7.9 Cargo hoses used for transfer of these products should be marked "FOR ALKYLENE OXIDE TRANSFER ONLY".

4.7.10 Cargo tanks, void spaces and other enclosed spaces adjacent to an integral gravity cargo tank carrying propylene oxide should either contain a compatible cargo (those cargoes specified in 4.7.2 are examples of substances considered incompatible) or be inerted by injection of a suitable inert gas. Any hold space in which an independent cargo tank is located should be inerted. Such inerted spaces and tanks should be monitored for these products and oxygen. The oxygen content of these spaces should be maintained below 2%. Portable sampling equipment is satisfactory.

4.7.11 In no case should air be allowed to enter the cargo pump or piping system while these products are contained within the system.

4.1.12 Prior to disconnecting shore-lines, the pressure in liquid and vapour lines should be relieved through suitable valves installed at the loading header. Liquid and vapour from these lines should not be discharged to atmosphere.

4.7.13 Propylene oxide may be carried in pressure tanks or in independent or integral gravity tanks. Ethylene oxide/propylene oxide mixtures should be carried in independent gravity tanks or pressure tanks. Tanks should be designed for the maximum pressure expected to be encountered during loading, conveying and discharging cargo.

4.7.14 (a) Tanks for the carriage of propylene oxide with a design pressure less than 0.6 kp/cm^2 gauge and tanks for the carriage of ethylene oxide/propylene oxide mixtures with a design pressure less than 1.2 kp/cm^2 gauge should have a cooling system to maintain the cargo below the reference temperature.*

* See 1.4.15.

(b) The refrigeration requirement for tanks with a design pressure less than 0.6 kp/cm^2 gauge may be waived by the Administration for ships operating in restricted areas or on voyages of restricted duration, and account may be taken in such cases of any insulation of the tanks. The area and times of year for which such carriage would be permitted should be included in the conditions of the Certificate of Fitness.

4.7.15 (a) Any cooling system should maintain the liquid temperature below the boiling temperature at the containment pressure. At least two complete cooling plants, automatically regulated by variations within the tanks, should be provided. Each cooling plant should be complete, with the necessary auxiliaries for proper operation. The control system should also be capable of being manually operated. An alarm should be provided to indicate malfunctioning of the temperature controls. The capacity of each cooling system should be sufficient to maintain the temperature of the liquid cargo below the reference temperature * of the system.

(b) An alternative arrangement may consist of three cooling plants, any two of which should be sufficient to maintain the liquid temperatures below the reference temperature.*

(c) Cooling media which are separated from the products by a single wall only should be non-reactive with the products.

(d) Cooling systems requiring compression of the products should not be used.

* See 1.4.15.

4.7.16 Pressure-relief-valve settings should not be less than 0.2 kp/cm^2 gauge and for pressure tanks not greater than 7.0 kp/cm^2 gauge for the carriage of propylene oxide and not greater than 5.3 kp/cm^2 gauge for the carriage of propylene oxide/ethylene oxide mixtures.

4.7.17 (a) The piping system for tanks to be loaded with these products should be separated (as defined in 1.4.13) from piping systems for all other tanks, including empty tanks. If the piping system for the tanks to be loaded is not independent (as defined in 1.4.14), the required piping separation should be accomplished by the removal of spool-pieces, valves, or other pipe sections and the installation of blank flanges at these locations, The required separation applies to all liquid and vapour piping, liquid and vapour vent lines and any other possible connections, such as common inert-gas supply lines.

(b) These products may be transported only in accordance with cargo handling plans that have been approved by the Administration. Each intended loading arrangement should be shown on a separate cargo-handling plan. Cargo-handling plans should show the entire cargo piping system and the locations for installation of blank flanges needed to meet the above piping separation requirements. A copy of each approved cargo-handling plan should be maintained on board the ship. The Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk should be endorsed to include reference to the approved cargo-handling plans.

(c) Before each initial loading of these products and before every subsequent return to such service, certification verifying that the required piping separation has been achieved should be obtained from a responsible person acceptable to the port Administration and carried on board the ship. Each connection between a blank flange and a pipeline flange should be fitted with a wire and seal by the responsible person to ensure that inadvertent removal of the blank flange is impossible.

4.7.18 (a) No cargo tanks should be more than 98% liquid-full at the reference temperature. *

(b) The maximum volume to which a cargo tank should be loaded is: $V_L = 0.98\ V \frac{d_R}{d_L}$

where

V_L = maximum volume to which the tank may be loaded
V = volume of the tank
d_R = relative density of cargo at the reference temperature *
d_L = relative density of cargo at the loading temperature and pressure

* See 1.4.15.

(c) The maximum allowable tank filling limits for each cargo tank should be indicated for each loading temperature which may be applied, and for the applicable maximum reference temperature, on a list to be approved by the Administration. A copy of the list should be permanently kept on board by the master.

4.1.19 The cargo should be carried under a suitable protective padding of nitrogen gas. An automatic nitrogen make-up system should be installed to prevent the tank pressure falling below 0.07 kp/cm^2 gauge in the event of product temperature fall due to ambient conditions or maloperation of refrigeration systems. Sufficient nitrogen should be available on board to satisfy the demand of the automatic pressure control. Nitrogen of commercially pure quality (99.9% by volume) should be used for padding. A battery of nitrogen bottles connected to the cargo tanks through a pressure-reduction valve satisfies the intention of the expression "automatic" in this context.

4.7.20 The cargo-tank vapour space should be tested prior to and after loading to ensure that the oxygen content is 2% by volume or less.

4.7.21 A water-spray system of sufficient capacity should be provided to blanket effectively the area surrounding the loading manifold, the exposed deck piping associated with product handling and the tank domes. The arrangement of piping and nozzles should be such as to give a uniform distribution rate of 10 l,/m^2/min. The water-spray system should be capable of both local and remote manual operation and the arrangement should ensure that any spilled cargo is washed away. Remote manual operation should be arranged such that remote starting of pumps supplying the water-spray system and remote operation of any normally closed valves in the system can be carried out from a suitable location outside the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected. Additionally, a water hose with pressure to the nozzle, when atmospheric temperatures permit, should be connected ready for immediate use during loading and unloading operations.

4.7.22 A remotely operated controlled-closing-rate shutoff valve should be provided at each cargo-hose connection used during cargo transfer.

4.8 Acids

4.8.1 The ship's shell plating should not form any boundaries of tanks containing mineral acids.

4.8.2 Proposals for lining mild steel tanks and related piping systems with corrosion-resistant materials may be considered by the Administration. The elasticity of the lining should not be less than that of the supporting boundary plating.

4.8.3 Unless constructed wholly of corrosion-resistant materials or fitted with an approved lining, the plating thickness should take into account the corrosivity of the cargo.

4.8.4 Flanges of the loading and discharge manifold connections should be provided with shields, which may be portable, to guard against the danger of the cargo being sprayed; and, in addition, drip trays should be provided to guard against leakage onto the deck.

4.8.5 Because of the danger of evolution of hydrogen when these substances are being carried, no electrical equipment or other sources of ignition should be permitted in enclosed spaces adjacent to cargo tanks.

4.8.6 Substances subjected to the requirements of this section should be segregated from oil fuel bunkers in addition to the segregation requirements in 2.6.

4.8.7 Provision should be made for suitable apparatus to detect leakage of cargo into adjacent spaces.

4.8.8 The cargo pump-room bilge pumping and drainage arrangements should be of corrosion-resistant materials.

4.9 Toxic products

4.9.1 Exhaust openings of tank vent systems should be located:

(a) at a height of B/3 or 6 m, whichever is greater, above the weather deck or, in the case of a deck tank, the access gangway.

(b) not less than 6 m above the fore-and-aft gangway, if fitted within 6 m of the gangway; and

(c) 15 m from any opening or air intake to any accommodation and service spaces.

(d) the vent height may be reduced to 3 m above the deck or fore and aft gangway as applicable, provided high-velocity vent valves of a type approved by the Administration, directing the vapour-air mixture upwards in an unimpeded jet with an exit velocity of at least 30 m/s, are fitted.

4.9.2 Tank venting systems should be provided with a connection for a vapour-return line to the shore installation.

4.9.3 Products should:

(a) not be stowed adjacent to bunker tanks;

(b) have separate piping systems; and

(c) have tank vent systems separate from tanks containing non-toxic products.

4.9.4 Cargo-tank relief-valve settings should be a minimum of 0.2 kp/cm^2. However, tanks on existing ships previously approved for the carriage of toxic products should have a minimum relief-valve setting as near kp/cm^2 as possible, taking into account the scantlings of the tank.

4.10 Cargoes protected by additives

4.10.1 Certain cargoes, as listed in column *m* in the table of chapter VI, by the nature of their chemical make-up, tend, under certain conditions of temperature, exposure to air or contact with a catalyst, to undergo polymerization, decomposition, oxidation or other chemical changes. Mitigation of this tendency is carried out by introducing small amounts of chemical additives into the liquid cargo or controlling the cargo-tank environment.

4.10.2 Ships carrying these cargoes should be so designed as to eliminate from the cargo tanks and cargo-handling system any material of construction or contaminants which could act as a catalyst or destroy the inhibitor.

4.10.3 Care should be taken to ensure that these cargoes are sufficiently protected to prevent deleterious chemical change at all times during the voyage. Ships carrying such cargoes should be provided with a certificate of protection from the manufacturer and kept during the voyage, specifying:

.1 name and amount of additive present;

.2 whether the additive is oxygen-dependent;

.3 date additive was put in the product and duration of effectiveness;

.4 any temperature limitations qualifying the additives' effective lifetime; and

.5 the action to be taken should the length of voyage exceed the effective lifetime of the additives.

4.10.4 Ships using the exclusion of air as the method of preventing oxidation of the cargo should comply with 2.19.3.

4.10.5 A product containing an oxygen-dependent additive should be carried without inertion.

4.10.6 Venting systems should be of a design that eliminates blockage from polymer build-up. Venting equipment should be of a type that can be checked periodically for adequacy of operation.

4.10.7 Crystallization or solidification of cargoes normally carried in the molten state can lead to depletion of inhibitor in parts of the tank contents. Subsequent remelting can thus yield pockets of uninhibited liquid, with the accompanying risk of dangerous polymerization. To prevent this, care should be taken to ensure that at no time are such cargoes allowed to crystallize or solidify, either wholly or partially, in any part of the tank. Any required heating arrangements should be such as to ensure that in no part of the tank does cargo become overheated to such an extent that any dangerous polymerization can be initiated. If the temperature from steam coils would induce overheating, an indirect low-temperature heating system should be used.

4.11 Cargoes which have a vapour pressure greater than 1.033 kp/cm^2 at 37.8°C

4.11.1 Unless the tank is specially designed to withstand the vapour pressure of the cargo, provision should be made to maintain the temperature of the cargo below its boiling point at atmospheric pressure.

4.11.2 Connections for returning the expelled gases ashore during loading should be provided.

4.11.3 Each tank should be provided with a pressure gauge indicating the pressure in the vapour space above the cargo.

4.11.4 Where the cargo is being cooled, each tank should be provided with thermometers at the top and bottom of the tank.

4.12 Materials of construction

4.12.1 Copper, copper alloys, zinc, aluminium, galvanized steel and mercury should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come into contact with cargo liquid or vapour.

4.12.2 Copper, copper alloys, zinc or galvanized steel should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.3 Aluminium, magnesium, zinc, galvanized steel and lithium should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.4 Copper and copper-bearing alloys should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.5 Aluminium or copper or alloys of either should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.6 Aluminium, stainless steel or steel covered with a suitable protective lining or coating should be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.7 The following materials of construction should be used:

(a) for concentrations of 98% or greater, aluminium or stainless steel;

(b) for concentrations of less than 98%, special acid-resistant stainless steel.

4.12.8 Copper, silver, mercury and magnesium or other acetylide-forming metals and their alloys should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.9 Copper and copper-bearing alloys with greater than 1 % copper should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.10 All material of construction in contact with the cargo should be solid austenitic stainless steel.

4.13 Cargo pump-rooms

4.13.1 The ventilation system as described in 3.1.2 should have a minimum capacity of at least 45 changes of air per hour, based upon the total volume of space. The ventilation-system exhaust ducts should discharge at least 10 m away from openings into accommodation spaces, intakes to ventilation systems, work areas or other similar spaces and at least 4 m above the tank deck.

4.13.2 Cargo pumps should be located in the cargo tank or the cargo pumproom should be located on the deck level. Special consideration by the Administration should be required for below-deck cargo pump-rooms.

4.14 Overflow control (Alternative 1)

The provisions of this section are applicable in addition to the required gauging devices where specific reference is made in column *m* of the summary of minimum requirements in chapter VI.

4.14.1 High-level alarm: Cargo tanks should be fitted with an alarm which will indicate when there is imminent danger of the tank being overfilled. Means should be provided to enable the alarm to be tested prior to loading.

4.14.2 Tank overflow control

(a) A system should be provided which should:

(i) be automatic, not dependent upon manual intervention or control, and acceptable to the Administration, to ensure that cargo tanks, while being loaded, cannot overflow on to the deck or overboard;

(ii) come into operation when the normal tank loading procedures have failed to stop the tank liquid level exceeding the normal full condition; and

(iii) operate independently of the high-level alarm required by 4.14.1.

(b) Where the system includes a valve whose automatic closure is to prevent the overflow of a cargo tank, such a valve should operate as follows:

(i) The total closure time, in seconds, i.e. the time interval from operation of the initiating signal to complete valve closure, should not exceed

$$\frac{3{,}600U}{LR}$$

where

U = ullage volume (m3) at operating signal level;
LR = maximum loading rate (m3/h) agreed between ship and shore facility as referred to in subparagraph (ii)(3).

(ii) (1) Information about valve characteristics, including closing times, should be available on board and the times should be capable of being verified and reproduced.

(2) Automatic valves should close without jerkiness.

(3) The loading rate (LR) should be calculated to limit surge pressure on valve closure to an acceptable level, taking into account the loading hose or arm and the ship and shore pipeline systems.

(4) The valve should be arranged to "fail safe" in the case of maloperation or system power failure. This will normally mean the valve failing to the closed position except when the system includes a stored-power source sufficient to operate all valves in the system at least twice and an alarm would indicate a system fault or main power failure. The fail-safe closure time should not be less than the closing time.

(c) When a ship fitted with shutdown valves to comply with the requirements of this paragraph is handling products to which this paragraph does not apply, the valves may be isolated from the system by means agreed with the Administration. Such means may involve the complete removal of the valve or the installation of a change-over system of bends or blanks with removable pipes. Any disturbance of the automatic system for the purposes described in this subparagraph and the system's subsequent restoration should be noted in the ship's operating log-book.

4.14 Overflow control (Alternative 2)

The provisions of this section are applicable in addition to the required gauging devices where specific reference is made in column m of the summary of minimum requirements in chapter VI.

4.14.1 High-level alarm: Cargo tanks should be fitted with a visible and audible alarm which will indicate when the liquid level in the cargo tank approaches the normal full condition. This high-level alarm should be independent of the equipment under 3.9 and 4.14.2.

4.14.2 Tank overflow control: A system should be provided which should:

(a) come into operation when the normal tank loading procedures have failed to stop the tank liquid level exceeding the normal full condition;

(b) give a visual and audible alarm to the ship's operator;

(c) provide, if necessary, an agreed signal for sequential shutdown of on-shore pumps and/or valves and the ship's shutdown valves. The signal as well as the pump and valve shutdown may be dependent on operator's intervention. In any case, the loading rate LR (in m3/h) should not exceed:

$$\frac{3{,}600U}{t}$$

where:

U is the ullage volume (m3) at operating signal level;
t is the time in seconds needed from the initiating signal to fully stopping the cargo flow into the tank. This time should be the sum of the times needed for each step in sequential operations such as:

operators' responses to signals;
stopping pumps; and
closing valves.

All loading operations should be terminated at once in case any system essential for safe loading becomes inoperative.

4.14.3 All level alarms should be capable of being tested prior to loading.

In case of a power failure on any system essential for safe loading, an alarm should be given to the operators concerned.

4.15 Cargo contamination

4.15.1 Where column *m* of the summary of minimum requirements in chapter VI refers to this paragraph, alkaline or acidic materials, such as caustic soda or sulphuric acid, should not be allowed to contaminate this cargo.

4.15.2 Where column m of the summary of minimum requirements in chapter VI refers to this paragraph, water should not be allowed to contaminate this cargo. In addition the following provisions apply:

(a) Air inlets to pressure/vacuum-relief valves of tanks containing this cargo should be situated at least 2 m above the weather deck.

(b) Water or steam should not be used as the heat-transfer media in a cargo temperature control system required by 2.15.

(c) This cargo should not be carried in cargo tanks adjacent to permanent ballast or water tanks unless the tanks are empty and dry.

(d) This cargo should not be carried in tanks adjacent to slop tanks, cargo tanks containing ballast or slops or other cargoes containing water which may react in a dangerous manner. Pumps, pipes or vent lines serving such tanks should be separate from similar equipment serving tanks containing this cargo. Pipelines from slop tanks or ballast lines should not pass through tanks containing this cargo unless in a tunnel.

4.16 Samples taken from chemical cargoes

4.16.1 Samples which have to be kept on board must be stowed in a designated space situated in the cargo-tank area or, exceptionally, elsewhere to the approval of the Administration.

4.16.2 The stowage space should be:

(a) cell-divided in order to avoid shifting of the bottles at sea;

(b) made of material fully resistant to the different liquids intended to be stowed;

(c) equipped with adequate ventilation arrangements.

4.16.3 Samples which react with each other dangerously should not be stowed close to each other.

4.16.4 Samples should not be retained on board longer than necessary.

4.17 Respiratory and eye protection

Where column *m* of the summary of minimum requirements in chapter VI refers to this paragraph, the provisions of 3.16.10 should apply.

4.18 Cargoes not to be exposed to excessive heat

4.18.1 Where the possibility exists of a dangerous reaction of this cargo, such as polymerization, decomposition, thermal instability or evolution of gas, resulting from local overheating of the cargo in either the tank or associated pipelines, this cargo should be loaded and carried adequately segregated from other products whose temperature is sufficiently high to initiate a reaction of this cargo.

4.18.2 Heating coils in tanks carrying this cargo should be blanked off or secured by equivalent means.

4.18.3 Because of its heat-sensitive nature, this cargo should not be carried in deck tanks which are not insulated.

4.19 Ammonium nitrate solution, 93% or less

4.19.1 The ammonium nitrate solution should contain at least 7% by weight of water. The acidity (pH) of the cargo when diluted with 10 parts of water to one part of cargo by weight should be between 5.0 and 7.0. The solution should not contain more than 10 ppm chloride ions, 10 ppm ferric ions, and should be free of other contaminants.

4.19.2 Tanks and equipment for ammonium nitrate solution should be independent from tanks and equipment containing other cargoes or combustible products. Equipment which in service or when defective may release combustible products into the cargo, e.g. lubricants, should not be used. Tanks should not be used for seawater ballast.

4.19.3 Except where expressly approved by the Administration, ammonium nitrate solutions should not be transported in tanks which have previously contained other cargoes. Tanks and associated equipment should be re-cleaned to the satisfaction of the Administration.

4.19.4 The temperature of the heat-exchanging medium in the tank heating system should not exceed 160°C. The heating system should be provided with a control system to keep the cargo at a bulk mean temperature of 140°C. High temperature alarms at 145°C and 150°C and a low-temperature alarm at 125°C should be provided. Where the temperature of the heat-exchanging medium exceeds 160°C, an alarm should also be given. Temperature alarms and controls should be located on the navigating bridge.

4.19.5 Where the mean bulk cargo temperature reaches 145°C, a cargo sample should be diluted with 10 parts of distilled or demineralized water to one part of cargo by weight and the pH should be determined by means of a narrow-range indicator paper or stick. Measurements of pH should then be taken every 24 h. If the pH is below 4.2, ammonia gas should be injected into the cargo until a pH of 5 is reached.

4.19.6 A fixed installation should be provided to inject ammonia gas into the cargo. Controls for this system should be located on the navigating bridge. For this purpose, 300 kg of ammonia per 1,000 tons of ammonium nitrate solution should be available on board.

4.19.7 Cargo pumps should be of the centrifugal deepwell type or of the centrifugal type with water-flushed seals.

4.19.8 Vent piping should be fitted with approved weatherhoods to prevent clogging. Such weatherhoods should be accessible for inspection and cleaning.

4.19.9 Hot work on tanks, piping and equipment which have been in contact with ammonium nitrate solution should only be done after all traces of ammonium nitrate have been removed, inside as well as outside.

4.19.10 As a condition of carriage of this product, the ship should meet the Code in full as would be applicable to a ship constructed or converted after 14 June 1983.

4.20 Hydrogen peroxide solutions

Hydrogen peroxide solutions over 60% but not over 70% by weight

4.20.1 Hydrogen peroxide solutions of over 60% but not over 70% should be carried in dedicated ships only and no other cargoes should be carried.

4.20.2 Cargo tanks and associated equipment should be either pure aluminium (99.5%) or solid stainless steel (e.g. 304, 304L, 316, 316L, 3'16Ti) and passivated in accordance with approved procedures. Aluminium should not be used for piping on deck. All nonmetallic materials of construction for the containment system should neither be attacked by hydrogen peroxide nor contribute to its decomposition.

4.20.3 Pump-rooms should not be used for cargo-transfer operations.

4.20.4 Cargo tanks should be separated by a cofferdam from fuel-oil tanks or any other space containing flammable or combustible materials.

4.20.5 Tanks intended for the carriage of hydrogen peroxide should not be used for seawater ballast.

4.20.6 Temperature sensors should be installed at the top and bottom of the tank. Remote temperature readouts and continuous monitoring should be located on the bridge. If the temperature in the tank rises above 35°C, visible and audible alarms should activate on the navigating bridge.

4.20.7 Fixed oxygen monitors (or gas-sampling lines) should be provided in void spaces adjacent to tanks to detect leakage of the cargo into these spaces. Remote readouts, continuous monitoring (if gas-sampling lines are used, intermittent sampling is satisfactory) and visible and audible alarms similar to those for the temperature sensors should also be located on the navigating bridge. The visible and audible alarms should activate if the oxygen concentration in these void spaces exceeds 30% by volume. Two portable oxygen monitors should also be available as back-up systems.

4.20.8 As a safeguard against uncontrolled decomposition, a cargo-jettisoning system should be installed to discharge the cargo overboard. The cargo should be jettisoned if the temperature rise of the cargo exceeds a rate of 2°C/h over a 5 h period or when the temperature in the tank exceeds 40°C.

4.20.9 Cargo-tank venting systems should have pressure/vacuum-relief valves for normal controlled venting and rupture discs or a similar device for emergency venting should tank pressure rise rapidly as a result of uncontrolled decomposition. Rupture discs should be sized on the basis of tank design pressure, tank size and anticipated decomposition rate.

4.20.10 A fixed water-spray system should be provided for diluting and washing away any concentrated solution spilled on deck. The areas covered by the water-spray should include the manifold/hose connections and the tank tops of those tanks designated for carrying hydrogen peroxide. The minimum application rate should satisfy the following criteria:

(a) The product should be diluted from the original concentration to 35% by weight within five minutes of the spill.

(b) The rate and estimated size of the spill should be based upon maximum anticipated loading and discharge rates, the time required to stop flow of cargo in the event of tank overfill or a piping/hose failure, and the time necessary to begin application of dilution water with actuation at the cargo-control location or on the navigating bridge.

4.20.11 Hydrogen peroxide should be stabilized to prevent decomposition. A certificate of stabilization should be provided by the manufacturer specifying:

(a) name and amount of stabilizer added;

(b) date stabilizer was added and duration of effectiveness;

(c) any temperature limitations qualifying the stabilizer's effective lifetime;

(d) the action to be taken should the length of voyage exceed the effective lifetime of the stabilizer.

4.20.12 Only those hydrogen peroxide solutions which have a maximum decomposition rate of 1.0% per year at 25°C should be carried. Certification from the shipper that the product meets this standard should be presented to the master and kept on board. A technical representative of the manufacturer should be on board to monitor the transfer operations and have the capability to test the stability of the hydrogen peroxide. He should certify to the master that the cargo has been loaded in a stable condition.

4.20.13 Protective clothing that is resistant to hydrogen peroxide should be provided for each crew member involved in cargo-transfer operations. Protective clothing should include coveralls that are nonflammable, suitable gloves, boots and eye protection.

4.20.14 As a condition of carriage of this product, the ship should meet the Code in full, as would be applicable to a ship constructed after 14 June 1983.

Hydrogen peroxide solutions over 8% but not over 60% by weight

4.20.15 The ship's shell plating should not form any boundaries of tanks containing this product.

4.20.16 Hydrogen peroxide should be carried in tanks thoroughly and effectively cleaned of all traces of previous cargoes and their vapours or ballast. Procedures for inspection, cleaning, passivation and loading of tanks should be in accordance with MSC/Circ. 394. A certificate should be on board the vessel indicating that the procedures in the circular have been followed. The passivation requirement may be waived by an Administration for domestic shipments of short duration. Particular care in this respect is essential to ensure the safe carriage of hydrogen peroxide.

(a) When hydrogen peroxide is carried, no other cargoes should be carried simultaneously.

(b) Tanks which have contained hydrogen peroxide may be used for other cargoes after cleaning in accordance with the procedures outlined in MSC/Circ. 394.

(c) Consideration in design should provide minimum internal tank structure, free draining, no entrapment and ease of visual inspection.

4.20.17 Cargo tanks and associated equipment should be either pure aluminium (99.5%) or solid stainless steel of types suitable for use with hydrogen peroxide (e.g. 304, 304L, 316, 316L, 316Ti). Aluminium should not be used for piping on deck. All nonmetallic materials of construction for the containment system should neither be attacked by hydrogen peroxide nor contribute to its decomposition.

4.20.18 Cargo tanks should be separated by a cofferdam from fuel-oil tanks or any other space containing materials incompatible with hydrogen peroxide.

4.20.19 Temperature sensors should be installed at the top and bottom of the tank. Remote temperature readouts and continuous monitoring should be located on the navigating bridge. If the temperature in the tank rises above 35°C, visible and audible alarms should activate on the navigating bridge.

4.20.20 Fixed oxygen monitors (or gas-sampling lines) should be provided in void spaces adjacent to tanks to detect leakage of the cargo into these spaces. The enhancement of flammability by oxygen enrichment should be recognized. Remote readouts, continuous monitoring (if gas-sampling lines are used, intermittent sampling is satisfactory) and visible and audible alarms similar to those for the temperature sensors should also be located on the navigating bridge. The visible and audible alarms should activate if the oxygen concentration in these void spaces exceeds 30% by volume. Two portable oxygen monitors should also be available as back-up systems.

4.20.21 As a safeguard against uncontrolled decomposition, a cargo jettisoning system should be installed to discharge the cargo overboard. The cargo should be jettisoned if the temperature rise of the cargo exceeds a rate of 2°C/h over a 5 h period or when the temperature in the tank exceeds 40°C.

4.20.22 Cargo-tank venting systems with filtration should have pressure/vacuum-relief valves for normal controlled venting and a device for emergency venting should tank pressure rise rapidly as a result of an uncontrolled decomposition rate, as stipulated in 4.20.21. These venting systems should be designed in such a manner that there is no introduction of seawater into the cargo tank even under heavy sea conditions. Emergency venting should be sized on the basis of tank design pressure and tank size.

4.20.23 A fixed water-spray system should be provided for diluting and washing away any concentrated solution spilled on deck. The areas covered by the water-spray should include the manifold/hose connections and the tank tops of those tanks designated for the carriage of hydrogen peroxide solutions. The minimum application rate should satisfy the following criteria:

(a) The product should be diluted from the original concentration to 35% by weight within five minutes of the spill.

(b) The rate and estimated size of the spill should be based upon maximum anticipated loading and discharge rates, the time required to stop flow of cargo in the event of tank overfill or a piping/hose failure, and the time necessary to begin application of dilution water with actuation at the cargo-control location or on the navigating bridge.

4.20.24 Hydrogen peroxide should be stabilized to prevent decomposition. A certificate of stabilization should be provided by the manufacturer specifying;

(a) name and amount of stabilizer added;

(b) date stabilizer was added and duration of effectiveness;

(c) any temperature limitations qualifying the stabilizer's effective lifetime;

(d) the action to be taken should the product become unstable during the voyage.

4.20.25 Only those hydrogen peroxide solutions which have a maximum decomposition rate of 1.0% per year at 25°C should be carried. Certification from the shipper that the product meets this standard should be presented to the master and kept on board. A technical representative of the manufacturer should be on board to monitor the transfer operations and have the capability to test the stability of the hydrogen peroxide. He should certify to the master that the cargo has been loaded in a stable condition.

4.20.26 Protective clothing that is resistant to hydrogen peroxide should be provided for each crew member involved in cargo-transfer operations. Protective clothing should include coveralls that are nonflammable, suitable gloves, boots and eye protection.

4.20.27 During transfer of hydrogen peroxide, the related piping system should be separate from all other systems. Cargo hoses used for transfer of hydrogen peroxide should be marked "FOR HYDROGEN PEROXIDE TRANSFER ONLY".

4.21 Sodium chlorate solution, 50% or less

4.21.1 Tanks and associated equipment which have contained this product may be used for other cargoes after thorough cleaning by washing or purging.

4.21.2 In the event of spillage of this product, all spilled liquid should be thoroughly washed away without delay. To minimize fire risk, spillage should not be allowed to dry out.

4.22 Alkyl (C_7 – C_9) nitrates, all isomers

4.22.1 The carriage temperature of the cargo should be maintained below 100°C to prevent the occurrence of a self-sustaining exothermic decomposition reaction.

4.22.2 The cargo may not be carried in independent pressure vessels permanently affixed to the vessel's deck unless:

.1 the tanks are sufficiently insulated from fire; and

.2 the vessel has a water deluge system for the tanks such that the cargo temperature is maintained below 100°C and the temperature rise in the tanks does not exceed 1.5° C/h for a fire of 650°C (1,200°'F).

4.23 Temperature sensors

Temperature sensors should be used to monitor the cargo pump temperature to detect overheating due to pump failures.

Chapter V - Operational requirements

5.1 Maximum allowable quantity of cargo per tank

5.1.1 The quantity of a cargo required to be carried in a type 1 ship should not exceed 1,250 m3 in any one tank.

5.1.2 The quantity of a cargo required to be carried in a type 2 ship should not exceed 3,000 m3 in any one tank.

5.2 Cargo information

5.2.1 A copy of this Code or national regulations incorporating the provisions of the Code should be on board every ship covered by this Code.

5.2.2 Information should be on board and available to all concerned, giving the necessary data for the safe carriage of the cargo. Such information should include a cargo-stowage plan to be kept in an accessible place, indicating all cargo on board, including each dangerous chemical carried:

(a) a full description of the physical and chemical properties, including reactivity, necessary for the safe containment of the cargo;

(b) action to be taken in the event of spills or leaks;

(c) countermeasures against accidental personal contact;

(d) fire-fighting procedures and fire-fighting media; and

(e) procedures for cargo transfer, tank cleaning, gas-freeing and ballasting;

(f) for those cargoes required to be stabilized or inhibited in accordance with sections 4.4 and 4.10 respectively, the cargo should be refused if the certificate required by 4.4 or 4.10.3 is not supplied.

5.2.3 If sufficient information necessary for the safe transportation of the cargo is not available, the cargo should be refused.

5.2.4 Cargoes which evolve highly toxic imperceptible vapours should not be transported unless perceptible additives are introduced into the cargo.

5.2.5 Where column m in the table of chapter VI refers to this paragraph, the cargo's viscosity at 20°C should be specified on a shipping document and if the cargo's viscosity exceeds 25 mPa.s at 20°C, the temperature at which the cargo has a viscosity of 25 mPa.s should be specified in the shipping document.

5.2.6 Where column m in the table of chapter VI refers to this paragraph, the cargo's viscosity at ZO°C should be specified on a shipping document and, if the cargo's viscosity exceeds 60 mPa.s at 20°C, the temperature at which the cargo has a viscosity of 60 mPa.s should be specified in the shipping document.

5.2.7 Where column *m* in the table of chapter VI refers to this paragraph and the possibility exists that it will be unloaded within Special Areas *, the cargo's viscosity at 20"C should be specified on a shipping document and, if the cargo's viscosity exceeds 25 mPa.s at 20°C, the temperature at which the cargo has a viscosity of 25 mPa.s should be specified in the shipping document.

* Special areas are defined in regulation 7(7) of Annex II to MARPOL 73/78.

5.2.8 Where column *m* in the table of chapter VI refers to this paragraph, the cargo's melting point should be indicated in the shipping document.

5.3 Personnel training

5.3.1 All personnel should be adequately trained in the use of protective equipment and have basic training in the procedures appropriate to their duties necessary under emergency conditions.

5.3.2 Personnel involved in cargo operations should be adequately trained in handling procedures.

5.3.3 Officers should be trained in emergency procedures to deal with conditions of leakage, spillage or fire involving the cargo and a sufficient number of them should be instructed and trained in essential first aid for cargoes carried.

5.4 Tank entry

5.4.1 Personnel should not enter cargo tanks, void spaces around such tanks, cargo-handling spaces, or other enclosed spaces unless:

(a) the compartment is free of toxic vapours and not deficient in oxygen; or

(b) personnel wear breathing apparatus and other necessary protective equipment and the entire operation is under the close supervision of a responsible officer.

5.4.2 Personnel should not enter such spaces when the only hazard is of a purely flammable nature except under the close supervision of a responsible officer.

5.5 Openings in cargo tanks

During handling and carriage of cargoes producing flammable and/or toxic vapours, or when ballasting after the discharge of such cargo, or when loading cargo, cargo-tank lids should always be kept closed. With any hazardous cargo, cargo-tank lids, ullage and sighting ports, tank washing access covers should be open only when necessary.

5.6 Tank heating coil returns

Where the method described in 2.15.6(c) is used for heating or cooling in cargo tanks that may contain toxic products, the coil return should be tested not only at the commencement of heating or cooling of a toxic product but also on the first occasion the coil is used subsequent to having carried an unheated or uncooled toxic cargo.

5.7 Additional operational requirements

Additional operational requirements are found in the following paragraphs of the Code:

2.6.1	4.51	4.7.15	4.19.3
2.6.2(a) and (b)	4.54	4.7.17	4.19.5
2.6.4	4.5.6	4.7.18	4.1 9.6
2.15.2	4.5.1 1	4.7.19	4.19.9
2.21.1	4.6.1	4.7.20	4.20.3
2.21.2	4.6.3	4.7.21	4.20.5
3.1 1.1	4.6.4	4.7.22	4.20.8
3.11.2	4.7.1	4.8.4	4.20.12
3.16	4.7.2	4.8.5	4.20.15

3.17	4.7.6	4.8.6	4.20.16
4.1.1	4.7.8	4.9.3(a)	4.20.21
4.1.7	4. 7.9	4.10.1	4.20.25
4.1.8	4. 7.10	4.10.3	4.20.27
4.2.7	4. 7.11	4.10.6	4.21.1
4.3.1	4.7.12	4.18	4.21.2
4.4	4.7.13	4.19.2	

Chapter VA - Additional measures for the protection of the marine environment

5A.1 General

5A.1.1 The requirements of this chapter apply to ships carrying products noted as category A, B or C noxious liquid substances in chapter VI.

5A.2 Condition of carriage

5A.2.1 The condition of carriage for products listed in the Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk should reflect the requirements of regulation 5A of Annex II of MARPOL 73/78.

5A.2.2 A category B substance with a melting point equal to or greater than 15`C should not be carried in a cargo tank any boundary of which is formed by the ship's shell plating and should only be carried in a cargo tank fitted with a cargo heating system. *

* When 5A.2.2 is referred to in column *w* in the table of chapter VI for a product but the melting point of the cargo is less than 15°C, the requirements of 5A.2.2 need not apply. The melting point of the cargo should be specified in the shipping document.

5A.3 Procedures and Arrangements Manual

5A.3.1 Each ship should be provided with a Procedures and Arrangements Manual developed for the ship in accordance with the provisions of the Standards for Procedures and Arrangements and approved by the Administration.

5A.3.2 Each ship should be fitted with equipment and arrangements identified in its Procedures and Arrangements Manual.

Chapter VI - Summary of minimum requirements

The summary of minimum requirements of the products covered by the Code is set out in chapter 17 of the IBC Code.

For the purpose of application of the minimum requirements under this Code, the cross-references in the IBC Code shown in the left-hand column of the following table should be taken to mean references to the BCH Code shown in the right-hand column. Where a reference is made in the BCH Code to column *m* in the table of chapter VI it should be taken to mean any of the columns *m*, *n* and *o* in the table of chapter 17 of the IBC Code.

IBC/BCH Codes cross-references to the requirements

IBC Code chapter 17 items	IBC Code reference*	BCH Code reference**
Ship type (*column e*)		
1 = ship type 1	(2.1.2)	(2.2.4(a))
2 = ship type 2	(2.1.2)	(2.2.4(b))
3 = ship type 3	(2.1.2)	(2.2.4(c))
Tank type (*column f*)		
1 = independent tank	(4.1.1)	(2.3.2)
2 = integral tank	(4.1.2)	(2.3.1)
C = gravity tank	(4.1.3)	(2.4)
P = pressure tank	(4.1.4)	-
Tank environmental control (*column h*)		
Inert: inerting	(9.1.2.2)	(2.19.2(a))
Pad: liquid or gas	(9.1.2.2)	(2.19.2(b))
Dry: drying	(9.1.2.3)	(2.19.2(c))
Vent: natural or forced	(9.1.2.4)	(2.19.2(d))
Electrical equipment (*column i*)		
NF: non-flammable product	(10.1.6)	Standard electrical system
Yes: Flashpoint exceeding 60°C (closed-cup)	(10.1.6)	Standard electrical system
No: Product having a flash-point not exceeding 60°C (closed-cup)	(10.1.6)	Special electrical systems
Gauging (*column j*)		
O: open gauging	(13.1.1.1)	Open device (3.9(a))
R: restricted gauging	(13.1.1.2)	Restricted device (3.9(b))
C: closed gauging	(13.1.1.3)	Closed device (3.9 (c)
I: indirect gauging	(13.1.1.3)	Indirect device (3.9(d))
Materials of construction (*column m*)		
	N1	4.12.1
	N2	4.12.2
	N3	4.12.3
	N4	4.12.4
	N7	4.12.5
	N6	4.12.8

N7	4.12.9
N8	4.12.1, except copper and copper alloys may be used
Z	-
Y 1	4.12.6
Y2	4.12.7(a)
Y3	4.12.7(b)
Y4	4.12.10
Y5	4.12.6 except aluminium is not permitted

Respiratory and eye protection (*column n*)

E: see 14.2.8	3.16.10

* Numbers in parentheses refer to the sections of the text that are cited in the explanatory notes in chapter 17 of the IBC code.
** Numbers in parentheses refer to sections of the text of the BCH Code corresponding to the equivalent sections of the IBC Code.

IBC Code chapter 17 items	IBC Code reference	BCH Code reference
Special requirements (*column o*)		
	15.1	4.4
	15.2	4.19
	15.3	4.1
	15.4	4.2
	15.5.1-13	4.20.1-14
	15.5.14-26	4.20.15-27
	15.6	4.6
	15.7	4.5
	5.8	4.7
	15.9	4.21
	15.10	4.3
	15.11	4.8
	15.12	4.9
	15.13	4.10
	15.14	4.11
	15.16.1	4.15.1
	15.16.2	4.15.2
	15.17	4.13.1
	15.18	4.13.2
	15.19	4.14
	15.19.6	4.14.1
	15.20	4.22
	15.21	4.23
	16.2.6	5.2.5
	16.2.7	5.2.6
	16.2.8	5.2.7
	16.2.9	5.2.8
	16.6	4.18
	16A.2.2	5A.2.2

Chapter VII - List of chemicals to which the Code does not apply

The list of chemicals which have been reviewed for their safety and pollution hazards and determined not to present hazards to such an extent as to warrant the application of the Code is set out in chapter 18 of the IBC Code.

Chapter VIII - Transport of liquid chemical wastes

8.1 Preamble

8.1.1 Maritime transport of liquid chemical wastes could present a threat to human health and to the environment,

8.1.2 Liquid chemical wastes should, therefore, be transported in accordance with relevant international conventions and recommendations and, in particular, where it concerns maritime transport in bulk, with the requirements of this Code.

8.2 Definitions

For the purpose of this chapter:

8.2.1 *Liquid chemical wastes* are substances, solutions or mixtures, offered for shipment, containing or contaminated with one or more constituents which are subject to the requirements of this Code and for which no direct use is envisaged but which are carried for dumping, incineration or other methods of disposal other than at sea.

8.2.2 *Transboundary movement* means maritime transport of wastes from an area under the national jurisdiction of one country to or through an area under the national jurisdiction of another country, or to or through an area not under the national jurisdiction of any country, provided at least two countries are concerned by the movement.

8.3 Applicability

8.3.1 The requirements of this chapter are applicable to the transboundary movement of liquid chemical wastes in bulk by seagoing ships and should be considered in conjunction with all other requirements of this Code.

8.3.2 The requirements of this chapter do not apply to:

.1 wastes derived from shipboard operations which are covered by the requirements of MARPOL 73/78;

.2 liquid chemical wastes carried by ships engaged in the incineration of such wastes at sea which are covered by chapter 19 of the IBC Code; and

.3 substances, solutions or mixtures containing or contaminated with radioactive materials which are subject to the applicable requirements for radioactive materials.

8.4 Permitted shipments

8.4.1 Transboundary movement of wastes is permitted to commence only when:

.1 notification has been sent by the competent authority of the country of origin, or by the generator or exporter through the channel of the competent authority of the country of origin, to the country of final destination; and

.2 the competent authority of the country of origin, having received the written consent of the country of final destination stating that the wastes will be safely incinerated or treated by other methods of disposal, has given authorization to the movement.

8.5 Documentation

8.5.1 In addition to the documentation specified in 5.2 of this Code, ships engaged in transboundary movement of liquid chemical wastes should carry on board a waste movement document issued by the competent authority of the country of origin.

8.6 Classification of liquid chemical wastes

8.6.1 For the purpose of the protection of the marine environment, all liquid chemical wastes transported in bulk should be treated as Category A noxious liquid substances, irrespective of the actual evaluated category.

8.7 Carriage and handling of liquid chemical wastes

8.7.1 Liquid chemical wastes should be carried in ships and cargo tanks in accordance with the minimum requirements for liquid chemical wastes specified in chapter 17 of the IBC Code, unless there are clear grounds indicating that the hazards of the wastes would warrant:

.1 carriage in accordance with the ship type 1 requirements; or

.2 any additional requirements of this Code applicable to the substance or, in the case of a mixture, its constituent presenting the predominant hazard.

Appendix

Model form of Certificate of Fitness
for the Carriage of Dangerous
Chemicals in Bulk *

CERTIFICATE OF FITNESS FOR THE CARRIAGE OF DANGEROUS CHEMICALS IN BULK

(Official seal)

Issued in pursuance of the

IMO CODE FOR THE CONSTRUCTION AND EQUIPMENT
OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK
(resolutions MEPC.20(22) and MSC.9(53))[1]

under the authority of the Government of

(full official designation of country)

by

(full official designation of the competent person or
organization recognized by the Administration)

Name of ship	Distinctive Number or letters	Port of registry	Gross tonnage	Ship type (Code paragraph 2.2.4)[2]

Date on which keel was laid or on which the ship was at a similar stage of construction or (in the case of a converted ship) date on which conversion to chemical tanker was commenced:

Date on which the building contract was placed:

* The Certificate should be drawn up in the official language of the issuing country. If the language used is neither English nor French, the text should include a translation into one of these languages.

THIS IS TO CERTIFY

1 (i) That the ship has been surveyed in accordance with the provisions of section 1.6 of the Code;

(ii) that the survey showed that the construction and equipment of the ship:

*(a) complied with the relevant provisions of the Code applicable to ships referred to in 1.7.2;

*(b) complied with the provisions of the Code applicable to ships referred to in 1.7.3.

2 That the ship has been provided with a manual in accordance with the standards for procedures and arrangements as called for by regulations 5, 5A and 8 of Annex II of MARPOL 73/78, and that the arrangements and equipment of the ship prescribed in the manual are in all respects satisfactory and comply with the applicable requirements of the said Standards;

3 That the ship is suitable for the carriage in bulk of the following products, provided that all relevant operational provisions of the Code are observed:

Products [3, 4]	Conditions of carriage [5, 6] (tank numbers, etc.)

* Continued on the annexed signed and dated sheet(s) numbered 1A.

* Tank numbers referred to in this list are identified on the annexed signed and dated tank plan numbered 2A.

4 That in accordance with 1.7.3/2.2.5 * the provisions of the Code are modified in respect of the ship in the following manner:

*Delete as appropriate.

5 That the ship must be loaded:

* (a) in accordance with the loading conditions provided in the approved loading manual, stamped and dated .,.....,.... ..... and signed by a responsible officer of the Administration, or of an organization recognized by the Administration;

* (b) in accordance with the loading (imitations appended to this Certificate.

Where it is required to load the ship other than in accordance with the above instruction, then the necessary calculations to justify the proposed loading conditions should be communicated to the certifying Administration who may authorize in writing the adoption of the proposed loading condition. **

This Certificate is valid until
subject to surveys in accordance with 1.6 of the Code

Issued at ..... 19 ....
(place of issue, of Certificate)

The undersigned declares that he is duly authorized by the said Government to issue this Certificate.

(signature of official issuing the Certificate and/or seal of issuing authority)

Notes on completion of Certificate

[1] The Certificate can be issued only to ships entitled to fly the flags of States which are Parties tc MARPOL 73/78.

[2] Ship type: Any entry under this column must relate to all relevant recommendations, e.g. an entry “type 2” should mean type 2 In ail respects prescribed by the Code This column would not usually apply in the case of an existing ship and in such a case should be noted “See paragraph 1(ii)(b)"

[3] Products: products listed in chapter VI of the Code, or which have been evaluated by the Administration in accordance with 1-8 of the Code, should be listed. In respect of the latter “new” products, any special requirements provisionally prescribed should be noted.

[4] Products: The list of products the ship is suitable to carry should include the noxious liquid substances of category D which are not covered by the Code and should be identified as “chapter VII category D”.

[5] Conditions of carriage: The limitations on the carriage of category B or category C substances under 5A.2 of the Code should also be indicated

[6] Conditions of carriage: If a Certificate is issued to a ship which is modified in accordance with the provision of regulation 1(12) of Annex II to MARPOL 73/78 the Certificate should indicate in the top of the table of products and conditions of carriage the following statement “This ship is certificated to carry only pollution hazard chemicals”

* Delete as appropriate.

** Instead of being incorporated in the Certificate, this text may be appended to the Certificate if duly signed and stamped.

ENDORSEMENT FOR ANNUAL AND INTERMEDIATE SURVEYS

THIS IS TO CERTIFY that at a survey required by 1.6 of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, the ship was found to comply with the relevant provisions of the Code.

Annual survey.

Signed:
(signature of duly authorized official)

Place:

Date:

(seal or stamp of the Authority, as appropriate)

Annual*/Intermediate* survey:

Signed:
(signature of duly authorized official)

Place:

Date:

(seal or stamp of the Authority, as appropriate)

Annual*/Intermediate* survey:

Signed:
(signature of duly authorized official)

Place:

Date:

(seal or stamp of the Authority, as appropriate)

Annual survey.

Signed:
(signature of duly authorized official)

Place:

Date:

(seal or stamp of the Authority, as appropriate)

* Delete as appropriate.

ATTACHMENT 1A TO THE CERTIFICATE OF FITNESS
FOR THE CARRIAGE OF DANGEROUS CHEMICALS IN BULK

Continued list of products to those specified in section 3, and their conditions of carriage.

Products	Conditions of carriage (tank numbers, etc.)

Date
(as for Certificate)

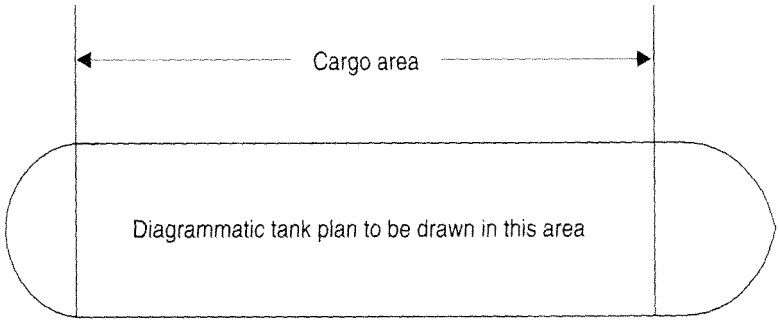
(signature of official issuing the Certificate and/or seal of issuing authority)

ATTACHMENT 2A TO THE CERTIFICATE OF FITNESS
FOR THE CARRIAGE OF DANGEROUS CHEMICALS IN BULK

TANK PLAN (specimen)

Name of ship,

Distinctive number or letters



Date
(as for Certificate)

(Signature of official issuing
the Certificate and/or seal
of Issuing authority)

Decisions of the MSC and MEPC

Criteria for hazard evaluation of bulk chemicals
(approved by the MSC at its forty-second session, 1980, and by the MEPC at its twentieth session, 1984)

1 Introduction

1.1 The criteria are intended for use when considering chemicals for inclusion in chapter VI and for assigning appropriate special requirements. They should also be used by Administrations for preliminary evaluation of products which are not included in the Code, pending their consideration by the Subcommittee on Bulk Chemicals.

1.2 Although the criteria have been developed to identify chemicals which appear to require special precautions, they should not be used as absolutes. Human experience must always be taken into account. A certain amount of flexibility is allowable in dealing with products which human experience shows may present greater or lesser hazards than the evaluation system suggests.

1.3 For a number of products the suggested numerical values will need adjustment to account for such physical properties as vapour pressure, solubility and density. For example, in estimating the inhalation hazard, the LC_{50} will provide a relative idea of the vapour toxicity but the chemical's volatility and odour characteristics also need to be considered for a realistic hazard assessment. Products which are volatile and offer little warning that their vapours are harmful (chloroform, benzene) are more dangerous than those having a low vapour pressure at ambient temperatures and a distinct odour (propionic acid, ethanolamine). Products with a higher LC_{50} should also be considered, if they are less dense than water and of low solubility, since they will float if spilled from a damaged tank and present a much greater inhalation hazard than those which are more dense and sink. Similarly, the LD_{50} (oral) cannot be used as the sole criterion for judging the hazard from ingestion; products which are soluble in water and do not have a pronounced taste or odour are more likely to be ingested in larger doses. For this reason, products with a somewhat lower LD_{50} but which have a very low solubility in water, or a distinct taste, should not be included. Finally, with regard to derma) toxicity, some products are absorbed rapidly through the skin or absorbed with very little or no irritation (phenol, aniline). Products with these characteristics but a somewhat higher LD_{50} (dermal) should be included.

1.4 The following criteria are intended for guidance only, and a certain flexibility of approach must be allowed for products which in reality may present greater or lesser hazards than the evaluation system suggests. For this reason, experience and good judgement are necessary.

PART A - SAFETY HAZARDS

2 Minimum hazard criteria

2.1 Chemicals which fall into one or more of the following categories should be considered hazardous, and be included in chapter VI.

.1 Significantly toxic by inhalation - LC_{50} (1 h, rats) less than or equal to 2,000 ppm, taking volatility into account.

.2 Significantly toxic by oral ingestion - LD_{50} less than or equal to 1,000 mg/kg (oral, rat). Factors such as solubility and taste should be taken into account.

.3 Significantly toxic by skin absorption - LD_{50} less than or equal to 1,200 mg/kg (dermal, rabbit). Products with a somewhat higher LD_{50} but which are absorbed with very little or no irritation should be included.

.4 Inhalation of vapours is known to cause allergic sensitization, leading to serious or long-term effects.
.5 Intermittent exposure to vapours over an extended period of time is known to cause moderate to severe injury.

.6 Liquids that are corrosive to the skin, i.e., liquids that cause visible necrosis of the skin tissue at the site of contact when tested on the intact skin of an animal for a period of up to 4 hours.

.7 Liquids that are skin sensitizers, leading to serious or long-term effects.

.8 Liquids that are sufficiently reactive with water to cause a hazard, due to the production of gas, aerosols or large amounts of heat.

.9 Inhibition, stabilization, refrigeration or tank environmental control required to prevent hazardous reactivity.

.10 Auto-ignition temperature below 200°C (ASTM D2155-66; DIN 51 794).

.11 Flashpoint below 23°C (closed-cup) and difference between upper and lower limits of flammability (expressed as a percentage by volume in air) exceeds 20%.

.12 Severely corrosive to the materials of normal ship construction (principally steel) such as to endanger the integrity of the ship.

2.2 Products that meet one or more of the criteria listed in 2.1.1 to 2.1.12 inclusive are to be further evaluated to determine the required standard of containment, etc. It should be understood that only if a substance is brought within the scope of the Code by satisfying one of the minimum requirements above is it then appropriate to apply the further criteria as set out in 3 to determine the required standard of containment, etc.

3 Criteria for summary of minimum requirements

Except where otherwise stated, products that meet one or more of the criteria under each requirement will be considered for the assignment of that requirement.

3.1 Ship type

3.1.1 *Type 1*

.1 Substances with particularly severe toxicity risks. (Products with toxicity risks too severe for type 2 ships and determined on a case-by-case basis to be appropriate for type 1 ships. Substances determined to be too toxic for type 1 ships should be prohibited in bulk shipment.)

.2 Extremely reactive with water, producing large quantities of toxic or corrosive gas or aerosols (e.g. chlorosulphonic acid).

.3 Very severe flammability characteristics, i.e.:

.3.1 auto-ignition temperature below 65"C (ASTM D2155-66; DIN 51 794); or

.3.2 difference between the limits of flammability (expressed as a percentage by volume in air) exceeds 50%.

3.1.2 *Type 2*

.1 Moderately to highly toxic products (meets one or more of the following criteria):

.1.1 LD_{50} (oral, rats) equal to or less than 300 mg/kg;

.1.2 LD_{50} (dermal, rabbits) equal to or less than 600 mg/kg;

.1.3 LD_{50} (1 h, rats) equal to or less than 1,000 ppm, taking volatility into account;

.2 Highly reactive with water, producing toxic or corrosive gas or aerosols (e.g. oleum).

.3 Severe flammability characteristics, i.e.:

.3.1 auto-ignition temperature below 200°C (ASTM D2155-66; DIN 51 794); or

.3.2 difference between the limits of flammability exceeds 40%.

3.1.3 *Type 3* - All other bulk liquids meeting the minimum hazard criteria.

3.2 Tank type

3.2.1 *Independent gravity - 1G*

.1 Extremely toxic by inhalation, i.e. LC_{50} (1 h, rats) less than 200 ppm, with adjustments upwards or downward depending on volatility.

.2 Severely toxic by skin absorption - LD_{50} (dermal, rabbits) less than 200 mg/kg.

.3 Auto-ignition temperature below 65°C (ASTM D2155-66; DIN 51 794).

.4 Difference between the limits of flammability exceeds 40%.

.5 Required because of specific structural considerations (e.g. molten sulphur, hydrochloric acid).

.6 Extremely reactive with water, producing large quantities of toxic or corrosive gas or aerosols.

3.2.2 *Integral gravity - 2G*

All other bulk liquids.

3.3 Venting device

3.3.1 *Controlled*

.1 Significantly toxic by inhalation – LC_{50} (1 h, rats) less than or equal to 2,000 ppm, taking volatility into account.

.2 Intermittent exposure to vapours over an extended period of time is known to cause moderate to severe injury.

.3 Inhalation of vapours is known to cause allergic sensitization.

.4 Cargo requiring inertion.

.5 Flashpoint equal to or less than 60°C (closed-cup).

.6 Corrosive vapours.

3.3.2 *Open*

All other bulk products.

3.4 Gauging device

3.4.1 *Closed*

.1 Highly to severely toxic by inhalation (acute) – LC_{50} (1 h, rats) less than 1,000 ppm, taking volatility into account.

.2 Intermittent exposure to vapours over an extended period of time is known to cause severe injury.

.3 Inhalation of vapours is known to cause allergic sensitization, leading to serious or long-term effects,

.4 Highly to severely toxic by skin absorption - LDS0 (dermal, rabbits) less than 600 mg/kg.

.5 Severely corrosive vapours.

3.4.2 *Restricted*

.1 Significantly to moderately toxic by inhalation (acute) – LC_{50} (1 h, rats) less than or equal to 2,000 ppm, but not less than 1,000 ppm, taking volatility into account.

.2 Intermittent exposure to vapours over an extended period of time is known to cause moderate injury.

.3 Inhalation of vapours is known to cause allergic sensitization.

.4 Cargo requiring inertion.

.5 Corrosive vapours.

.6 Flashpoint equal to or less than 60°C (closed-cup).

3.4.3 *Open*

All other bulk products.

3.5 Tank environment control

3.5.1 *Inert*

.1 Cargo is air-reactive, resulting in a hazardous situation, e.g. peroxide formation.

.2 Auto-ignition temperature below 200°C (ASTM D2155-66; DIN 51 794).

.3 Difference between the limits of flammability (expressed as a percentage by volume in air) exceeds 40%.

3.5.2 *Dry*

Product is reactive with water vapour, leading to a dangerous situation.

3.6 Toxic-vapour-detection equipment
(required on board the vessel)

3.6.1 Significantly toxic by inhalation – LC_{50} (1 h, rats) less than or equal to 2,000 ppm, taking volatility into account.

3.6.2 Inhalation of vapours is known to cause allergic sensitization, leading to serious or long-term effects.

3.6.3 Intermittent exposure to vapours over an extended period of time is known to cause moderate to severe injury

3.7 Cargo-tank overflow protection

3.7.1 *High-level alarm and a tank overflow control system (free from manual intervention)*

.1 Highly to severely toxic products (meets one or more of the following criteria):

.1.1 LD_{50} (oral, rats) less than 300 mg/kg;

.1.2 LD_{50} (dermal, rabbits) less than 600 mg/kg;

.1.3 LC_{50} (1 h, rats) less than 1,000 ppm, taking volatility into account.

.2 Inhalation of vapours is known to cause allergic sensitization, leading to serious or long-term effects.

.3 Highly corrosive liquids, i.e. liquids that cause visible necrosis of the skin tissue at the site of contact when tested on the intact skin of an animal for a period of up to 3 minutes, e.g. oleum, chlorosulphonic acid.

.4 Auto-ignition temperature below 200°C (ASTM D2155-66; DIN 51 794).

.5 Difference between the limits of flammability (expressed as a percentage by volume in air) exceeds 40%.

3.7.2 *High-level alarms only*

.1 Significantly toxic products (meets one or more of the following criteria):

.1.1 LC_{50} (1 h, rats) less than or equal to 2,000 ppm, taking volatility into account;

.1.2 LD_{50} (oral, rats) less than or equal to 1,000 mg/kg;

.1.3 LD_{50} (dermal, rabbits) less than or equal to 1,200 mg/kg.

.2 Inhalation of vapours is known to cause allergic sensitization.

.3 Corrosive liquids, i.e. liquids that cause visible necrosis of the skin tissue at the site of contact when tested on the intact skin of an animal for a period of between 3 and 60 minutes.

.4 Flashpoint equal to or less than 60°C (closed-cup).

3.8 Toxic products

3.8.1 *Exhaust openings of tank vent systems*

.1 LC_{50} (1 h, rats) less than 1,000 ppm, taking volatility into account.

.2 Intermittent exposure to vapours over an extended period of time is known to cause moderate to severe injury.

.3 Inhalation of vapours is known to cause allergic sensitization.

3.8.2 *Stowage, piping and venting*

.1 LC_{50} (1 h, rats) less than or equal to 2,000 ppm, taking volatility into account.

.2 LD_{50} (oral, rats) less than or equal to 300 mg/kg.

.3 LD_{50} (dermal, rabbits) less than or equal to 600 mg/kg.

3.9 Pump-rooms

3.9.1 *Increased pump-room ventilation*

.1 Highly to severely toxic by inhalation, i.e. LC_{50} (1 h, rats) less than or equal to 1,000 ppm, taking volatility into account.

.2 Intermittent exposure to vapours over an extended period of time is known to cause moderate to severe injury.

.3 Inhalation of vapours is known to cause allergic sensitization.

.4 Corrosive or severely irritating vapours.

3.9.2 *Location or pump or pump-room*

Special consideration, taking into account severe inhalation toxicity risks.

3.10 Respiratory and eye protection

3.10.1 Highly to severely toxic by inhalation (acute) - LC_{50} (1 h, rats) less than 1,000 ppm, taking volatility into account. Highly narcotic substances are also to be considered.

3.10.2 Inhalation of vapours is known to cause allergic sensitization, leading to serious or long-term effects.

3.10.3 Corrosive or severely irritating vapours.

3.10.4 Highly reactive with water, producing toxic or corrosive gas or aerosols (e.g. oleum).

PART B - MARINE POLLUTION HAZARD

4 Minimum hazard criteria

Substances, the marine pollution hazards of which have been evaluated by GESAMP* and found to meet one or more of the following categories, should be considered hazardous and be included in chapter 17 of the IBC Code (chapter VI of the Bulk Chemical Code):

.1 bioaccumulated with attendant risk to aquatic life or human health or liable to cause tainting to the seafood (+, Z or T in column A of the GESAMP hazard profile);

.2 toxic to aquatic life - 96 h TL_m less than 100 mg/1 (2, 3 or 4 in column B);

.3 practically non-toxic to aquatic life - 96 h TL_m less than 1,000 mg/l (1 in column B) when the substance presents hazards to human health – LD_{50} (laboratory mammal) less than 500 mg/kg (2 in column C) and is moderately objectionable because of smell or poisonous or irritant characteristics (XX in column E).

* GESAMP is the IMO/EAO/UNESCO/WMO/WHO/IAEA/UN/UNEP joint Group of Experts on the Scientific Aspects of Marine Pollution. The rationale for the hazard evaluation is contained in GESAMP Reports and Studies No. 17 (1982).

5 Criteria for summary of minimum requirements

Unless a substance has been assigned higher criteria from the evaluation of its safety hazards, substances that meet one or more of the criteria under each requirement will be considered for the assignment of that requirement.

5.1 Ship type

5.1.1 *Type 1*

.1 Substances which are bioaccumulated to a significant extent and are known to produce a hazard to aquatic life or human health (+ in column A of the GESAMP hazard profile) and which are highly toxic to living resources (4 in column B); or

.2 Substances which are bioaccumulated to a significant extent and are known to produce a hazard to aquatic life or human health (+ in column A) * and which cause severe reduction of amenities (XXX in column E); or

.3 Substances which are liable to cause tainting of seafood Tin column A)* and which are highly toxic to living resources (4 in column B).

* See footnote to the table in the note.

5.1.2 *Type 2*

.1 Substances which are bioaccumulated to a significant extent and are known to produce a hazard to aquatic life or human health (+ in column A) except those in type 1 above; or

.2 Substances which are bioaccumulated with attendant risk to aquatic organisms or human health, however with short retention of the order of one week or less (Z in column A) and which are highly or moderately toxic to living resources (4 or 3 in column B); or

.3 Substances which are bioaccumulated with attendant risk to aquatic organisms or human health, but with short retention of the order of one week or less (Z in column A) and which cause severe reduction of amenities (XXX in column E).

.4 Substances which are liable to cause tainting of seafood (T in column A) * except those in type 1 above; or

.5 Substances which are highly toxic to living resources (4 in column B); or

.6 Substances which are moderately toxic to living resources (3 in column B) and which cause severe reduction of amenities (XXX in column E).

* See footnote to the table in the note.

5.1.3 *Type 3*

All substances which do not fall under the criteria for ship types 1 and 2 above but which have been allocated with pollution categories A, B and C in accordance with appendix I to Annex II of MARPOL 73/78.

5.2 Cargo-tank overflow protection

5.2.1 *High-level alarm and a tank overflow control system*

.1 Substances identified as appropriate for type 1 ships.

5.2.2 *High-level alarm only*

.1 Substances identified as appropriate for type 2 ships.

.2 All category A and B substances not included in 5.2.1 or 5.2.2.1.

.3 All category C substances the flashpoint of which is less than 60°C.

Note:

For ease of interpretation, the criteria detailed in 5.1 above are shown in tabular form below. Those products whose hazard profiles exhibit the complete spectrum required by any one horizontal line in the table should be restricted to carriage in the ship type prescribed (or in ships offering even better protection).

Ship type	Bioaccumulation and tainting A	Damage to living resources B	Reduction of Amenities E
1	+ + T*	4 4	XXX
2	+ Z Z Z T* O O	 4 3 4 3	 XXX XXX
3	All other substances falling under pollution categories A, B and C.	All other substances falling under pollution categories A, B and C.	All other substances falling under pollution categories A, B and C.

T*: Substances with strong tainting properties as identified by the Sub-Committee on Bulk Chemicals at its fifteenth session. These are as follows:

Camphor oil	Dichlorophenols
Creosote (wood tar)	Ethyl acrylate
Cresols (mixed isomers)	Naphthalene
Carbolic oil	alpha-Methylnaphthalene
Dichloroethyl ether	Naphthenic acids

Recommendation on uniform interpretation of the application of 2.7.1 and 2.7.3 of the Bulk Chemical Code to existing chemical tankers

(approved by the MSC at its thirty-ninth session, 1978)

1 Paragraph 2.7.1

1.1 In implementing the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk ;BCH Code/Bulk Chemical Code) with respect to existing chemical tankers built before the effective date of the Code (in the following, referred to as "existing chemical tankers"), the application of 1.7.3(d)(i) * of the Code became a problem at the implementation dated 12 April 1978 inasmuch as the Code states that "full compliance with 2.7.1 would not be expected" for existing chemical tankers. The intent of this provision was inter alia to allow existing chemical tankers with midship houses to continue to operate without having to comply fully with 2.7.1. This phrase implies, however, that a total waiver of 2.7.1 was not intended. To provide guidance to Administrations applying 1.7.3(d)(i)" to existing chemical tankers, the following uniform interpretation applies:

* As a result of amendments to the Code, these now refer to paragraph 1.7.3(f).

1.2 Existing chemical tankers constructed with an accommodation space (i.e. midship house) located within the boundaries of the cargo area may continue to operate with such an arrangement. When flammable and/or toxic cargoes are permitted to be carried in the cargo tanks below the midship house, the following conditions should be met:

.1 Accommodation spaces are not allowed in the space bounded by the cargo-tank tops and the first deck of the midship house. (Hereafter, this space will be referred to as the "bridge space".)

.2 Cargo-tank tops forming the boundary of the bridge space should be free of any deck penetrations. Cargo-tank hatches, butterworth openings, deepwell pumps, ullage openings, sounding tubes and any other such penetrations in the cargo-tank tops should not be permitted in this space.

.3 Electrical cable, pipe runs and other penetrations in the first deck of the midship house immediately above the cargo-tank tops are allowed provided these penetrations are made gastight. Doors, hatches and other access openings in this deck of the midship house should not be permitted.

.4 When the bridge space is bounded by a bulkhead at either side at the fore and aft end, the ventilation requirements of 3.1.2 should be met. The increased ventilation rates prescribed in 4.13.2 * are not applicable to the bridge space.

* As a result of amendments to the Code, this now refers to paragraph 4.13.1

.5 Electrical installations within the bridge space should meet the requirements of 3.5.

.6 Other than for approved connections to shutoff valves and expansion joints, cargo piping should be joined by welding.

.7 Where an existing chemical tanker has been constructed in such a manner that accommodation aft is located partially over a cargo pump-room which forms the aft end of the cargo-tank area, the chemical tank may continue to operate with such an arrangement provided that, under all conditions of cargo handling (i.e. loading, discharging, transferring) and during tank cleaning and gas-freeing, and whenever work involving equipment within the pump-room is being undertaken, the mechanical ventilation required by the Code is in operation.

2 Paragraph 2.7.3

2.1 Recognizing that many existing chemical tankers will encounter extreme difficulty in complying with 2.7.3 of the Bulk Chemical Code, the following uniform interpretation with respect to existing chemical tankers applies to 2.7.3:

.1 The requirements in 2.7.3 for the location of doors and portlights on accommodations may be waived for existing chemical tankers provided the following measures are taken:

.1.1 Portlights located on the forward bulkhead and along the house sides on the first tier up to the first door or 3.05 m (whichever is less) from the forward bulkhead of the aft deckhouse accommodation, and those on the midship house bulkheads facing the cargo area, except for wheelhouse windows, should be fixed (i.e. incapable of being opened) and gastight. Wheelhouse windows should meet the requirements of paragraph 2.7.3.

.1.2 Doors located on the forward bulkhead of the after deckhouse accommodation that lead out onto the cargo-tank deck should be permanently sealed shut. Where existing arrangements preclude this, a suitable airlock arrangement at the present door location should be provided. This airlock, when fitted, should include a gastight self-closing metal outer door and a substantially gastight self-closing inner door. The inner door should be at least a metal joiner door. The airlock space between the doors should be mechanically ventilated from a non-hazardous location and maintained at an overpressure to the space outside the airlock. An audible and visual alarm system to give warning on both sides of the airlock should be provided to indicate if more than one door is moved from the closed position.

.1.3 Doors located more than 2.4 m above the cargo-tank deck and facing the cargo-tank area should be substantially gastight and self-closing. This provision applies to doors on the aft deckhouse accommodation as well as the midship house.

.1.4 Doors leading out onto the cargo-tank deck from the bridge space of the midship house are exempt from the above requirements.

Guidelines for a uniform application of the survival requirements of the Bulk Chemical Code and the Gas Carrier Code

(approved by the MSC at its forty-second session, 1980 *)

* These guidelines were originally annex 2 of STAB XXIV/12 and later part of MSC/Circ.406/ Rev.1.

Preamble

The following should be considered as guidelines for the purpose of uniform application of the survival requirements of the Bulk Chemical Code [BCH Code] and the Gas Carrier Code. Alternative methods to the suggested specific programme of calculations and presentation which demonstrate, to the Administration's satisfaction, compliance with the applicable survival criteria may be accepted.

1 Alternative methods of calculation and presentation of ship survival capability

1.1 The parcel tanker will require a complete analysis of the limiting survival characteristics over the full range of intended loading conditions (as detailed in 2),

1.2 The dedicated service tanker will require approval of calculations based on service conditions proposed by the builder or owner, in which case the certificate of fitness should be endorsed in respect of the conditions accepted.

1.3 The inherently safe ship is one that will meet survival requirements with the ship assumed to be at a maximum draught and trim, with all compartments within the extent of damage assumed to be empty and with maximum vertical centre of gravity (adjusted for free liquids).

2 Minimum required metacentric height (GM) or maximum allowable height of the centre of gravity (KG) as a function of the draught of the parcel tanker

2.1 A systematic investigation of damage-survival characteristics should be undertaken by making calculations to obtain the minimum required GM or maximum allowable KG at a sufficient number of draughts within the operating range to permit the construction of a series of curves of "required GM" or "allowable KG" in relation to draught and cargo-tank content in way of the damage. The curves must be sufficiently comprehensive to cover operational trim requirements.

2.2 Each of the curves thus constructed relates to one position of assumed damage only and the calculations should be repeated for each damage and lesser extent of damage to be assumed at any part of the ship.

2.3 Where it can be determined by inspection that the effect of certain assumed damage will be less onerous than other assumed damage for which calculations are provided and curves prepared, then the investigation of such damage cases may be dispensed with.

2.4 The damage calculations should take account of:

> **.1** tanks in way of the assumed damage filled with liquid at increments of about 25% between empty and the maximum weight of liquid, or liquids, intended to be carried in the particular tanks under consideration;
>
> **.2** the distribution of liquids in the adjacent tanks concerned which will give the most severe result, taking into account trim;

.3 a number of draughts over the operating range, up to and including the Tropical Freeboard Mark. The fresh water freeboards need not be considered;

.4 the effect of damage involving the machinery space and adjacent tanks containing liquids over a number of draughts as in 2.4.3;

.5 the ship in either the departure or the arrival condition, whichever will give the most severe result;

.6 the ship without trim and a sufficient number of trims covering the operating range, in order to permit interpolation.

3 Particulars concerning survival capability calculations

3.1 The calculations should be based on moulded lines and include large appendages such as shaft bosses, skegs and bow thrusters.

3.2 The metacentric heights (GM), stability levers (GZ) and centre of gravity positions (KG) for judging the final survival conditions should be calculated by the constant-displacement (lost-buoyancy) method.

3.3 The calculations should be done for the ship freely trimming.

3.4 Only computer calculations acceptable to the Administration should be used.

3.5 Where the assumed damage causes the ship to trim by the stern, the ship in the intact condition should be assumed to have the largest allowable trim by the stern, consistent with operational requirements.

3.6 Where the assumed damage causes the ship to trim by the bow, the ship in the intact condition should be assumed to have the largest allowable trim by the bow, consistent with operational requirements.

3.7 Lesser extent of damage should be taken into account only where ' indicated by the presence of subdivision extending into the maximum extent of damage, e.g. double-bottom tanks, side ballast tanks, side cargo tanks, fuel - tanks and void spaces. However, the following should be given attention:

.1 *Lesser extent* means the reduction of any one of the three maximum dimensions of damage singly or in combination and also the assessment of the effect of damage affecting any combination of compartments within the maximum extent of damage.

.2 Where any damage involves the release of very heavy cargo liquid, then heel to the intact side of the ship may take place. In such cases the effect of lesser vertical extent of damage above the level of the tank top may result in the larger angle of heel, since otherwise the effect of cargo loss may be compensated by flood water entering the double-bottom tanks on the damaged side.

3.8 The number of calculations required to show compliance with survival requirements should be that necessary to obtain sufficient data for the loading manual and should be such that all loading conditions indicated in paragraph 1 can be covered, i.e. no additional calculations should be necessary once the series of calculations has been executed.

3.9 Calculations to determine the displacement, trim and the vertical position of the centre of gravity should be performed for each operational loading condition. The vertical position of the centre of gravity should be corrected for free surface effects. One method would be to construct graphs showing the free surface moments of the criterion angle for all filling levels at a specific gravity of one. The free surface moments for all tanks can then be taken from the graphs and be multiplied by the cargo specific gravity.

3.10 In calculating the effect of free surface of consumable liquids it is to be assumed that, for each type of liquid, at least one transverse pair or a single centreline tank has maximum free surface, and the tank or combination of tanks to be taken into account is to be that where the effect of free surfaces is the greatest; in each tank the centre of gravity of the contents is to be taken at the centre of volume of the tank. The remaining tanks are to be assumed either completely empty or completely filled, and the distribution of consumable liquids among these tanks is to be such as to obtain the greatest possible height above the keel for the centre of gravity.

3.11 To take account of the presence of structure within cargo compartments, a permeability of 0.45 should be assumed as stated in the Codes. Where, in particular cases, such as the cargo tanks of gas carriers, this assumption would lead to a significant discrepancy in cargo-tank volume, it is preferable to calculate the permeability taking into account actual tank structure; the volume of tank insulation should then be calculated separately and an appropriate permeability applied.

3.12 Attention should be paid to the possibility of progressive flooding through deck cargo pipes and common cargo-tank ventilation pipes if these are immersed at large angles of heel after damage. The possibility of progressive flooding through ballast piping passing through the assumed extent of damage, where positive-action valves are not fitted to the ballast system at the open ends of the pipes in the tanks served, should be considered. Where remote control systems are fitted to ballast valves and these controls pass through the assumed extent of damage, then the effect of damage to the system should be considered to ensure that the valves would remain closed in that event.

3.13 Where the ship is required to be capable of sustaining bottom damage anywhere in its length (L), the following method should be used when damage is assumed to occur in the vicinity of the 0.3L position from the forward perpendicular:

> **.1** When applying the longitudinal extent of bottom damage applicable to the foremost part of the ship, no part of the damage should be assumed to extend abaft the 0.3L position from the forward perpendicular.
>
> **.2** When applying the longitudinal extent of damage applicable to the rest of the ship's length, the damage should be assumed to extend to a foremost limit including a point at 0.3L minus 5.0 m abaft the forward perpendicular.

3.14 In ships carrying liquefied gases, large cargo tanks may be subdivided into sections by centreline and transverse bulkheads which are liquid-tight but which have openings near the top of the tank. These openings would permit spillage of cargo from one section of the cargo tank to another when the ship is heeled where the tank is undamaged, or loss of cargo due to spillage from sections of a damaged cargo tank. The effect of this spillage should be taken into account in calculations and also in any calculation of GM or KG for loading conditions where a "required GM" or "allowable KG" curve is to be used.

3.15 In ships carrying liquefied gases, the ability of longitudinal bulkheads fitted within cargo tanks to withstand the unequal pressures due to flooding of one section of cargo tank should only be considered in the final stage of flooding.

3.16 Where lubricating-oil drain tanks fitted below the main engine would be affected by the vertical extent of bottom damage, flooding of the engine-room by way of the drain tank and engine should be assumed to take place.

3.17 In ships with machinery spaces aft, the machinery space and steering gear compartment should be regarded as being common for damage purposes when any access is fitted in the after machinery-space bulkhead, unless a remotely operated sliding watertight door is fitted or the sill of the access openings fitted with hinged watertight doors which are to be kept closed at sea is at least 0.3 m above the damage waterline and will not be submerged within the minimum range of residual stability.

3.18 Where dry cargoes are carried at the same time as bulk liquid cargoes which require compliance with the requirements of the Codes then the permeability of the space carrying the dry cargo is to be ascertained.

3.19 The harmonized regulations specify that no account should be taken of cross-flooding arrangements to attain stipulated limits of heel in the final state of equilibrium after damage. However, compartments on the opposite side of a ship could be regarded as single compartments from the aspect of flooding if they were to be linked by openings or ducts of sufficiently large area. In such cases consideration should be given to the adequacy of tank air flow and to the effect of free surface.

4 Stability information and Certificate of Fitness

4.1 With regard to loading conditions to be submitted to the Administration (exclusive of the loading condition contained in loading and stability manual), the principal objective, at the stage of design evaluation, is that the Administration can satisfy itself that the calculations presented will cover all conditions of full and partial loading, including variations of draught and trim. To achieve this objective the Administration may either:

.1 require a complete analysis of survival requirements over the full range of probable loading conditions; or

.2 undertake approval on the basis of service conditions proposed by the builder or owner, in which case the Certificate of Fitness should be endorsed for the conditions accepted.

4.2 Particular attention should be paid to the provision of adequate stability data to enable the master to take into account accurately the effect of liquid heeling moments of the contents of undamaged tanks. These heeling moments vary with the specific gravity of the liquid and the percentage filling of the tanks and may change significantly in magnitude from condition to condition. Adequate information would include curves showing the variation of liquid heeling moment with the contents of each individual tank.

4.3 In addition to the usual loading information required under intact stability requirements, the master should be supplied with the following information pertaining to damage stability:

.1 data relative to loading and distribution of cargo and ballast necessary to ensure compliance with damage-survival requirements;

.2 data relative to the ship's survival capabilities;

.3 a damage-control drawing showing the position of important fittings and listing instructions for their control;

.4 data relating to the effect of free surface or liquid heeling moments of cargo tanks at all stages of filling;

.5 example calculations and standard blank forms to facilitate calculations.

4.4 The following should be stated on the Certificate of Fitness;

.1 the deepest draught or least freeboard for those loading conditions which require greater freeboard than the International Load Line Certificate (1966);

.2 the range of specific gravities of cargoes which may be carried; this relates to all cargoes;

.3 the particular cargo tanks in which certain ranges of specific gravities of cargoes may be carried, if relevant;

.4 details of fittings, valves etc., the control of which is essential for survival, together with instructions for control, operation and logging; and

.5 identification of required loading and stability manual.

Calculation of the capacity of the foam systems for chemical tankers

1 In section 3.14 of the Bulk Chemical Code concerning fire-extinguishing arrangements for cargo-tank areas (ninth set of amendments) the foam supply has to be determined in accordance with paragraphs 3.14.5 to 3.14.7. In order to provide for a correct interpretation of the requirements, the Sub-Committee on Fire Protection agreed on the following example for a calculation of foam system for a chemical tanker of 10,000 tonnes deadweight.

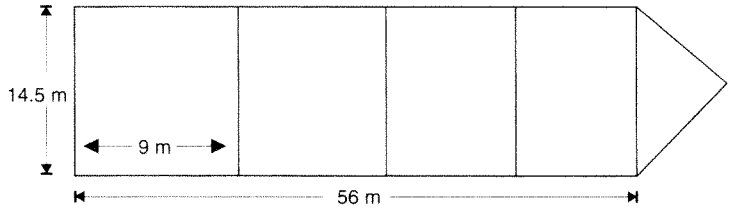
2 The Maritime Safety Committee at its forty-fourth session agreed that this example * be followed when calculating the capacity of foam systems for chemical tankers.

* This was later published as MSC/Circ.314.

Example of foam system calculation for chemical tanker of 10,000 dwt

Ship particulars

Beam	= 14.5 m	
Length of cargo area	= 56 m	
Length of largest cargo tank	= 9 m	
Cargo-deck area	= 14.5 m x 56 m	= 812 m^2
Horizontal sectional area of single largest tank	= 14.5 m x 9 m	= 130.5 m^2
(Note: For the purpose of this illustration, a single tank encompasses the entire beam of the ship)		
Proposed monitor spacing	= 9 m	
Area protected by largest monitor	= 9 m x 14.5 m	= 130.5 m^2



Calculations

1 Determination of foam supply rate:

3.14.5 - The largest of:

3.14.5(a) - the foam supply rate based upon the entire cargo-deck area

2 l/m^2/min x 812 m^2 = 1,624 l/min

3.14.5(b) - the foam supply rate based upon the horizontal sectional area of the single largest tank

20 l/m^2/min x 130.5 m^2 = 2,610 l/min

3.14.5(c) - the foam supply rate based upon the area protected by the largest monitor

10 l/m^2/min x 130.5 m^2 = *1,305 l/min

(* Shall not be less than 1,250 l/min)

The foam supply rate is therefore 2,610 l/min, which is the largest of the three above calculated rates.

2 Determination of the required quantity of foam concentrate:

3.14.6 - 2,610 l/min is the foam supply rate from regulation 3.14.5. This flow rate for 30 minutes will require

30 min x 2,610 l/min = 78,300 litres of foam-water solution.

If a 5% foam concentrate is used, then 5% of the 78,300 l must be foam concentrate, or

0.05 x 78,300 = 3,915 l

3 Determination of the minimum monitor capacity:

3.14.7 - Each monitor must supply at least:

(a) 50% of the required foam rate; or
(b) 10 l/m^2/min for the area it protects; or
(c) 1,250 l/min,
whichever is greater

50% of the foam supply rate = 2,610 l/min x 0.5 = 1,305 l/min

10 l/m^2/min multiplied by the area the monitor protects

= 130.5 m2 x 10 l/m^2/min
= 1,305 //min

The minimum monitor capacity is therefore 1,305 l/min.

Designer wishes to increase monitor spacing to 15 m between monitors.

1 Recalculate required foam supply:

3.14.5(a) - same as before - 1,624 l/min

3.14.5(b) - same as before - 2,610 l/min

3.14.5(c) - larger area covered by monitor is

15m x 14.5m = 217.5m2

10 l/m^2/min x 217.5 m^2 = 2,175 l/min

The required foam rate therefore remains 2,610 1/min.

2 Recalculate required foam concentrate supply:

3.14.6 - The minimum foam supply rate has not changed; therefore 3,915 l of foam concentrate are still required.

3 Recalculate minimum monitor capacity:

3.14.7 - 50% of foam supply rate

2,610 l/min x 0.5 = 1,305 l/min

10 l/m^2/min of area protected by monitor = 10 l/m^2/min x 217.5 m2
= 2,175 l/min

The new minimum monitor capacity is therefore 2,175 l/min.

Recommendation for chemical tankers and gas carriers constructed before 1 July 1986

Resolution MSC.7(48), adopted on 17 June 1983

THE MARITIME SAFETY COMMITTEE,

RECALLING resolutions MSC.4(48) and MSC.S(48) by which it adopted the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) and the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code),

NOTING that the IBC Code and the IGC Code shall apply to chemical tankers and gas carriers respectively, constructed on or after 1 July 1986,

1 RESOLVES that, in respect of chemical tankers and gas carriers constructed on or after 1 July 1986, the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (Bulk Chemical Code) adopted by resolution A.212(VII) and the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (Gas Carrier Code) adopted by resolution A.328(IX) will be superseded by the IBC Code and the IGC Code respectively,

2 RECOMMENDS that chemical tankers and gas carriers constructed before 1 July 1986 should comply with the requirements of the Bulk Chemical Code (resolution A.212(VII)), the Gas Carrier Code (resolution A.328(IX)) and the Code for Existing Ships Carrying Liquefied Gases in Bulk (resolution A.329(IX)) as amended, as applicable,

3 RECOMMENDS FURTHER that for chemical tankers and gas carriers constructed before 1 July 1986, the IBC Code and the IGC Code should be considered at least equivalent to the Bulk Chemical Code (resolution A.212(VII)) and the Gas Carrier Code (resolution A.328(IX)) up to and including the tenth and fourth sets of amendments respectively,

4 INVITES all Governments concerned to permit the application of the provisions of the IBC Code and the IGC Code to chemical tankers and gas carriers constructed before 1 July 1986 and, where the requirements of these Codes have been fully complied with, to endorse the Certificates of Fitness issued in accordance with resolution A.212(VII) and resolution A.328(IX) accordingly. A model form of endorsement is attached.

MODEL FORM OF ENDORSEMENT TO BE INCLUDED IN THE CERTIFICATE OF FITNESS

Under the provisions of paragraph 4 of this resolution, the following text of endorsement should be inserted in paragraph 4 of the Certificate of Fitness issued under resolution A.212(VII) or paragraph 5 of the Certificate of Fitness issued under resolution A.328(IX):

"As permitted by resolution MSC.7(48) the ship has been surveyed in accordance with the International Code for the Construction and Equipment of Ships [Carrying Dangerous Chemicals] * [Carrying Liquefied Gases] * in Bulk and found to comply fully with relevant provisions thereof."

* Delete as appropriate.