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EXTENSION OF THE CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK, TO INCLUDE MARINE POLLUTION PREVENTION

A. General description of the present Code

During the past decade, the world has experienced a revolution in the production and transportation of chemicals. Where once movement in drums or barrels was sufficient to meet demands, specially built or converted tankers are now required.

To cope with the hazards involved in the transport of bulk chemicals, IMCO began work developing a code in January 1968 in order to provide uniform safety standards internationally.

As a first step a recommendation for existing vessels was developed as an operating guide for vessels which transport dangerous chemicals in bulk (MSC/Circ.70).

The more comprehensive Code of 1971 is based upon a philosophy of relating cargo containment features of vessel design, construction and operation to the hazards of the various chemicals covered by the Code. Figure 1, Summary of Minimum Requirements shows the solution to the difficult problem of implementing that philosophy and the elements of the Code are presented as follows:

Chapter I - General

The important part of this chapter relates to the basic philosophy of the Code and its scope with respect to the products covered.

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

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

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

Products which have been reviewed and determined to meet the above criteria are listed in table I. The code is limited at present to those products which are liquids at normal temperatures.

Chapter I also provides the following phased time period for existing ships to come into compliance with the code, they should comply:

(1) With all operational requirements contained in the code after the effective date;

(2) With vapour detection equipment requirements and personnel protection standards for their cargoes within 1 year after the effective date;

(3) With tank vent requirements, gauging standards and fire protection standards for their cargoes within 2 years after the effective date; and

(4) With the remaining sections of the Code as soon as possible, but in any case within 6 years after the effective date.

Rigid compliance is not expected and certain dispensations from the Code are permitted and enumerated. The remainder of Chapter I contains important administrative information on the effective date of the Code, certification, equivalence and how new products may be included.

Chapter II - Cargo Containment

This chapter contains features of major significance to the design of ships; for the first time, measures to prevent the cargo from release appear as a ship design standard. Recognizing that damage resulting from collision or grounding may lead to uncontrolled release of the cargo, three degrees of physical protection for the cargoes were developed. The degrees, or "ship types", define the location of the cargo with respect to the ship's side and bottom and the extent to which a ship should be capable of remaining afloat after damage. The assignment of ship types to the various cargoes takes into account the nature and severity of the product's hazard to the environment should it be released.

The highest standard of physical protection, ship type I, is required for those substances considered to have the greatest environmental hazard (i.e. which on release would have wide reaching effects beyond the immediate neighbourhood of the vessel). Ship type I requires the cargo to be located inboard from the side of the vessel a distance equal to one-fifth of the beam and above the bottom a distance equal to one-fifteenth of the beam. Further, ship type 1 must be able to withstand prescribed damages (two compartment standard of subdivision and damage stability throughout its length).

Ship type II is required for those cargoes with significant hazards but whose release does not have wide reaching effects. Specifications for ship type 2 require the cargo to be located inboard from the side of the vessel a minimum distance of 760 mm. and above the bottom a distance of one-fifteenth of the beam, thereby providing the cargo protection against low-energy collisions and groundings which are often associated with vessels in port. Increased survivability of the vessel is also required. Ships of lengths in excess of 150 m must provide a two-compartment standard of subdivision and damage stability throughout its length. Ships of less than 150 m must meet a two-compartment standard of subdivision and damage stability in the cargo portion of the vessel, and a one-compartment standard of subdivision and damage stability for the engine room.

Ship type III is prescribed for products having lesser hazards and is close in division to normal tanker, although it is significant to note that increased survivability is required.

Underlying all the ship types is the safety of the crew and growing concern for the protection of the environment. In determining the survival capabilities the following damage conditions are assumed:

Collision:

Longitudinal extent, one-third $L^{\frac{2}{3}}$ or 14.5 m, whichever is less.

Transverse extent, a distance of B/5 or 11.5 m, whichever is less.

Vertical extent, upward from the base line without limit.

Stranding:

Vertical extent, a distance of B/15 or 6 m, whichever is less.

Longitudinal extent, for the forward one-third of the vessel a distance of L/10 is assumed; for the remainder a distance of 5 m is assumed.

Transverse extent, for the forward one-third of the vessel a distance of B/6 is assumed; for the remainder a distance of 10 m is assumed.

These damage assumptions were based upon available casualty information.

The cargo containment chapter also includes the following among other major provisions which will affect design of ships.

Cargo Segregation

Cargoes subject to this Code must be segregated from machinery and boiler spaces, accommodation spaces and other service spaces. Cargoes which react in a hazardous manner with other cargoes must be segregated from those cargoes by cofferdams, void spaces or mutually compatible cargoes. Further, tanks containing cargoes which react in a hazardous manner with other cargoes must have separate piping and vent systems.

Location and Arrangement of Accommodation Spaces

Accommodation spaces on vessels which carry cargoes subject to this Code must be located aft of cargo pumprooms and cargo tanks. The arrangement of the accommodation space must be such as to preclude cargo vapours from being drawn into it.

Cargo Piping

The sections dealing with cargo piping outline the design parameters for the piping systems and give considerations to the location of the cargo piping. For example cargo piping may not be installed under the deck between the outboard side of the cargo containment spaces and the skin of the vessel unless the clearances required under the ship type section are maintained. These minimum distances may be reduced when it can be shown that damage to the piping would not cause release of the cargo. Cargo transfer control systems are also prescribed.

Tank Vent Systems

Vessels which carry cargoes subject to this code must have Vent systems designed to minimize the possibility of cargo vapour accumulating about the deck. Further, the vent systems are required to be arranged in such a manner so that vapour is directed upward in the form of a jet.

Two types of tank vent systems are included in the Code. The first, open venting, is a system which offers no restriction except for friction losses to to the free flow of cargo vapours from the tank and is permitted for cargoes of lesser hazards. The second type, control venting, is a vent system using pressure vacuum relief valves fitted to each tank with vent exits extending to 4 m above the deck. The vent exits from a controlled venting system must be located a distance of at least 10 m from the nearest air intake or opening into accommodation or other service spaces. Control venting is required for tanks used to transport flammable and/or toxic cargoes.

Materials of Construction

Vessels must be constructed of materials suitable for the cargoes to be carried. This section contains considerations for selecting the materials of construction for vessels which transport cargoes subject to this Code. These include determinations of the following:

(1) The corrosive effect of the cargo;

(2) Whether or not a hazardous reaction can take place between the cargo and the materials of construction; and

(3) Whether or not a lining or coating system is compatible with the intended cargoes.

Pump and Pipeline Identification

The deck of a modern chemical tanker is a labyrinth of piping and pumping systems. This section requires that pumps, valves and pipeline systems be distinctively marked to identify the tanks they serve. This requirement provides a means of eliminating disastrous errors that can occur if a product is pumped into the wrong tank.

Chapter III - Safety Equipment and Related Considerations

Meeting the requirements in this chapter would make each vessel a safe working environment for its operating personnel. Chemical vessels are alive with various operations, such as cargo transfer, maintaining cargo state, tank cleaning and other similar operations, each of which presents hazards to the vessel's personnel. This chapter provides safeguards to reduce or eliminate these hazards. Within this chapter are the following major sections:

1. Ventilation in cargo handling spaces
2. Electrical requirements
3. Gauging
4. Vapour detection
5. Fire protection
6. Personnel protection

Chapter IV - Special Requirements

The special requirements included in the Code are grouped into three subject areas:

1. Special requirements for certain individual cargoes;
2. Special requirements for certain groups of products; and
3. Special requirements for construction and equipment.

Underlying each of the special requirements is the recognition that for certain products the more general parts of the Code required extension in order to provide the necessary degree of containment.

Chapter V - Operating Requirements

Consideration was given to the Tanker Safety Guide (Chemicals) prepared by the International Chamber of Shipping in developing a chapter on vessel operation. Since there was insufficient time to fully consider the most recent draft of the ICS guide before finalizing the Code, an extensive chapter on operating requirements could not be included. Instead, chapter V draws largely upon the

operational recommendations contained in the "Interim Recommendations for Existing Ships" and enumerates the various requirements contained in the Code which have operational implications.

The operating requirement that establishes a cargo size limit is one of major significance, and it was decided to include "holding figures" as follows:

(1) The quantity of a cargo required to be carried in a type I ship should not exceed 1,250 cubic meters in any one tank; and

(2) The quantity of a cargo required to be carried in a type II ship should not exceed 3,000 cubic meters in any one tank.

Chapter VI - Summary of Minimum Requirements

The "Summary of Minimum Requirements" will probably draw more attention than the remainder of the Code because it simply and quickly answers the question "What is required transport product X". What is more significant, however, is that the "Summary of Minimum Requirements" (figure 1) represents a systematic approach to considering the hazard potential, the physical properties of the products in their transported state, and the degree of containment provided elsewhere in the Code. Since full agreement could not be reached on a single hazard evaluation system, a criteria or method of relating the physical properties and the hazards to the degree of containment could not be included in the Code.

(a) Product name	(b) Ship type	(c) Tank type	(d) Tank vents	(e) Tank environmental control	(f) Electrical instruments	(g) Gaging	(h) Vapour detection	(i) Fire protection	(j) Special requirements (see ch.IV)
iso-Butyl Acrylate	2	2G	Cont..	No.....	SP.....	R	I-T	A	4.10
n-Butyl Acrylate	2	2G	Cont..	No.....	SP.....	R	I-T	A	4.10
iso-Butyraldehyde	3	2G	Cont..	No.....	SP.....	O	I-T	A	4.12.7
n-Butyraldehyde	3	2G	Cont..	No.....	SP.....	O	I-T	A	4.12.7
Camphor Oil	3	2G	Cont..	No.....	SP.....	O	I	B	
Carbolic Oil	2	2G	Cont..	No.....	SP.....	C	I-T	A	4.9, 4.14
Carbon Bisulfide	2	1G	Cont..	Inert...	No Use ..	C	I-T	C	4.1, 4.9, 4.14
Carbon Tetrachloride..	3	2G	Cont..	No.....	St.....	R	T	.....	4.9, 4.13.1, 1.13.2
Caustic Soda	3	2G	Open..	No.....	St.....	O	No	.....	4.12.1
Chlorobenzene.....	3	2G	Cont..	No.....	SP.....	R	I-T	B	
Chloroform	3	2G	Cont..	No.....	St.....	R	T	.....	4.9
Chlorohydrius, Crude..	2	2G	Cont..	No.....	SP.....	C	I-T	A	4.9, 4.14
Chloro Sulfonic Acid	1	2G	Cont..	No.....	.....	C	T	.....	4.8.2, 4.8.3, 4.8.4, 4.8.5, 4.8.6, 4.8.7, 4.8.8, 4.9, 4.14

FIGURE 1 - Extract of Summary of Minimum Requirements

TABLE 1 - PRODUCTS INCLUDED IN THE BULK CHEMICAL CODE

Acetic Acid
Acetic Anhydride
Acetone Cyanohydrin
Acetonitrile
Acrylic Acid
Acrylonitrile
Adiponitrile
Allyl Alcohol
Allyl Chloride
Aminoethanolamine
Ammonia, Aqua, less than 28%
Aniline
Benzene
iso-Butylacrylate
n-Butyl Acrylate
iso-Butyraldehyde
n-Butyraldehyde
Camphor Oil
Carbolic Oil
Carbon Disulphide
Carbon Tetrachloride
Caustic Potash
Caustic Soda
Chlorobenzene
Chloroethanol - 2 (Ethylene Chlorchydrin)
Chloroform
Chlorohydrins, Crude
Chlorosulphonic Acid
Cresols (mixed)
Crotonaldehyde
Cyclohexanene
Decyl Acrylate
Dibutylamine
o-Dichlorobenzene
Dichloroethyl Ether
1, 2-Dichloropropane
1, 3-Dichloropropene
Diethanolamine
Diethylamine
Diisopropylamine
Dimethylformamide
Epichlorohydrin
Ethyl Acrylate
Ethyl Ether
2-Ethylhexyl Acrylate
2-Ethyl-3-Propyl Acrolein
Ethylene Cranohydrin
Ethylene Dibromide
Ethylene Dichloride
Formaldehyde, 37% aqueous solution
Formic Acid
Furfural
Hydrochloric Acid
Isoprene
Methyl Acrylate
2-Methyl, 5 Ethyl Pyridine
Methyl Methacrylate
Methyl Styrene

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TABLE 1 (continued)

Monoethanolamine
Monisopropanolamine
Morpholine
Motor Fuel Anti-Knock Compounds
Coal Tar Naptha
Nitric Acid, 70% and greater concentrations
Mono-Nitrobenzene
2-Nitropropane
Oleum
Phenol
Phosphoric Acid
Phosphorus
2-Propiolactone
Propionic Acid
Propionic Anhydride
Propylamine
Propylene Oxide
Pyridine
Styrene Monomer
Sulphur, liquid
Sulphuric Acid
Tetrahydrofuran
Toluene Diisocynate
Triethanolamine
Triethylamine
Triethylenetetramine
Vinyl Acetate
Vinylidene Chloride

B. Amendments necessary to the Code from the marine pollution prevention point of view

In order to extend the Code to include marine pollution prevention, certain amendments have to be introduced.

I. Concerning the allocation of ship type requirements from the pollution point of view to various products covered by the Code, the following principles were adopted:

Type I ships

(a) Products which are bioaccumulated (+ in column A)* and have a high or moderate degree of toxicity (4 or 3 in column B)* or less toxicity coupled with other adverse properties such as hazard to human health or severe reduction of amenities.

(b) Products which would cause tainting (T column A)* and which are highly toxic (4 column B)*.

Type II ships

(a) Products which are bioaccumulated (+ column A)* but have low toxicity (2 or 1 column B)*.

(b) Products which do not bioaccumulate but have considerable toxicity (4 or 3 column B)* or lesser toxicity coupled with other objectionable features (e.g. 4 column C, xxx column E)*.

(c) Products which cause taint (T column I)* (except those in Type I above).

(d) Products which bioaccumulate but with a short retention (Z column A)* and which are highly or moderately toxic or less toxic but with some other objectionable features.

Type III ships

(a) Products which bioaccumulate but with a short retention (Z column A)* and a slight degree of toxicity.

(b) Products with no bioaccumulative properties and only low degrees of toxicity or combinations of minimal toxicity and other less important objectionable properties.

*/ according to the GESAMP hazard rating profile (GESAMP IV/9/Supp.1 Annex IV)

II. Applying the above criteria the following products listed in Chapters VI and VII of the Code would necessitate re-allocation of associated ship Type and overflow control requirements as follows:

TENTATIVE MINIMUM REQUIREMENTS TAKING ACCOUNT OF MARINE POLLUTION PREVENTION

	Product	Ship Type	Overflow Control
	Acetic Anhydride	2+	4.14.1
	Acetone Cyanohydrin	2	4.14.2
	Acetonitrile	2+	N/R
	Acrylic Acid	3+	4.14.1
	Acrylonitrile	2	4.14.2
	Adiponitrile	3+	N/R
	Allyl Alcohol	2+	4.14.2
	Allyl Chloride	2+	4.14.1
	Ammonia (28% aqueous)	2	4.14.2
*	Amyl Acetate	3	4.14.1
	Aniline	2+	4.14.1
	Benzene	3+	4.14.1
*	Benzyl Chloride	2	4.14.2
	n-Butyl Acrylate	2+	N/R
	iso-Butyraldehyde	3	4.14.1
	n-Butyraldehyde	2	4.14.2
	Butyric Acid	2	4.14.2
	Camphor Oil	2	4.14.2
	Carbon Disulphide	1	4.14.3
	Carbon Tetrachloride	3	4.14.1
	Caustic Soda	3+	4.14.1
	Chloroform	3	4.14.1
	Chlorosulphonic Acid	1+	4.14.3
	Cresols	2	4.14.2
	Crotonaldehyde	2+	4.14.2
*	Cyclohexane	3	4.14.1
	Chloroacetic Acid	3	4.14.1
	O-Dichlorobenzene	2	4.14.2

	Product	Ship Type	Overflow Control
	Dichloropropane	2+	4.14.1
	Dichloropropene	2+	4.14.1
	Diethanolamine	3+	N/R
	Diethylamine	3+	4.14.1
	Diethylene Triamine	3+	4.14.1
	Diethyl Ether (Ethyl Ether)	2+	N/R
	Dimethylamine (40% aqueous)	3+	4.14.1
	Dimethyl Formamide	3+	N/R
	Epichlorohydrin	2+	4.14.2
	Ethyl Acrylate	2+	N/R
	Ethylene Cyanohydrin	3+	N/R
	Ethylene Diamine	2+	4.14.1
	Ethylene Dichloride	2+	4.14.1
	Formaldehyde	3+	4.14.1
	Formic Acid	3+	N/R
	Furfural	3+	4.14.1
	Hydrochloric Acid	3+	N/R
	Isoprene	3+	N/R
*	Liquid sulphur	3+	N/R
	Methyl Acrylate	2+	N/R
*	Methylene Chloride	3	4.14.1
	Methyl Methacrylate	2+	N/R
	Monoethanolamine	3+	N/R
	Morpholine	3+	N/R
	Nitric Acid	2+	4.14.1
	Oleum	2+	4.14.1
*	Perchloroethylene	3	4.14.1
	Phenol	2+	4.14.2
	Phosphorus	1+	4.14.3

	Product	Ship Type	Overflow Control
	Phosphoric Acid	3+	N/R
	Propylene Oxide	2+	N/R
	Pyridine	2	4.14.2
	Styrene Monomer	3+	4.14.1
	Sulphuric Acid	3+	4.14.1
	Tetra Ethyl Lead	2+	4.14.2
*	Toluene	3	4.14.1
*	Trichloroethane	3	4.14.1
*	Trichloroethylene	3	4.14.1
	Triethanolamine	3+	N/R
*	Turpentine	2	4.14.2
	Vinyl Acetate	3+	4.14.1
	Vinylidene Chloride	2+	4.14.1
*	Xylene	3	4.14.1

Legend

* Products not previously covered by the Code which would now be included after consideration of marine pollution prevention.

\+ Represents no change in requirements.

N/R No overflow control requirements for this cargo.

III. Other amendments to various provisions of the Code would include:

Chapter II

2.6.2 Amend the first sentence to read:

"Cargoes, residues of cargoes, or mixtures containing cargoes which are dangerously water-reactive and which react in a hazardous manner with other cargoes, residues or mixtures should ..... (no change) ...

2.8.6 Amend to read as follows:

Arrangements should be installed to deal with drainage and any possible cargo leakage in pump rooms. The bilge system serving the pump room should be operable from outside the pump room.

2.21 Delete and replace by

2.21 Ballast and Slop tank Arrangements

2.21.1 One or more holding tanks for the storage of cargo stripping, cargo contaminated bilge water and any cargo leakage should be provided. Such tanks of $20m^3$ or less may be exempted from the transverse tank location requirements of paragraph 2.2.4. A slop tank for tank washings may be accepted for the purpose, provided the design, equipment and location of the tank complies with the requirements of the Code for the chemical concerned.

2.21.2 Cargo tank washings which are not discharged ashore may be stored in cargo tanks or tanks specifically provided for this purpose. The design and equipment of tanks used for the containment of cargo tank washings should comply with the requirements of this Code for the particular chemical concerned but such tanks need not comply with location specified in 2.2.4(a)(iii) and 2.2.4(b)(iii).

2.21.3 Cargoes, residues of cargoes, or mixtures containing cargoes which are dangerously water-reactive and which react in a hazardous manner with other cargoes should not be placed in tanks adjacent to slop tanks and cargo tanks containing ballast or slops. Pumps, pipes or vent lines serving such tanks should be isolated from similar equipment serving tanks containing cargo dangerously reactive with water. Slop tanks lines or ballast lines should not pass through tanks containing cargoes which are dangerously reactive with water unless encased in a tunnel.

2.21.4 Pumps, ballast lines, vent lines and other similar equipment serving permanent ballast tanks should be isolated from 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 tank deck level and non-return valves are fitted.

2.21.5 A shore connexion with a standard coupling should be provided for transferring contaminated water.

Add new section

2.24 Construction Requirements to Facilitate Tank Cleaning

2.24.1 Vessels should be provided with arrangements to minimize the amount of cargo remaining in the tanks after discharge. Where suction wells are installed, their size should be as small as practicable, and in any case their depth should not exceed [25% of double bottom height or 350 mm whichever is less].

2.24.2 Tanks for containment of cargoes required to be carried in Type I and II ships should as far as practicable have smooth interior boundaries.

CHAPTER IV

4.14 Overflow control

The provisions of this section are applicable in addition to the required gauging devices where specific reference is made in column j of the Summary of Minimum Requirements, Chapter VI.

4.14.1 Cargo tanks should be fitted with a high level alarm that will indicate when there is imminent danger of the tank being over-filled. Means should be provided to enable the alarm to be tested prior to loading.

4.14.2 Tanks designed to carry products subject to this paragraph should, in addition to the high level alarm provided by 4.14.1, be provided with remote operated valves for the purpose of stopping cargo loading.

4.14.3 Tanks designed to carry products subject to this paragraph should, in addition to the high level alarm required by paragraph 4.14.1, be provided with an automatic system to stop cargo loading when there is imminent danger of the tank being overfilled. The system should not be dependent upon any manual intervention or control and include an automatically operated valve to shut off flow and an alarm that will indicate operation of the system.

4.14.4 The remote and automatic valves referred to in paragraphs 4.14.2 and 4.14.3 should be:

(a) of the fail safe (shut-down on loss of power) type;

(b) capable of local manual operation;

(c) designed to avoid excessive pressures in the piping on both ship and shore;

(d) positioned either at the manifold or cargo tank.

4.14.5 The Administration may alternatively accept an overflow control system:

(a) that includes remote control of the pumps or valves at designated shore loading terminals mentioned on the certificate; or,

(b) that retains any overflow within designated tanks on board which comply with the requirement of the Code,

where the Administration is satisfied that such an arrangement is safe and effective. Details of such control systems and arrangements should be forwarded to the Organization for the purpose of informing other Administrations.

Chapter V

Add a new paragraph to this Chapter, as follows:

"Permanent ballast tanks should not be used if adjacent cargo tanks contain dangerously water-reactive cargo."

5.6 Additional Operational Requirements

Delete "2.21.1" and "2.21.2"